

Tulsiramji Gaikwad Patil College of Engineering & Technology, Nagpur

(An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)

SCHEME OF INSTRUCTION & SYLLABUS

Programme: Mechanical Engineering

Scheme of Instructions : Final Year B.Tech in Mechanical Engineering Semester-

VII

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs./Wk	Credits	EXAMSCHEME				
									CT1	CT2	TA/CA	ESE	TOTAL
1	PCC	BME4701	Refrigeration and Air Conditioning	4	-	-	4	4	15	15	10	60	100
2	PCC	BME4702	Additive Manufacturing & 3D Printing	3	-	-	3	3	15	15	10	60	100
3	PCC	BME4703	Lab- Refrigeration and Air Conditioning	-	-	2	2	1	-	-	25	25	50
4	PCC	BME4704	Advanced CAD Lab	-	-	2	2	1	-	-	25	25	50
5	PEC	BME4705-8	Professional Elective-V	4	-	-	4	4	15	15	10	60	100
6	OEC	B\$\$\$X01-14	Open Elective-III	4	-	-	4	4	15	15	10	60	100
7	OEC	B\$\$\$X01-14	Open Elective-IV	3	-	-	3	3	15	15	10	60	100
8	OEC	B\$\$\$X01-14	Open Elective-V	3	-	-	3	3	15	15	10	60	100
9	MCC	BAU4707	Behavioral and Interpersonal Skills	2	-	-	2	Audit	-	-	-	-	-
			Total	23	-	4	27	23	90	90	110	410	700

***There will be two presentations, based on seminar topic to be selected in consultation with guide preferably based on emerging trends.**

L-Lecture T-Tutorial P-Practical

CT1-ClassTest1

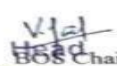
TA/CA-Teacher Assessment/ Continuous Assessment

CT2-ClassTest2


ESE-End Semester Examination (For Laboratory End Semester performance)


Course Category	HSMC(Hum., Soc.Sc,Mgmt.)	BSC (BasicSc.)	ESC (Engg. Sc.)	PCC (Professional CoreCourses)	PEC (ProfessionalElect iveCourses)	OEC(OpenElect ivecoursesfromo therdiscipline)	Project/Seminar /IndustrialTrainin g	MCC(Mandatory Courses)
Credits	-	--	--	9	4	10	-	Yes
CumulativeSum	11	25	24	48	15	15	3	--

PROGRESSIVE TOTAL CREDITS: 124+23=147


HOD
Chairman
Department of Mechanical Engineering
Tulsiramji Gaikwad Patil College of
Engineering & Technology, Nagpur


Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
and Technology, Nagpur


Vice-Principal
Tulsiramji Gaikwad-Patil
College Of Engineering &
Technology, Nagpur


Principal
Tulsiramji Gaikwad-Patil
College Of Engineering &
Technology, Nagpur

Program: Mechanical Engineering

List of Electives offered by Mechanical Engineering Professional Elective


Professional Elective-I	Professional Elective-II	Professional Elective-III	Professional Elective-IV	Professional Elective-V
Semester V BME3507	Semester V BME3511	Semester VI BME3607	Semester VI BME3611	Semester VII BME4706
BME3507:Power Plant Engineering	BME3511:Renewable Energy System	BME3607: Mechanical Measurement and metrology	BME3611:Industrial Fluid Power	BME4705:StressAnalysis
BME3508:Computer Aided Designing	BME3512:Control System Engineering	BME3608:Mechanical Vibrations	BME3612:Finite Element Analysis	BME4706:Material Handling System
BME3509:Advance Manufacturing Techniques	BME3513:Tool Design	BME3609:Industrial Robotics	BME3613:AutomotiveS ystem	BME4707:Composite Material
BME3510:Production Management	BME3514:Industrial Engineering	BME3610:Operation Research	BME3614:Product Design and Development	BME4708:Total Quality Management

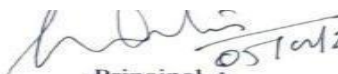
Open Elective

List of Open Elective					
Sr. No.	Course Code	Course Title	Sr.No.	Course Code	Course Title
1	BCSXX01	Cyber Law and Ethics	9	BMEXX09	Additive Manufacturing Techniques
2	BCSXX02	Block chain Technology	10	BMEXX10	Automobile Engineering
3	BITXX03	Cyber Security	11	BEEXX11	Power Plant Engineering
4	BITXX04	Artificial Intelligence	12	BEEXX12	Electrical Materials
5	BECXX05	Internet of Things	13	BAEXX13	Avionics
6	BECXX06	Embedded Systems	14	BAEXX14	Unmanned Aerial Vehicles
7	BCEXX07	Introduction to Art and Aesthetics	15	BBTXX15	Biomaterials
8	BCEXX08	Metro Systems and Engineering	16	BBTXX16	Food and Nutrition Technology


HOD
Department of Mechanical Engineering
Tulsiramji Gaikwad Patil College of
Engineering & Technology, Nagpur


Dean Academics
Tulsiramji Gaikwad Patil
College Of Engineering
and Technology, Nagpur


Vice-Principal
Tulsiramji Gaikwad Patil
College Of Engineering &
Technology, Nagpur


Principal
Tulsiramji Gaikwad Patil
College Of Engineering &
Technology, Nagpur

	Tulsiramji Gaikwad-Patil College of Engineering and Technology Wardha Road, Nagpur-441 108 NAAC Accredited (A+ Grade)	
--	---	--

Fourth Year (Semester-VII) B. Tech. Mechanical Engineering

BME4701: Refrigeration and Air Conditioning

Teaching Scheme			Examination Scheme	
Lecture	4 Hrs/Week		CT-1	15 Marks
Tutorial	-		CT-2	15 Marks
Total Credit	4		TA	10 Marks
			ESE	60 Marks
			Total	100 Marks
			Duration of Exam: 03 Hrs .	

Course Objectives

1	Learn different refrigeration processes.
2	Learn about various compound refrigeration and multi evaporation system
3	Understand air refrigeration system.
4	Examine different cryogenic processes.
5	Solve different heat load calculation

Course Contents		CO
Unit I	Refrigeration: Introduction, unit of refrigeration, analysis of simple vapour compression refrigeration system, effect of sub cooling, superheating on coefficient of performance. Study of Vapour Absorption Refrigeration System: Aqua Ammonia, Lithium Bromide- Water system, Refrigerants – Properties, classification, nomenclature, its global warming & ozone depletion potential, montreal protocol, kyoto protocol, alternate refrigerants.	CO1
Unit II	Compound vapour compression refrigeration system, multiple evaporator system, types of compressor, condenser, evaporator, expansion devices, hermetic compressors, methods of defrosting.	CO2
Unit III	Air cycle refrigeration: Air cycle refrigeration & its application, types of air refrigeration system, vortex tube, thermoelectric refrigeration, steam jet refrigeration. (Analytical treatment is expected on air refrigeration system).	CO3
Unit IV	Cryogenics: Introduction, application of cryogenics, cascade system, Joules Thomson coefficient, inversion curve, methods of liquefaction of air with analytical treatment.	CO4
Unit V	Advanced Psychrometric & Heat Load Calculations: Introduction to psychrometric properties and processes of air. Classification of air conditioning systems, Applications of psychrometry to various air conditioning systems, RSHF, ESHF, GSHF, air washers, air coolers.	CO5

Text Books



1	Refrigeration and Air Conditioning, R.S.Khurmi, S.Chand and Company.
---	--

2	Refrigeration and Air Conditioning, Arora and Domkundwar, Dhanpat Rai
3	Refrigeration and Air Conditioning, Arora C P, Tata McGraw Hill.
Reference Books	
1	Principles of Refrigeration, Roy Dossat, Pearson Education.
2	Commercial Refrigeration, Edwin P. Anderson, Taraporevala Sons & Co.
3	ASHRAE Hand Books, Air Conditioning Engineers
Useful Links	
1	https://archive.nptel.ac.in/courses/112/107/112107208/
2	https://archive.nptel.ac.in/courses/112/105/112105129/
3.	https://archive.nptel.ac.in/courses/112/105/112105128/

Course Code	Course Outcomes	CL	Class Sessions
BME4701.1	Calculate Coefficient of Performance by using the Simple vapour compression Refrigeration System	4	9
BME4701.2	Calculate Coefficient of Performance by using the compound vapour compression Refrigeration and multiple evaporator System	3	9
BME4701.3	Illustrate concept of different Air cycle refrigeration system	4	9
BME4701.4	Illustrate the concept Cryogenics and its different types	4	9
BME4701.5	Calculate Heat Load for Air conditioning system	3	9


 Department of Mechanical Engineering
 Tulsiramji Gaikwad Patil College of
 Engineering & Technology, NAGPUR


 Dean Academics
 Tulsiramji Gaikwad-Patil
 College Of Engineering
 and Technology, Nagpur

		<div>Tulsiramji Gaikwad-Patil College of Engineering and Technology Wardha Road, Nagpur-441 108 NAAC Accredited with A+ Grade (An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)</div>			
Fourth Year (Semester VII) B.Tech Mechanical Engineering					
BME4702: Additive Manufacturing 3D Printing					
Teaching Scheme				ExaminationScheme	
Theory	3Hrs/Week			CT-I	15 Marks
Tutorial	-			CT-II	15 Marks
Total Credits	3			CA	10 Marks
				ESE	60 Marks
				Total Marks	100 Marks
				Duration of ESE: 3Hrs	
Course Objectives					
1	Aware of rapidly evolving and widely used fabrication technology				
2	Aware of the technology for conceptual modeling, prototyping and rapid manufacturing				
3	Impart detailed knowledge of wide applications of Additive Manufacturing (AM) in industry and society; and in particular, key applications of AM such as rapid tooling, medical AM and rapid manufacturing				
4	Give students an understanding of 3D printers				
Course Contents					
Unit I	Unit-I: Introduction to Additive Manufacturing and 3D Printing Technology Development of Additive Manufacturing, Major trends shaping the evaluation of 3D printing, Technology Improvement, Process, Classification of Additive Manufacturing Systems, Advantages and Limitations, Additive V/S Conventional Manufacturing Processes.				
Unit II	Unit-II: Materials in Additive Manufacturing Choosing Materials for Manufacturing, Multiple Materials, Metal AM Processes & Materials, Composite Materials, Biomaterials, Hierarchical Materials , Ceramics & Bio-ceramics, 4D Printing& Bio-Active Materials				
Unit III	Unit-III: Additive Manufacturing Equipment Process Equipment- Design and process parameters, Governing Bonding Mechanism, Common Faults and Troubleshooting, Process design				
Unit IV	Unit-IV: Post Processing Support Material Removal, Surface Texture Improvements, Accuracy Improvements, Aesthetic Improvements, Property Enhancements Using Non-thermal Techniques, Property Enhancements Using Thermal Techniques				

Unit V	Unit-V: Applications and Examples Application - Material Relationship, Applications in Design, Applications in Engineering, Analysis and Planning, Applications in Manufacturing and Tooling, Applications in Aerospace Industry, Applications in Automotive Industry, Applications in Jeweler Industry, Applications in Arts and Architecture.
---------------	---

Text Books

T.1	Additive Manufacturing and 3D Printing Technology: Principles and Applications, Dr. G.K. Awari, Dr.D.P.Kothari, Prof. Vishwjeet Ambade, Dr. C. S. Thorat, CRC Press, Taylor & Francis Group
T.2	Additive Manufacturing Technologies 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing , Ian Gibson • David Rosen • Brent Stucker, Springer New York Heidelberg Dordrecht London
T.3	Additive Manufacturing Innovations, Advances, and Applications , t.S. Srivatsan • t.S. Sudarshan, CRC Press, Taylor & Francis Group

Reference Books

R.1	Understanding Additive Manufacturing Rapid Prototyping · Rapid Tooling · Rapid Manufacturing Andreas Gebhardt, Hanser Publishers, Munich Hanser Publications, Cincinnati
R.2	Additive Manufacturing of Metals: The Technology, Materials, Design and Production , Li Yang Keng Hsu • Brian Baughman Donald Godfrey • Francisco Medina Mamballykalathil Menon Soeren Wiener, Springer Series in Advanced Manufacturing

Useful Links

1	https://onlinecourses.nptel.ac.in/noc21_me115/preview
2	https://onlinecourses.nptel.ac.in/noc20_me50/preview

Course Code	Course Outcomes	BT level	Class Sessions
BME4702.1	Identify the Different 3D printing Technology and machines used in Additive manufacturing.	4	9
BME4702.2	Categorize and Select suitable Material for printing.	4	9
BME4702.3	Categorize and Select the different equipments in Additive manufacturing	4	9
BME4702.4	Illustrate the concept of Post processing	3	9
BME4702.5	Illustrate applications of Additive manufacturing	3	9


 Head
 Department of Mechanical Engineering
 Tulsiramji Gaikwad Patil College of
 Engineering & Technology, NAGPUR


 Dean Academics
 Tulsiramji Gaikwad-Patil
 College Of Engineering
 and Technology, Nagpur



**Tulsiramji Gaikwad-Patil College of Engineering and
Technology**

Wardha Road, Nagpur-441 108
NAAC Accredited (A+ Grade)



Fourth Year (Semester-VII) B. Tech. Mechanical Engineering

BME4703: Lab-Refrigeration and Air Conditioning

Teaching Scheme			Examination Scheme	
Practical	2 Hrs/week		CA	25 Marks
			ESE	25 Marks
Total Credit	1		Total	50 Marks
			Duration of Exam: 03 Hrs .	

Course Objectives

1	Learn different types of Compressors.
2	Understand significance of various Coontrols used in Refrigeration.
3	Examine COP of Windows Air Conditioning system.
4	Learn different parameters of using Vapour Compression system.
5	Perform experiment on different characteristics of Desert Cooler.

Experiment No.	Name of Experiment	CO
1	Explore the importance of various types of Compressors.	CO1
2	Explore the significance of various Condensers, Evaporators, and Expansion Devices used in Refrigeration and Air Conditioning system.	CO1
3	Demonstrate the various types of controls used in Refrigeration and Air Conditioning system.	CO2
4	Examination of various components of house hold Refrigerator	CO2
5	Examination of various parts of Windows Air Conditioning system.	CO3
6	Calculation of capacity and COP of Windows Air Conditioning system.	CO3
7	Iterations on summer air-conditioning test rig for temperature variations.	CO3
8	Demonstrate an experiment on winter air-conditioning test rig.	CO3
9	Evaluation of parameters using Vapour Compression system.	CO4
10	Evaluation of performance characteristics of Desert Cooler.	CO5

Text Books

1	Refrigeration and Air Conditioning, R.S.Khurmi, S.Chand and Company.
2	Refrigeration and Air Conditioning, Arora and Domkundwar, Dhanpat Rai
3	Refrigeration and Air Conditioning, Arora C P, Tata McGraw Hill.

Reference Books

1	Principles of Refrigeration, Roy Dossat, Pearson Education.
---	---

2	Commercial Refrigeration, Edwin P. Anderson, Taraporevala Sons & Co.
3.	ASHRAE Hand Books, Air Conditioning Engineers
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc19_me58/preview
2	https://archive.nptel.ac.in/courses/112/105/112105129/

Course Code	Course Outcomes	CL	Lab Sessions
BME4703.1	Demonstrate various types of Compressor sand Paraphrasing the condenser, evaporators and expansion devices used in refrigeration system.	3	2
BME4703.2	Interpret the various controls used in refrigeration and air conditioning system.	3	2
BME4703.3	Execute the performance of various types of air conditioning system	4	2
BME4703.4	Evaluate the performance of the cooling capacity of the refrigeration system	3	2
BME4703.5	Evaluate the performance of desert cooler system	3	2


 Head
 Department of Mechanical Engineering
 Tulsiramji Gaikwad Patil College of
 Engineering & Technology, NAGPUR


 Dean Academics
 Tulsiramji Gaikwad-Patil
 College Of Engineering
 and Technology, Nagpur



**Tulsiramji Gaikwad-Patil College of Engineering and
Technology**

Wardha Road, Nagpur-441 108
NAAC Accredited (A+ Grade)



Fourth Year (Semester-VII) B. Tech. Mechanical Engineering

BME4704: Advanced CAD Lab

Teaching Scheme			Examination Scheme	
Practical	2 Hrs/week		CA	25 Marks
			ESE	25 Marks
Total Credit	1		Total	50 Marks
			Duration of Exam: 03 Hrs .	

Course Objectives

1	Understand the basics of CAD System.
2	Apply geometric modeling technique for the development of engineering object.
3	Apply Finite element method for engineering object .

Experiment No.	Name of Experiment	CO
1	Development of a Program for generation of Circle using Bresenham's algorithms.	CO1
2	Development of a Program for generation Ellipse using Bresenham's algorithms.	CO1
3	Design a Program for 2-D & 3-D transformations algorithms.	CO1
4	Apply the concept of 2-D Geometric modeling of an Engineering object to demonstrating Boolean operations.	CO2
5	Apply the concept of 3-D Geometric Modeling of an Engineering object to demonstrating extrude, revolve and loft commands.	CO3
6	Calculate Stress, strain using finite element method for 1-D bar element.	CO4
7	Calculate Stress, strain using finite element method for 1-D truss element.	CO4
8	Apply Finite element method to calculate Stress, strain of 2-D CST element.	CO4
9	Design two simple solid models showing geometric properties using CAD software.	CO5
10	Prepare any Assembly model.	CO5

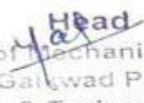

Text Books



1	Computer Aided Design and Manufacturing, Groover, M.P., Prentice-Hall of India, 5th Edition, 2005.
2	CAD/CAM Theory and Practice, Zeid Ibrahim, Tata McGraw Hill, 4th edition, 2001.

Reference Books



1	Automation Production Systems and Computer Integrated Manufacturing, Groover, M. P. Prentice-Hall of India, 2nd Edition.
---	--



2	CAD/CAM Principles and Applications, Rao, P.N. Tata McGraw Hill, 2002.
Useful Links	
1	https://nptel.ac.in/courses/112/102/112102101/
2	https://nptel.ac.in/courses/112/102/112102102/

Course Code	Course Outcomes	CL	Lab Sessions
BME4704.1	Develop the C-Programs to generate basic entities, Curves and Transformation.	3	2
BME4704.2	Apply the Concept of 2D Geometric modeling of an engineering object.	3	2
BME4704.3	Apply the Concept of 3 D Geometric modeling of an engineering object.	3	2
BME4704.4	Apply finite element method to analyze structure like bar, trusses and CST Element.	3	2
BME4704.5	Create 2-D and 3-D geometrical model and its assembly by modeling software.	4	2
<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;">  Head Department of Mechanical Engineering Tulsiramji Gaikwad Patil College of Engineering & Technology. NAGPUR </div> <div style="text-align: center;">  Dean Academics Tulsiramji Gaikwad-Patil College Of Engineering and Technology, Nagpur </div> </div>			

	Tulsiramji Gaikwad-Patil College of Engineering and Technology Wardha Road, Nagpur-441 108 NAAC Accredited (A+ Grade)			
Fourth Year (Semester-VII) B. Tech. Mechanical Engineering				
BME4706: PE-V- Material Handling System				
Teaching Scheme			Examination Scheme	
Lectures	4 Hrs/week		CT-1	15 Marks
Tutorial	-		CT-2	15 Marks
Total Credit	4		TA	10 Marks
			ESE	60 Marks
			Total	100 Marks
		Duration of ESE: 03 Hrs .		
Course Objectives				
1	Understand the basic concepts of materials handling.			
2	Analyze Selection of Material Handling Equipments.			
3	Design of Mechanical Handling Equipments.			
4	Choose equipments used for Material Storage.			
Course Contents				
Unit I	Elements of Material Handling System: -Importance, terminology, objectives and benefits of better Material Handling; Principles and features of Material Handling System; Interrelationships between material handling and Plant layout, physical facilities and other organizational functions; Classification of Material Handling equipments. Selection of Material Handling Equipment: Classifications & Attributes			
Unit II	Selection of Material Handling Equipments:- Factors affecting for selection; Material Handling equation; choices of Material Handling equipment; general analysis procedures; basic analytical techniques; the unit load concept; selection of suitable types of systems for applications; activity cost data and economic analysis for design of components of Material Handling Systems; functions and parameters affecting service; packing and storage of materials.High quality design system			
Unit III	Design of Mechanical Handling Equipments:- [A] Design of Hoists: - Drives for hoisting, components, and hoisting mechanisms; rail traveling components and mechanisms; hoisting gear operation during transient motion; selecting the motor rating and determining breaking torque for hoisting mechanisms. [B] Design of Cranes:- Hand-propelled and electrically driven EOT overhead traveling cranes; Traveling mechanisms of cantilever and monorail cranes; design considerations for structures of rotary Cranes with fixed radius; fixed post and overhead traveling cranes; Stability of stationary Rotary and traveling rotary cranes. Analysis of material handling equipment using software			
Unit IV	Design of load lifting attachments:- Load chains and types of ropes used in Material Handling System; Forged, Standard and Ramshorn Hooks; Crane Grabs and Clamps; Grab Buckets; Electromagnet; Design consideration for conveyor belts; Application of attachments. Design specification for fully automated system.			
Unit V	Gravity flow of solids through slides and chutes; Storage in bins and hoppers; Belt conveyors;Bucket-elevators; Screw conveyors;Vibratory Conveyors; Cabin conveyors; Mobile racks etc. Safety and design,Safety regulations and discipline, material handling safety with health			

Text Books	
1	Aspects of Materials Handling, Arora, K. & Shinde, V., University Science Press
2	Material Handling Equipments, N. Rudenko, Peace Publishers.
Reference Books	
1	Bulk Solid Handling, C. R. Cock and J. Mason, Leonard Hill Publication Co. Ltd.
2	Material Handling Hand Book, Kulwiar R. A., John Wiley Publication.
Useful Links	
1	https://nptel.ac.in/courses/112/107/112107142/
2	https://nptel.ac.in/content/storage2/courses/

Course Code	Course Outcomes	CL	Class Sessions
BME4706.1	Understand importance of material handling in a plant	2	9
BME4706.2	Demonstrate the understanding of mechanism and working of various materials handling systems.	5	9
BME4706.3	Analyze design components of material handling systems	4	9
BME4706.4	Understand equipments used for Material Storage	2	9
BME4706.5	Estimate Safety and design for material handling system	5	9
<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;">  Head Department of Mechanical Engineering Tulsiramji Gaikwad Patil College of Engineering & Technology, NAGPUR </div> <div style="text-align: center;">  Dean Academics Tulsiramji Gaikwad-Patil College Of Engineering and Technology, Nagpur </div> </div>			



	Tulsiramji Gaikwad-Patil College of Engineering and Technology Wardha Road, Nagpur-441 108 NAAC Accredited (A+ Grade)			
Fourth Year (Semester-VII) B. Tech. Mechanical Engineering				
BME4708: PE-V- Total Quality Management				
Teaching Scheme			Examination Scheme	
Lectures	4 Hrs/week		CT-1	15 Marks
Tutorial	-		CT-2	15 Marks
Total Credit	4		TA	10 Marks
			ESE	60 Marks
			Total	100 Marks
			Duration of ESE: 03 Hrs .	
Course Objectives				
1	Understand quality and TQM and explaining the salient contributions of Quality Gurus like Deming, Juran and Crosby. General barriers in implementing TQM.			
2	Apply the tools and techniques of quality management to manufacturing and services processes.			
3	Understand Quality Management principles and process.			
Course Contents				
Unit I	Unit I —Introduction to Total Quality Management Concept of Quality, Need for Quality. Definition of Quality Dimensions of a Product and Quality of Service, Concept of TQM, Framework of TQM. Contributions of Deming, Juran, and Crosby, benefits and challenges of implementing TQM in various industries.			
Unit II	Unit II— Principles of Total Quality Management Continuous process improvement PDCA cycle, Kaizen, 8D Methodology. Supplier partnership, Supplier Rating. Strategies for involving employees and suppliers in continuous improvement initiatives. Taguchi technique— Introduction, Loss Function, Parameter, and Tolerance Design, Signal to Noise ratio.			
Unit III	Unit III — Statistical Process Control and Process Capability Statistical Process Control- Central Tendency, Normal curve, Control Charts, Statistical tools and techniques to assess and improve process capability. Process Capability, Quality Function Development (QFD), TPM - Concepts, improvement.			
Unit IV	Unit IV - Tools and Techniques in Total Quality Management The seven traditional tools of quality, measure and evaluate the effectiveness of TQM tools. New management tools, Six-sigma: Concepts, Methodology, Applications to Manufacturing and Service Sector including IT. FMEA Stages and Types.			
Unit V	Unit V — Quality Systems in Total Quality Management Introduction to IS/ISO 9004:2000. Quality Management Systems, Guidelines for performance improvements, Quality Audits, knowledge of quality systems, audits, leadership, and software tools to real-world case studies and scenarios., Leadership and Quality Council, Employee Involvement in TQM, Motivation, Empowerment, Recognition and reward,			

	Overview software used for TOM.
Text Books	
1	A textbook of Methods of Total Quality Management by Himalaya Publishing House.
2	A textbook of quality control and total quality management by Tata Mcgraw Hill.
3	A textbook essence of total quality management by prentice hall of India.
Reference Books	
1	Total Quality Management:Naidu, Nvr ; New Delhi : New Age International, 2006.
2	Total Quality Management:S D Bagade ;Mumbai : Himalaya Publishing House, 2011
Useful Links	
1	https://archive.nptel.ac.in/courses/110/104/110104080/
2	https://archive.nptel.ac.in/courses/110/104/110104085/
3	https://elearn.nptel.ac.in/shop/nptel/total-quality-management-i/

Course Code	Course Outcomes	CL	Class Sessions
BME4708.1	Analyze the benefits and challenges of implementing TQM in various industries and sectors.	4	9
BME4708.2	Summarize strategies for involving employees and suppliers in continuous improvement initiatives.	5	9
BME4708.3	Apply statistical tools and techniques to assess and improve process capability.	3	9
BME4708.4	Summarize the effectiveness of TQM tools in achieving quality objectives and organizational goals.	5	9
BME4708.5	Apply knowledge of quality systems, audits, leadership, and software tools to real-world case studies and scenarios.	3	9


 Department of Mechanical Engineering
 Tulsiramji Gaikwad Patil College of
 Engineering & Technology, NAGPUR


 Dean Academics
 Tulsiramji Gaikwad-Patil
 College Of Engineering
 and Technology, Nagpur

		Tulsiramji Gaikwad-Patil College of Engineering and Technology Wardha Road, Nagpur-441 108 NAAC Accredited (A+ Grade)			
Fourth Year (Semester-VII) B. Tech. Mechanical Engineering					
BBAXX17: Open Elective-V: Industry 4.0					
Teaching Scheme				Examination Scheme	
Lectures	3 Hrs/week	CT-1		15 Marks	
Tutorial	-	CT-2		15 Marks	
Total Credit	3	TA		10 Marks	
		ESE		60 Marks	
		Total	100 Marks	Duration of ESE: 03 Hrs .	
Course Objectives					
1	Understand the various sensors and actuators.				
2	Understand the Sustainability Assessment and Smart Factories for Industry 4.0.				
3	Analyze the Cyber-Physical Systems and Artificial Intelligence and Big Data for Industry 4.0.				
Course Contents					
Unit I	Sensing & Actuation: Transducer, Sensor and its Characteristics, Sensor Classification, Actuator and its Classification, Actuator Characteristics. Industry 4.0: Historical Context its Classification, Drivers - Megatrends, Tipping Points.				
Unit II	Sustainability Assessment of Manufacturing Industry: Introduction to Sustainable Industry, Sustainability in Industry 4.0, Introduction to Globalization Issues, Introduction to Emerging Issues, Sustainability Assessment of Emerging Issues. Lean Production System: Introduction of Lean Production System, Classification of wastes, Value streams in Lean, Lean production in Industry 4.0, Implementation of Lean implies.				
Unit III	Smart and Connected Business Perspective: Introduction and its classification of Smart and Connected Business, need of smart business model, Value creation in smart business model, Layers and technologies for creating values. Smart Factories: Introduction and Components of smart factory, Characteristics of smart factories, Supporting technologies for smart factories, Automation pyramid of a smart factory.				
Unit IV	Cyber-Physical Systems and Next-Generation Sensors: Differences with Embedded Systems, Features and application of Cyber-Physical Systems, CPS Architecture for Industry 4.0, Need and application of next-Generation Sensors, Design Challenges of Next Generation Sensors. Collaboration Platform and Product Lifecycle Management: Collaboration Productivity in Industry 4.0, Product Lifecycle Management, PLM for Industry 4.0, Scope of PLM.				
Unit V	Augmented Reality and Virtual Reality: Augmented Reality and Virtual Reality in IIoT, Introduction and Chronological order of Augmented Reality, Applications of Augmented Reality, Types of Augmented Reality, Introduction and Chronological order of Virtual Reality, Applications of Augmented Reality, Types of Augmented Reality. Introduction of Artificial Intelligence and Big Data: Techniques and scope of AI, Role of AI in Industry 4.0, Classification of big data, Characteristics of Big Data.				

Text Books	
1	Ravi Kant, Hema Gurung, “Industry 4.0: Concepts, Processes and Systems”.
2	Bartodziej, Christoph Jan,”The Concept Industry 4.0”.
3	Klaus Schwab,”The Fourth Industrial Revolution”.
Reference Books	
1	Alp Ustundag and Emre Cevikcan,” Industry 4.0: Managing the Digital Transformation”.
2	Mahdi Sharifzadeh, “Industry 4.0 Vision for the Supply of Energy and Materials: Enabling Technologies and Emerging Applications”.
3	Aydin Azizi, Reza Vatankhah Barenji, “Industry 4.0: Technologies, Applications, and Challenges (Emerging Trends in Mechatronics)”.
Useful Links	
1	https://nptel.ac.in/courses/106105195

Course Code	Course Outcomes	CL	Class Sessions
BBAXX17.1	Understand the Sensor, Actuation and basics of Industry 4.0.	2	9
BBAXX17.2	Understand the Sustainability Assessment and Lean Production method in manufacturing industry.	2	9
BBAXX17.3	Understand the importance of Smart and Connected Business, and Smart Factories for Industry 4.0.	2	9
BBAXX17.4	Analyze the Cyber-Physical Systems and Next-Generation Sensors, and Product Lifecycle Management for Industry 4.0.	4	9
BBAXX17.5	Analyze the Augmented Reality, Virtual Reality, Artificial Intelligence and Big Data for Industry 4.0.	4	9


 Head
 Department of Mechanical Engineering
 Tulsiramji Gaikwad Patil College of
 Engineering & Technology, NAGPUR


 Dean Academics
 Tulsiramji Gaikwad-Patil
 College Of Engineering
 and Technology, Nagpur