Tulsiramji Gaikwad-Patil College of Engineering & Technology, Nagpur

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

SCHEME OF INSTRUCTION & SYLLABI

Program: Mechanical Engineering

Scheme of Instructions: Final Year B.Tech. in Mechanical Engineering Semester–VII (As Per NEP 2020)

Sr. No.	Course Category	Course Code	Course Title	T/P	Contact Hrs/Wk			Credits	Exam Scheme			ESE Duration	Total Marks
					L	P	Hrs		CT/IA	CA	ESE		
1	**PCC**	BME34701	Refrigeration and Air Conditioning	T	4	-	4	4	30	10	60	3Hrs	100
2	**PCC**	BME34702	Design of Mechanical drives	T	4	-	4	4	30	10	60	3Hrs	100
4	**PCC**	BME34703	Sustainable Development Goals	T	2	-	2	2	14	06	30	2 Hrs	50
5	**PEC**	BME34704-07	Program Elective-IV	T	4	-	4	4	30	10	60	3Hrs	100
6	**MDM**	BEE 34712	Introduction to Electric Vehicles	T	4	-	4	4	30	10	60	3Hrs	100
7	**PCC**	BME34708	Refrigeration and Air Conditioning Lab	P	-	2	2	1	-	25	25	2 Hrs	50
8	**PCC**	BME34709	Advance CAD Lab	P	-	2	2	1	-	25	25	2 Hrs	50
9	**Project**	BME34710	Project	P	-	8	8	4	-	100	100	2 Hrs	200
			Total		**15**	**12**	**27**	**24**	**134**	**196**	**440**	**18 Hrs**	**750**

Course Category	PCC (Program Core Courses)	PEC (Program Elective Courses)	(MDM) Multidisciplinary Minor	OEC (Open Elective courses from other discipline)	VSEC (Vocational and Skill Enhancement Course)	HSSM (Humanities Social Science and management)(VEC/IKS/AEC)	FP/CP/OJT/RM/ Project (Experimental Learning Courses)
Credits	12	4	4	-	-	-	4
Cumulative Sum	52	14	15	8	8	14	6

PROGRESSIVE TOTAL CREDITS:126+24=150

Chairperson HOD	Vice Principal / Director Academics	Director Administration	Principal	June,2026 Date of Release	1.00 Version	Applicable for AY2026-27 Onwards

Mechanical Engineering (NBA Accredited)
Tulsiramji Gaikwad-Patil College of Engineering, Nagpur

Director Academics
Tulsiramji Gaikwad-Patil College Of Engineering And Technology, Nagpur

Dr. Premanand Naktode
Principal
TGPCET, Nagpur

Program: Mechanical Engineering

List of **Program Electives** offered By Mechanical Engineering Department (NBA Accredited)

Program Elective- I	Program Elective-II	Program Elective- III	Program Elective- IV
Semester V	**Semester VI**	**Semester VI**	**Semester VII**
BME33504: Industrial Economics and Management	BME33605: Hydraulic and Pneumatic Systems	BME33609: Finite Element Method	BME34704: Material Handling System
BME33505: Computer Aided Design	BME33606: Mechanical Measurement and Metrology	BME33610: Advanced Manufacturing techniques	BME34705: Total Quality Management
BME33506: Automotive System	BME33607: Ginning Processes	BME33611: Operation Research	BME34706: Ginning Management
BME33507: Smart Manufacturing	BME33608: Control System Engineering	BME33612: Industrial Robotics	BME34707: Computer Integrated Manufacturing

Program: Mechanical Engineering

List of **Open Electives** offered Mechanical Engineering Department (NBA Accredited)

Open Elective-I	Open Elective-II	Open Elective-III
III-Semester	**IV-Semester**	**V-Semester**
BME32306: Basics of Manufacturing Technology and Processes	BME32407:Automobile Engineering	B$$32XX:Additive Manufacturing

Chairperson	Vice Principal / Director Academics	Director Administration	Principal	June,2026	1.00	Applicable for AY2026-27 Onwards
HOD				Date of Release	Version	

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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

BME34701: Refrigeration and Air Conditioning

Teaching Scheme	
Lecture	4 Hrs/Week
Tutorial	-
Total Credit	4

Examination Scheme	
CT-1	15 Marks
CT-2	15 Marks
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

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.
Unit II	Compound vapour compression refrigeration system, multiple evaporator system, types of compressor, condenser, evaporator, expansion devices, hermatic compressors, methods of defrosting.
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).
Unit IV	**Cryogenics:** Introduction, application of cryogenics, cascade system, Joules Thomson coefficient, inversion curve, methods of liquefaction of air with analytical treatment.
Unit V	**Advanced Psychometric & Heat Load Calculations:** Introduction to psychometric properties and processes of air. Classification of air conditioning systems, Applications of psychometry to various air conditioning systems, RSHF, ESHF, GSHF, air washers, air coolers.

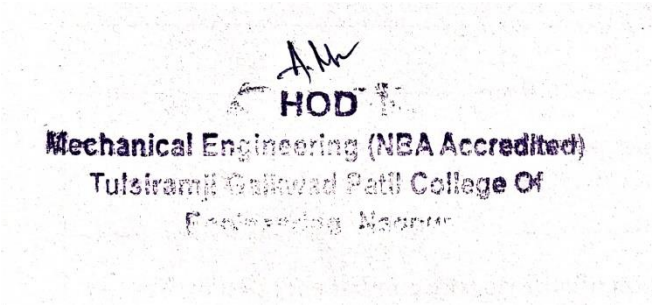
Text Books

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
BME34701.1	**Calculate** Coefficient of Performance by using the Simple vapour compression Refrigeration System	4	9
BME34701.2	**Calculate** Coefficient of Performance by using the compound vapour compression Refrigeration and multiple evaporator System	3	9
BME34701.3	**Illustrate** concept of different Air cycle refrigeration system	4	9
BME34701.4	**Illustrate** the concept Cryogenics and its different types	4	9
BME34701.5	**Calculate** Heat Load for Air conditioning system	3	9



Tulsiramji Gaikwad-Patil College of Engineering and Technology

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NAAC Accredited with A+ Grade

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Fourth Year (Semester VII) B.Tech Mechanical Engineering

BME34702: Design of Mechanical drives

Teaching Scheme		Examination Scheme	
Theory	4Hrs/Week	**CT-I**	15 Marks
Tutorial	-	**CT-II**	15 Marks
Total Credits	**4**	**CA**	10 Marks
		ESE	60 Marks
		Total Marks	**100 Marks**
		Duration of ESE: 3Hrs	

Course Objectives

1	To understand the principles of design of various mechanical power transmission systems.
2	To design belt, chain, rope and gear drives for industrial applications.
3	To analyze speed variation and torque transmission requirements.
4	To apply standard design procedures using design data books and standards.

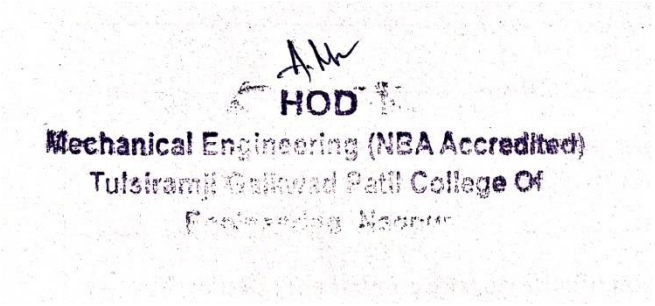
Course Contents

Unit I	**Introduction to Mechanical Drives** Classification of mechanical drives ,Types of power transmission systems ,Selection criteria for mechanical drives ,Standardization and design procedure ,Speed ratio and velocity ratio ,Service factor and design considerations
Unit II	**Belt Drives** Types of belt drives ,Flat belts and V-belts ,Materials of belts ,Velocity ratio and slip ,Length of belt ,Tension ratio ,Power transmission capacity ,Centrifugal tension ,Design of flat belt drives ,Design of V-belt drives
Unit III	**Rope Drives and Chain Drives** Rope Drives-Types of ropes (Fiber and Wire ropes) ,Design of rope drives ,Stresses in wire ropes ,Power transmitted **Chain Drives**-Types of chains ,Chain drive terminology,Velocity ratio, Design of chain drives ,Lubrication and maintenance
Unit IV	**Gear Drives – I** Classification of gears ,Gear terminology ,Law of gearing ,Involute profile ,Interference and undercutting ,Module, pitch and gear parameters ,Gear materials ,Design of spur gears (Lewis equation) Beam strength of gear teeth.

Unit V	**Gear Drives – II** Dynamic load on gear teeth,Wear load,Design for strength and wear ,Helical gears – terminology and design ,Gearbox selection and basic design considerations ,Introduction to bevel gears and worm gears

Text Books	
T.1	Bhandari V.B., Design of Machine Elements, Tata McGraw Hill
T.2	Khurmi R.S. & Gupta J.K., Machine Design, S. Chand Publishing
Reference Books	
R.1	Shigley J.E., Mechanical Engineering Design, McGraw-Hill Education
R.2	PSG Design Data Book, PSG College of Technology
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc25_me15/preview
2	https://terna.digimat.in/nptel/courses/video/112105124/L31.html

Course Code	Course Outcomes	BT level	Class Sessions
BME34702.1	Understand the fundamentals of mechanical power transmission systems.	4	9
BME34702.2	Design belt and rope drives for given power and speed requirements.	4	9
BME34702.3	Design chain drives and analyze their performance.	4	9
BME34702.4	Design spur and helical gears considering strength and wear criteria.	3	9
BME34702.5	Select suitable drive systems for industrial applications.	3	9



	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)**	

Fourth Year (Semester VII) B.Tech Mechanical Engineering

BME34703: Sustainable Development Goal

Teaching Scheme		**Examination Scheme**	
Theory	2 Hrs/Week	**CT-I**	07 Marks
Tutorial	-	**CT-II**	07 Marks
Total Credits	**2**	**CA**	06 Marks
		ESE	30 Marks
		Total Marks	**50 Marks**
		Duration of ESE: 2Hrs	

Course Objectives

1	To understand sustainability concepts and global SDG framework.
2	To integrate SDGs with mechanical engineering practices.
3	To analyze industrial, energy, and environmental challenges using SDG principles.
4	To apply mechanical engineering solutions for sustainable development.

Course Contents

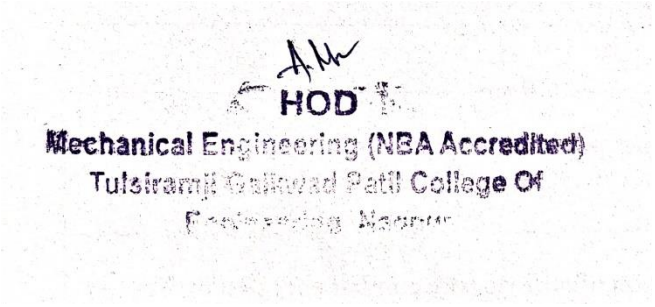
Unit I	**Foundations of Sustainability & Mechanical Context** Definition and principles of sustainability, Triple Bottom Line (Environmental, Economic, Social) Evolution: MDGs → SDGs, Climate Change fundamentals (GHG emissions, carbon footprint), Role of engineers in sustainable development **Mechanical Engineering Integration:** Energy efficiency in machines and systems; Sustainable materials (recyclable alloys, composites); Thermodynamic efficiency and waste heat recovery; Life Cycle Assessment (LCA) of mechanical components; Case: Efficient IC engines vs Electric Vehicles
Unit II	**SDGs & Engineering Applications** Overview of 17 SDGs, SDG clusters relevant to engineering: SDG 6: Water systems, SDG 7: Energy, SDG 9: Industry & Innovation, SDG 11: Smart Cities, SDG 12: Sustainable Production. \ **Mechanical Engineering Integration:** Renewable energy systems, HVAC energy optimization, Green manufacturing & lean production, Waste-to-energy systems, Sustainable transportation system.
Unit III	**Implementation & Future Technologies** SDG interconnections, Technology role (IoT, AI in sustainability), SDG financing & metrics, Climate resilience. **Mechanical Engineering Integration:** Smart manufacturing (Industry 4.0), Electric vehicles (EV systems), Smart energy systems, Sustainable construction materials, Industrial waste utilization (slag, fly ash)

Text Books

T.1	Hazra, Somnath., Bhukta, Anindya (2020) Sustainable Development Goals An Indian Perspective, Springer International Publishing, Switzerland
T.2	Ziai, Aram (2016) Development Discourse and Global History from colonialism to the sustainable

	development goals. Routledge, London & New York
Reference Books	
R.1	Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., Fuller, G., Woelm, F. 2020. The Sustainable Development Goals and COVID-19. Sustainable Development Report 2020. Cambridge: Cambridge University Press.
R.2	OECD (2019), Sustainable Results in Development: Using the SDGs for Shared Results and Impact, OECD Publishing, Paris, https://doi.org/10.1787/368cf8b4-en.
Useful Links	
1	https://nptel.ac.in/courses/109106200
2	https://www.un.org/sustainabledevelopment/

Course Code	Course Outcomes	CL	Class Sessions
BME34704.1	Explain sustainability principles and SDGs fundamentals	2	7
BME34704.2	Apply mechanical engineering techniques to achieve SDGs	2	7
BME34704.3	Analyze and propose sustainable engineering solutions	4	7



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

BME34704: PE-IV- Material Handling System

Teaching Scheme	
Lectures	4 Hrs/week
Tutorial	-
Total Credit	4

Examination Scheme	
CT-1	15 Marks
CT-2	15 Marks
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.

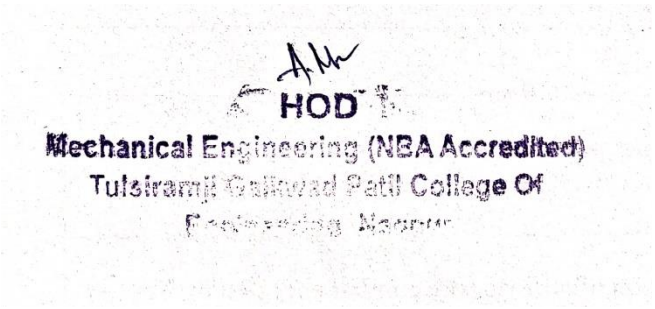
Course Contents

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, Kulwiac 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
BME34704.1	**Understand** importance of material handling in a plant	2	9
BME34704.2	**Demonstrate** the understanding of mechanism and working of various materials handling systems.	5	9
BME34704.3	**Analyze** design components of material handling systems	4	9
BME34704.4	**Understand** equipment used for Material Storage	2	9
BME34704.5	**Estimate** Safety and design for material handling system	5	9



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

BME34705: PE-IV- Total Quality Management

Teaching Scheme	
Lectures	4 Hrs/week
Tutorial	-
Total Credit	4

Examination Scheme	
CT-1	15 Marks
CT-2	15 Marks
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 fo involving employees and suppliers in continuous improvement initiatives. Taguchi technique— Introduction, Loss Function, Parameter, and Tolerance Design, Signalto Noiseratio.
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. FME A 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 softwareused 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 Mccraw 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
BME34705.1	**Analyze** the benefits and challenges of implementing TQM in various industries and sectors.	4	9
BME34705.2	**Summarize** strategies for involving employees and suppliers in continuous improvement initiatives.	5	9
BME34705.3	**Apply** statistical tools and techniques to assess and improve process capability.	3	9
BME34705.4	**Summarize** the effectiveness of TQM tools in achieving quality objectives and organizational goals.	5	9
BME34705.5	**Apply** knowledge of quality systems, audits, leadership, and software tools to real-world case studies and scenarios.	3	9

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Fourth Year (Semester VII) B.Tech Mechanical Engineering

BME34706: Ginning Management

Teaching Scheme		Examination Scheme	
Theory	4Hrs/Week	**CT-I**	15 Marks
Tutorial	-	**CT-II**	15 Marks
Total Credits	**4**	**CA**	10 Marks
		ESE	60 Marks
		Total Marks	**100 Marks**
		Duration of ESE: 3Hrs	

Course Objectives

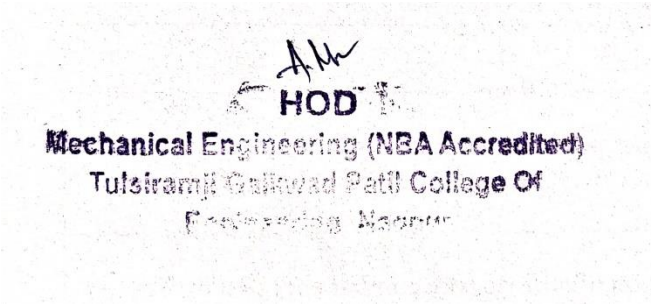
1	Students will able to understand safety practices, fire prevention methods, and fire fighting system design in ginning industries.
2	Students will able gain knowledge of installation, commissioning, machine layout, foundation drawing, and safety norms of ginning plants.
3	Students will able understand operational procedures, machine settings, production standards, and maintenance practices in ginning plants.
4	Students will able analyze techno-commercial aspects such as plant size, site selection, layout planning, investment, and profitability.
5	Students will able develop skills in marketing, cost estimation, customer identification, and techno-commercial proposal preparation for ginning plants.

Course Contents

Unit I	Safety in Ginning Industry, Prevention of Fire, related to cotton, fibre, Electrical, oil and inflammable. Design of Fire Fighting system, elements of FFS.
Unit II	Installation and Commissioning of Ginning Plant, Basic foundation drawing, layout of machine, material handling device, machine balancing knowledge for lifting and shifting, safety norms. Commissioning... Machine setting parameters as per manuals. Operation sequencing, no load trials, production norms, knowledge of product output.
Unit III	Maintenance of Ginning Plant, Preventive maintenance of complete plant, Ginning machine, Automation, Conveying system, consumables and tools, cleaning and greasing, trial run to find defects.
Unit IV	Techno Commercial aspects of Ginning Industry...Size of Cotton Ginnery, selection of site, plant layout, material handling, equipment selection, moisture maintenance, working period, capital requirements, operating cost, working capital, means of finance, profitability
Unit V	Marketing of Ginning Plant... Area wise Survey and Technology requirements, Customer identification, price/cost of Ginning Plant, making customer quality conscious rather cost, discussion on site selection, requirements of plant and machinery, PEB, Electrical Panel, Fire Fighting System, Civil work

Text Books	
T.1	Double Roller Ginning Technology … P G Patil, G R Anap, M K Sharma
Reference Books	
R.1	Cotton Ginnery Handbook USDA
Useful Links	
1	https://gphisar.ac.in/wp-content/uploads/2022/09/TT-3rd-sem-ST-I-Study-material.pdf

Course Code	Course Outcomes	CL	Class Sessions
BME34706.1	**Explain** safety measures, fire hazards related to cotton and inflammable materials, and design basic fire fighting systems for ginning plants.	2	9
BME34706.2	**Prepare** basic foundation drawings, plant layouts, and demonstrate knowledge of installation, commissioning, and safety compliance.	3	9
BME34706.3	**Perform** machine setting, operation sequencing, no-load trials, and implement preventive maintenance practices in ginning plants.	3	9
BME34706.4	**Analyze** techno-commercial feasibility including capital cost, operating cost, working capital, and profitability of a cotton ginning industry.	4	9
BME34706.5	**Prepare** a techno-commercial proposal including site survey, equipment selection, cost estimation, and marketing strategy for establishing a ginning plant. \	5	9



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

BEE34712: Introduction to Electric Vehicles

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

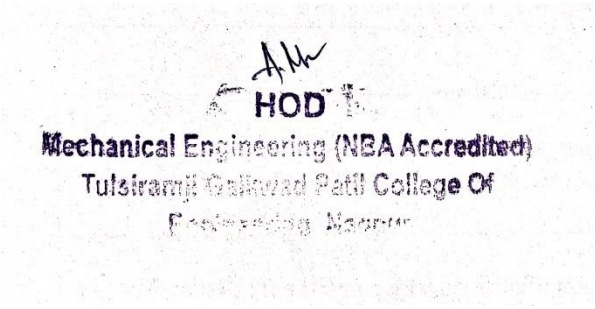
1	To introduce the fundamentals of electric vehicles (EVs), their need, history, and role in sustainable transportation.
2	To understand the components and architecture of electric vehicles including motors, batteries, and power electronics.
3	To study energy storage systems, battery management systems, and charging technologies.
4	To analyze EV powertrain configuration, performance characteristics, and control strategies.

Course Contents

Unit I	**Introduction to Electric Vehicles** History and evolution of Electric Vehicles, Need for Electric Vehicles ,Comparison of ICE vehicles and EVs ,Classification of EVs: BEV, HEV, PHEV, FCEV ,Environmental impact and sustainability
Unit II	**EV Architecture and Components** EV configuration and layout, Electric traction motors: DC Motor, Induction Motor, PMSM, BLDC ,Power converters and inverters ,Transmission system in EV, Regenerative braking system
Unit III	**Energy Storage Systems** Types of batteries: Lead Acid, NiMH, Lithium-ion, Battery characteristics and performance parameters, Battery Management System (BMS) ,State of Charge (SOC) and State of Health (SOH) ,Super capacitors and fuel cells (basic introduction)
Unit IV	**Charging Systems and Infrastructure** EV charging methods: Conductive and Inductive charging ,Charging levels: Level 1, Level 2, DC Fast Charging ,Charging standards (Type 1, Type 2, CCS, CHAdeMO) ,Smart charging and Grid integration ,Overview of EV charging infrastructure
Unit V	**EV Performance, Control & Policies** Vehicle dynamics in EV, Powertrain control strategies, Energy efficiency and range estimation, Government policies and incentives (India perspective),Challenges and future trends in EV technology

Text Books	
1	Electric Vehicles: Concepts and Fundamentals by Iqbal Husain
2	Electric and Hybrid Vehicles: Technologies, Modeling and Control — A Mechatronic Approach" by Henderson and Widmer
3	Electric and Hybrid Electric Vehicles" by Ronald K. Jurgen (Second Edition)
Reference Books	
1	Electric Vehicle Technology Explained" by James Larminie and John Lowry
2	Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design" by Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, and Ali Emadi
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_ee112/preview
2	https://nptel.ac.in/courses/108106182
3	https://elearn.nptel.ac.in/shop/nptel/electric-vehicles-and-renewable-energy/?v=13b5bfe96f3e

Course Code	Course Outcomes	CL	Class Sessions
BEE34712.1	Explain the need, classification, and working principles of Electric Vehicles.	2	9
BEE34712.2	Describe the components and architecture of EV powertrain systems.	2	9
BEE34712.3	Analyze battery systems, BMS functions, and charging technologies used in EVs.	4	9
BEE34712.4	Evaluate performance parameters and control strategies of electric vehicles.	5	9
BEE34712.5	Discuss challenges, policies, and future trends in EV technology.	3	9



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

BME34708: Refrigeration and Air Conditioning 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	**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

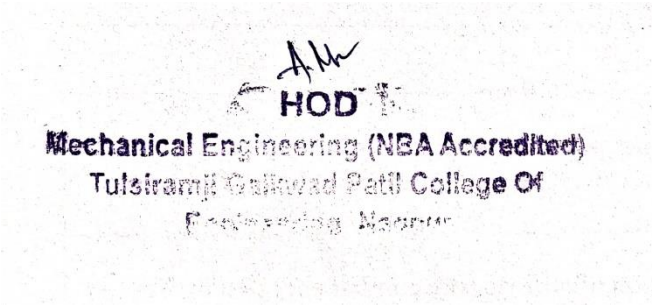
1	Refrigeration and Air Conditioning, R.S.Khurmi, S.Chand and Company.
2	Refrigeration and Air Conditioning, Arora and Domkundwar, Dhanpat Rai
3	Refrigeration and Air Conditioning, Arora C P, Tata McGraw Hill.

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
BME34708.1	Demonstrate various types of Compressor sand Paraphrasing the condenser, evaporators and expansion devices used in refrigeration system.	3	2
BME34708.2	Interpret the various controls used in refrigeration and air conditioning system.	3	2
BME34708.3	Execute the performance of various types of air conditioning system	4	2
BME34708.4	Evaluate the performance of the cooling capacity of the refrigeration system	3	2
BME34708.5	Evaluate the performance of desert cooler system	3	2



Tulsiramji Gaikwad-Patil College of Engineering and Technology

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

BME34709: 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 Bressenham's algorithms.	CO1
2	**Development** of a Program for generation Ellipse using Bressenham'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 Principals 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
BME34709.1	**Develop** the C-Programs to generate basic entities, Curves and Transformation.	3	2
BME34709.2	**Apply** the Concept of 2D Geometric modeling of an engineering object.	3	2
BME34709.3	**Apply** the Concept of 3 D Geometric modeling of an engineering object.	3	2
BME34709.4	**Apply** finite element method to analyze structure like bar, trusses and CST Element.	3	2
BME34709.5	**Create** 2-D and 3-D geometrical model and its assembly by modeling software.	4	2