Tulsiramji Gaikwad-Patil College of Engineering & Technology, Nagpur

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

SCHEME OF INSTRUCTIONS & SYLLABI

Programme: Mechanical Engineering (NBA Accredited)

Scheme of Instructions: Second Year B.Tech. in Mechanical Engineering (As Per New NEP 2020)

Semester--III

SN	Sem	Type	BoS/ Dept	Sub Code	Subject	T/P	Contact Hours			Credits	% Weightage			ESE Duration	Total Marks
							L	P	Hrs		CT/IA	CA	ESE		
1	III	PCC	ME	BME42301	Manufacturing Technology and Processes	T	3	-	3	3	30	10	60	3 Hrs	100
2	III	PCC	ME	BME42302	Material Engineering	T	3	-	3	3	30	10	60	3 Hrs	100
3	III	PCC	ME	BME42303	Manufacturing Technology and Processes lab	P	-	2	2	1	-	25	25	2 Hrs	50
4	III	PCC	ME	BME42304	Material Engineering lab	P	-	2	2	1	-	25	25	2 Hrs	50
5	III	OEC	ME	BME42306	Open Elective-I	T	4	-	4	4	30	10	60	3 Hrs	100
6	III	HSSM	BA	BBA42304	Managerial Economics	T	2	-	2	2	14	6	30	2 Hrs	50
7	III	VEC	SH	BSH42308	Sustainable Development Goals	T	2	-	2	2	14	6	30	2 Hrs	50
8	III	MDM	ME	BSH42306	Engineering Mathematics-III	T	2	-	2	2	14	6	30	2 Hrs	50
9	III	CEP	ME	BME42305	Micro Project	P	-	4	4	2	-	50	-	2 Hrs	50
10	III	CC	BSH	BSH423XX	Liberal Learning Module-III	P	-	2	2	1	-	50	-	2 Hrs	50
Total							**16**	**10**	**26**	**21**	**132**	**198**	**320**	**23 Hrs**	**650**

Course Category	BSC/ ESC (Basic Science Course/ Engineering Science Course.)	PCC (Program Core courses)	PEC (Program Elective courses)	Multidisciplinary courses	OEC (Open Elective courses from other discipline	SEC (Skill Course)	Humanities Social Science & Management	(ELC/FP/CEP) Experiential Learning Courses	CC (Liberal Learning Courses
Credits	--	08	--	02	04	--	02	02	01
Cumulative Sum	16 / 13	10	--	03	04	04	08	02	04

PROGRESSIVE TOTAL CREDITS: 43+21=64

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

Open Elective-I	Open Elective-II	Open Elective-III
III-Semester	**IV-Semester**	**V-Semester**
BME42306: Basics of Manufacturing Technology and Processes	BME42407:Automobile Engineering	BME43504:Additive Manufacturing

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

HOD
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Second Year (Semester-III) B.Tech. Mechanical Engineering

BME42301: Manufacturing Technology and Processes

Teaching Scheme		Examination Scheme	
Lectures	3 Hr / Week	**CT**	30
Tutorials	-	**CA**	10
Total Credits	3	**ESE**	60
		Total	100 Marks
		Duration of ESE: 03 Hrs	

Course Objectives:

1	To emphasize the importance manufacturing sciences in the day-to-day life.
2	To study the basic manufacturing processes and tools used.
3	To understand the manufacturing processes like casting, welding process & machining processes.

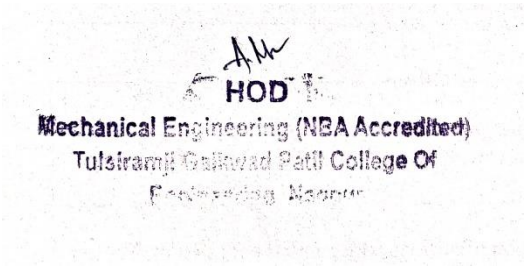
Course Contents

Unit I	**Joining Processes**: - Introduction to metal Joining- Types of Welding. Arc Welding & Gas Welding Processes, Thermit Welding, Defects & Inspection of Welding Joints, Electrodes, weldability of Metals, TIG Welding, MIG Welding, Resistance Welding. Soldering & Brazing.Plasma Arc welding, Electron Laser Beam welding.
Unit II	**Pattern Making& Moulding:-** Pattern making: Types, materials used, Pattern making allowances, color codes. Master Pattern, Core making: - Types, core material & its properties. Moulding: Types of sand moulds, moulding sand composition. moulding sand properties, sand preparation technique for casting.
Unit III	**Gating System & Casting Processes: -** Gating design -Elements of gating systems, pouring equipments, riser design Melting furnaces -Types, Electric furnace, Cupola construction& operation. Casting defects. Foundry mechanizing, Foundryequipments, Special casting processes such as investment Casting, Centrifugal Casting, Slush Casting. Advances in Gating system.
Unit IV	**Introduction to Machining Parameters in Lathe Machine**: Introduction to machining, Tool materials, nomenclature and tool materials properties, classification, HSS, carbide tool, coated tools, diamond coated tool. Theory of Metal Cutting: Introduction. Orthogonal and Oblique cutting. Mechanics of Metal Cutting. Introduction, Type, Construction of simple lathe mechanism and attachments for various operations, machine specifications, basis for selection of cutting speed. feed and depth of cut, time estimation for turning operations such as facing, step turning, taper turning, threading, knurling. Introdution of CNC Lathe Machine.
Unit V	**Shaper:** Introduction, type, specification, description of machines, hydraulic drives in shapers, cutting parameters. Mechanism of shaper: Quick return mechanism, Crank & slotted link mechanism, Table feed mechanism, attachments for shaper, Jigs and fixtures: Introduction, principles of jig and fixture, Principle of location, jig bushes, drilling jigs, type of clamps, classification of fixtures.

Text Books	
T.1	A Text Of Book Manufacturing Technolgy by Chand And Co.Publication.
T.2	A Text Of Book Manufacturing Technolgy II by . Chand And Co.Publication.
Reference Books	
R.1	Elements Of Workshop Technology: Vol.I 1 REVISE Manufacturing Process by Choudhury Hajra,S.K; Choudhury Hajra,A.K;Roy,Nirjhar
R.2	Elements Of Workshop Technology-II by Choudhary S.K. ;Choudhary A.K. Nirjhar Roy
R.3	Elements Of Workshop Technology: Vol.I 1 REVISE Manufacturing Process by Choudhury Hajra,S.K; Choudhury Hajra,A.K;Roy,Nirjhar

Useful Links	
1	https://www.digimat.in/nptel/courses/video/112105233/L01.html
2	https://nptel.ac.in/courses/112/103/112103250/

Course Code	Course Outcomes	CL	Class Sessions
BME42301.1	**Apply** the sand moldings technique for the castings.	**3**	**9**
BME42301.2	**Prepare** the gating and riser system needed for casting and requirements to achieve defect free casting.	**3**	**9**
BME42301.3	**Examine** appropriate welding process based on the type of industrial application.	**3**	**9**
BME42301.4	**Understand** the different processes and machine tools for cylindrical surface Machining.	**2**	**9**
BME42301.5	**Differentiate** various machining processes and conditions for flat surface machining using Single point cutting tool in a shaper machine.	**2**	**9**



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Second Year (Semester-III) B.Tech. Mechanical Engineering

BME42302:Material Engineering

Teaching Scheme			Examination Scheme	
Lectures	3 Hr / Week		**CT**	30
Tutorials	-		**CA**	10
Total Credits	3		**ESE**	60
			Total	100 Marks
			Duration of ESE: 03 Hrs	

Course Objectives:

1	To understand materials, their classification, properties and, application. Metals alloys, equilibrium diagram.
2	To understand plain carbon steels, its classification and applications, commercial heat treatment practice for HSS;Stainless steel.
3	To understand heat treatment processes and its importance.
4	To study Cast Iron, Non-Ferrous Alloys, Semiconducting Materials, Battery Materials.
5	To understand Powder Metallurgy.

Course Contents

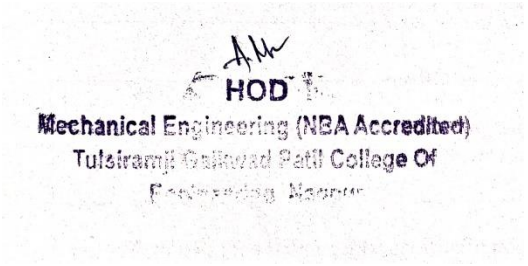
Unit I	**Introduction to materials**, classification of materials. Properties and applications of materials. Crystalline nature of metals, specially microscopic and macroscopic examinations of metals. Alloys and solid solutions, types and their formations, modified Gibbs's phase rule, Lever rule for phase mixtures and their application in system. **Study of equilibrium diagrams and invariant reactions**. Iron-Iron carbide equilibrium diagram, critical temperatures. Microstructure of slowly cooled steels. Estimation of carbon from microstructures; structure property relationship.
Unit II	**Classification and application of plain carbon steels**. Examples of alloy steel such as Hadfield Manganese Steel, ball Bearing Steels, etc. Tool Steels – Classification, composition, application and commercial heat treatment practice for HSS, Secondary hardening. Stainless Steels - Classification, composition, application and general heat treatment practice for Stainless Steels. Classification and applications of steels. Effect of Alloying elements.
Unit III	**Heat treatment** and its importance. Annealing, Normalizing, Hardening, Quench Cracks, Hardenability test. TTT diagram and its construction and related Heat Treatment Processes such as Austempering, Martempering, Patenting. Retention of Austenite, Effects and elimination of retained austenite, Tempering. Case / Surface hardening treatments such as Carburizing, Nitriding, Cyaniding, Carbonitriding, Flame and Induction hardening.
Unit IV	**Cast Iron–Classification**, Whitecast Iron, Gray Cast Iron, Nodular Cast Iron, Malleable Cast Iron, Chilled and alloy Cast Iron. (Production route, Composition, Microstructure and applications) Effects of various parameters on structure and properties of Cast Iron, Alloy cast Iron: Ni-resist, Ni-hard. Non-Ferrous Alloys – Study of non-ferrous alloys such as brasses, Bronzes, Aluminum Alloys. Bearing materials, Semiconducting Materials - Intrinsic and extrinsic semiconductors, Types of semiconductors, Doping of semiconductors, Battery Materials-Introduction to battery materials, Types of battery materials- Lithium, Lead, Cobalt, Nickel, Characteristics of battery materials.

Unit V	**Powder Metallurgy**: Powder manufacture and Conditioning, Production of Sintered Structural Components, Self-lubricating bearing, Cemented Carbides, Ceramics, Sintered Carbide cutting tools

Text Books	
T.1	Material Science & Engineering, An Introduction,6th Edition, Donald Askeland,1984.
T.2	Material Science & Engineering, V.R.Raghavan,1974.
T.3	Material Science & Engineering, WilliamCallister,1985.
T.4	Material Science& Engineering ,R.K.Rajput,2009
Reference Books	
R.1	Modern Physical Metallurgy, R.E.Smallman,Butterworths,1963
R.2	Phase transformations in metals and alloys-D.A.Potter and K.E.Easterling,CRCPress, 1992. 2.Transformations in Metals, P.G. Shewmon, Mc-Graw Hill, 1969.
R.3	Introduction to Physical Metallurgy 29revised edition,2009 Sidney H. AvnerMcGraw-Hill,1964

Useful Links	
1	https://nptel/2rxbxNem1iI?list=PLyqSpQzTE6M_ON8uXt-PP8uX6hMWJeYSJ
2	https://nptel/BJrTZ07bHm4?list=PLfIFNJ1DPG4lENg4VUTWyKxxB911aHuJz

Course Code	Course Outcomes	CL	Class Sessions
BME42302.1	**Analyze** the effect of Crystalline nature of metals and Iron-Iron carbide equilibrium diagram.	**4**	**9**
BME42302.2	**Interpret** the commercial steels.	**3**	**9**
BME42302.3	**Analyze** and implement suitable heat treatment processes.	**4**	**9**
BME42302.4	**Analyze** the Cast Iron.	**4**	**9**
BME42302.5	**Apply** the basics of powder Metallurgy for powder metallurgical components.	**3**	**9**



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Second Year (Semester-III) B.Tech. Mechanical Engineering

BME42303: Manufacturing Technology and Processes Lab

Teaching Scheme		Examination Scheme	
Lectures	2 Hr / Week	**CT**	25 Marks
Tutorials	-	**CA**	25 Marks
Total Credits	1	**ESE**	50 Marks
		Total	25 Marks
		Duration of ESE: 02 Hrs	

Course Objectives:

1	To gain practical knowledge of sand molding processes, including pattern making, mold preparation, and casting techniques.
2	To develop the ability to create sand molds for casting metal parts and understand the importance of proper mold design and material selection.
3	To Understand the principles and fundamentals of welding, machining parameters in latheand Shaper machine and their applications.

Sr.No.	List of Experiment	CO
1	To analyze Pattern Making process.	CO1
2	To perform job of Pattern Making.	CO1
3	To perform job of Sand Mould.	CO1
4	To analyze Casting Techniques Process.	CO2
5	To perform job of Casting Techniques.	CO2
6	To analyze the design of Gating System in sand mould techniques.	CO2
7	To analyze Joining Techniques Processes.	CO3
8	To perform Job of Welding.	CO3
9	Produce Thread Cutting, Taper Turning job as per given drawing in a Lathe Machine.	CO4
10	Produce key-slot as per given drawing in a Shaper Machine.	CO5
11	To analyze Pattern Making process.	CO1

Text Books

T.1	A Text Of Book Manufacturing Technolgy by Chand And Co.Publication.
T.2	A Text Of Book Manufacturing Technolgy II by . Chand And Co.Publication

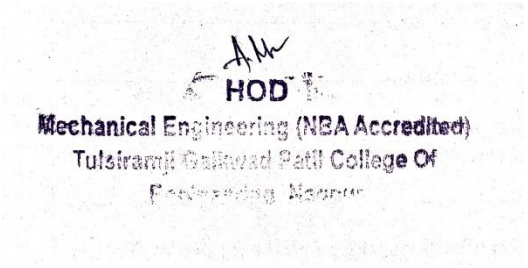
Reference Books

R.1	Elements Of Workshop Technology: Vol.I 1 REVISE Manufacturing Process by Choudhury Hajra,S.K; Choudhury Hajra,A.K;Roy,Nirj har.
R.2	Elements Of Workshop Technology-II by Choudhary S.K. ;Choudhary A.K. Nirjhar Roy.

Useful Links

1	https://www.digimat.in/nptel/courses/video/112105233/L01.html
2	https://nptel.ac.in/courses/112/103/112103250/

Course Code	Course Outcomes	CL	Lab Session
BME42303.1	**Create** the sand moldings technique for the castings.	**4**	**2**
BME42303.2	**Prepare** the gating and riser system needed for casting and requirements to achievedefect free casting.	**3**	**2**
BME42303.3	**Examine** appropriate welding process based on the type of industrial application.	**4**	**2**
BME42303.4	**Develop** a job using Lathe Machine.	**4**	**2**
BME42303.5	**Develop** a job using Shaper Machine	**4**	**2**



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Second Year (Semester-III) B.Tech. Mechanical Engineering

BME42304: Material Engineering Lab

Teaching Scheme		Examination Scheme	
Lectures	2 Hr / Week	**CT**	25 Marks
Tutorials	-	**CA**	25 Marks
Total Credits	1	**ESE**	50 Marks
		Total	25 Marks
		Duration of ESE: 02 Hrs	

Course Objectives:

1	To understand the metallurgical microscope.
2	To learn iron-iron carbon diagram in equilibrium.
3	To Know effect of alloying element on properties of Steel.

Sr.No.	List of Experiment	CO
1	Identifying the construction and working of a metallurgical microscope.	CO1
2	Interpreting crystal structure of metals.	CO1
3	Summarizing iron-iron carbon diagram in equilibrium.	CO2
4	Preparation of specimen for metallurgical microscope.	CO2
5	To observe and draw microstructure of steel.	CO3
6	To observe and draw microstructure of cast iron.	CO4
7	To observe and draw microstructure of non-ferrous metals & alloys.	CO4
8	Estimating the effect of annealing and normalizing on properties of Steel.	CO4
9	Estimating the effect of alloying element on properties of Steel.	CO4
10	To prepare the case study on powder metallurgy part manufacturing process.	CO5

Text Books

T.1	Material Science & Engineering, An Introduction, 6 th Edition, Donald Askeland, 1984.
T.2	Material Science & Engineering, V. R. Raghavan,1974.

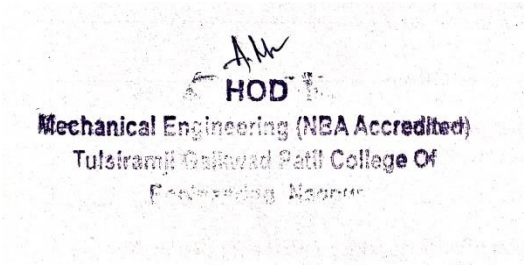
Reference Books

R.1	1. Phase transformations in metals and alloys- D.A. Potter and K.E. Easterling, CRC Press, 1992. 2. Transformations in Metals, P.G. Shewmon, Mc-Graw Hill, 1969.
R.2	Modern Physical Metallurgy, R. E. Smallman, Butterworths, 1963.

Useful Links

1	https://nptel/2rxbxNem1iI?list=PLyqSpQzTE6M_ON8uXt-PP8uX6hMWJeYSJ
2	https://nptel/BJrTZ07bHm4?list=PLfIFNJ1DPG4lENg4VUTWyKxxB911aHuJz

	Course Outcomes	CL	Lab Session
BME42304.1	**Distinguish** different type of materials, its physical and chemical properties with crystal ographic studies.	**4**	**2**
BME42304.2	**Analyze** the process of metals solidification with phase diagram.	**4**	**2**
BME42304.3	**Compare** the different heat treatment process and plane carbon steel alloys.	**4**	**2**
BME42304.4	**Categories** the different types of cast iron and nonferrous alloys with the applications.	**4**	**2**
BME42304.5	**Identify** the basic of powder Metallurgy with different Hardness testing method and Advance materials.	**3**	**2**



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Second Year (Semester-III) B.Tech. Mechanical Engineering

BME42306: (Open Elective-I) Basics of Manufacturing Technology and Processes

Teaching Scheme		Examination Scheme	
Lectures	4 Hr / Week	**CT**	30
Tutorials	-	**CA**	10
Total Credits	4	**ESE**	60
		Total	100 Marks
		Duration of ESE: 03 Hrs	

Course Objectives:

1	To emphasize the importance manufacturing sciences in the day-to-day life
2	To study the basic manufacturing processes and tools used
3	To understand the conventional manufacturing processes like casting, metal forming, and welding process.

Course Contents

Unit I	**Joining Processes**: - Introduction to metal Joining- Types of Welding. Arc Welding & Gas Welding Processes, Thermit Welding, Defects & Inspection of Welding Joints, Electrodes, weldability of Metals, TIG Welding, MIG Welding, Resistance Welding. Soldering & Brazing. Plasma Arc welding, Electron Laser Beam welding.
Unit II	**Pattern Making& Moulding:-** Pattern making: Types, materials used, Pattern making allowances, color codes. Master Pattern, Core making: - Types, core material & its properties. Moulding: Types of sand moulds, moulding sand composition. moulding sand properties, sand preparation technique for casting,
Unit III	**Gating System & Casting Processes: -** Gating design -Elements of gating systems, pouring equipments, riser design Melting furnaces -Types, Electric furnace, Cupola construction& operation. Casting defects. Foundry mechanizing, Foundry equipments, Special casting processes such as investment Casting, Centrifugal Casting, Slush Casting. Advances in Gating system.
Unit IV	**Introduction to Plastics: -** Difference of thermosetting and thermoplastic compounds, compression moulding, transfer moulding, injection moulding, film and sheet forming, thermoforming and their applications. Introduction to Joining of Plastics- Mechanical Fastening, Spin Welding, Solvent Bonding, Ultrasonic welding, Induction welding, Dielectric welding, Hot Plate welding, Vibration welding, Hot gas welding. Plastic joining.
Unit V	**Hot and cold working of metals:** Principles of rolling, forging, drop, press, upset, roll forging, extrusion, drawing, spinning, effect of hot working. Cold working processes**,** Cold rolling, swaging, forging, extrusion forward, backward and impact roll forming, tube drawing, wire drawing, spinning, sheet metal working, types of presses, drives, different operations and types of dies.

Text Books

T.1	A Text Of Book Manufacturing Technolgy by Chand And Co.Publication.
T.2	A Text Of Book Manufacturing Technolgy II by . Chand And Co.Publication

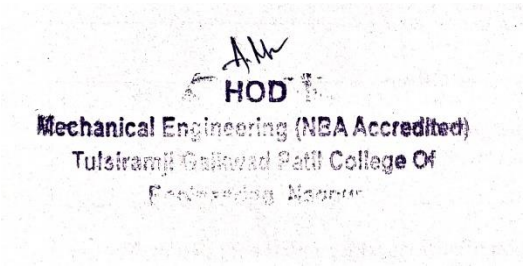
Reference Books

R.1	Elements Of Workshop Technology: Vol.I 1 REVISE Manufacturing Process by Choudhury Hajra,S.K; Choudhury Hajra,A.K;Roy,Nirjhar

R.2	Elements Of Workshop Technology-II by Choudhary S.K. ;Choudhary A.K. Nirjhar Roy

	Useful Links
1	https://www.digimat.in/nptel/courses/video/112105233/L01.html
2	https://nptel.ac.in/courses/112/103/112103250/

Course Code	Course Outcomes	CL	Class Sessions
BME42306.1	**Apply** the sand moldings technique for the castings.	**3**	**9**
BME42306.2	**Prepare** the gating and riser system needed for casting and requirements to achieve defect free casting.	**3**	**9**
BME42306.3	**Examine** appropriate welding process based on the type of industrial application.	**3**	**9**
BME42306.4	**Summarize** appropriate type of plastics and plastics processing method.	**2**	**9**
BME42306.5	**Analyze** effect of parameters influencing metal forming and compare hot working and cold working with applications.	**4**	**9**



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Second Year (Semester-III) B.Tech. Mechanical Engineering

BBA42304: Managerial Economics

Teaching Scheme			**Examination Scheme**	
Lectures	2 Hr / Week		**CT**	30
Tutorials	-		**CA**	20
Total Credits	2		**ESE**	50
			Total	30 Marks
			Duration of ESE: 02 Hrs	

Course Objectives:

1	To understand concepts and principles of managerial economics.
2	To understand market the concepts of Demand and Supply.
3	To understand market the concepts of Production Function and Cost Analysis.

Course Contents

Unit I	**Nature & Scope of Managerial Economics:** Managerial Economics - Introduction, Meaning, nature and scope. Fundamental Economics Concepts: Opportunity Cost, Discounting principle, Time perspective, Incremental reasoning, Equi-Marginal concept, Marginal concept in economics. Economies of information: Risk, uncertainty, Theory of firm.
Unit II	**Demand & Supply analysis:** Demand and Supply - Introduction, Market demandand supply functions and curves. Market equilibrium. Consumer behavior and rational choice: cardinal and ordinal approaches of consumer utility-Maximization of consumer utility by the technique of indifference curves and budget lines., Demand Fore casting and its methods and uses.
Unit III	**Production Function & Cost Analysis:** Introduction- Laws of diminishing returns to a factor. Returns to scale, Economies & Diseconomies of scale. Production function- Estimation of production function: Cobb Douglas and CES Production functions. Concepts of cost - Cost analysis, economic & accounting cost, Role of time in cost analysis. Cost Volume profit Analysis.

Text Books

T.1	Managerial Economics, Suma Damodran, 2006, Oxford University Press, New Delhi
T.2	Indian Economy, Mishra &Puri, 2007, Himalaya Publishing House
T.3	Managerial Economics, Peterson & Levis, Prentice Hall of India

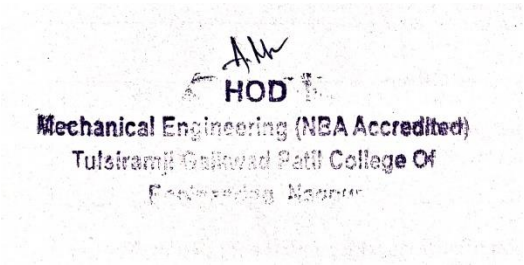
Reference Books

R.1	Managerial Economics, P. L. Mehta, Sultan Chand & Sons, New Delhi
R.2	Managerial Economics, D.N.Dwidevi, Vikas Publishing House Pvt. Ltd.

Useful Links

1	https://archive.nptel.ac.in/courses/110/101/110101149/
2	https://www.youtube.com/watch?v=vLPpF0hunwc

Course Code	Course Outcomes	CL	Class Sessions
BBA42304.1	**Recognize** the knowledge on concepts and principles of Managerial Economics	**2**	**9**
BBA42304.2	**Describe** and relate to the market the concepts of Demand and Supply	**2**	**9**
BBA42304.3	**Identify** and recognize the Production Function concept and Cost Analysis.	**2**	**9**



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Second Year (Semester III) B.Tech Mechanical Engineering

BSH42308: 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

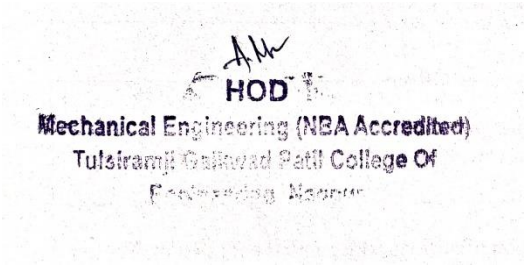
T.1	Hazra, Somnath., Bhukta, Anindya (2020) Sustainable Development Goals An Indian Perspective, Springer International Publishing, Switzerland
T.2	Ziai, Aram (2016) Development Discourse and Global History from colonialism to the sustainable development goals. Routledge, London & New York

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	BT level	Class Sessions
BSH42308.1	Explain sustainability principles and SDGs fundamentals	2	7
BSH42308.2	Apply mechanical engineering techniques to achieve SDGs	2	7
BSH42308.3	Analyze and propose sustainable engineering solutions	4	7



Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441108

NAAC Accredited with A+ Grade

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

Second Year (Semester-III) B. Tech. Mechanical Engineering

BSH42306: Engineering Mathematics-III

Teaching Scheme		Examination Scheme	
Lectures	2 Hr / Week	**CT**	30
Tutorials	-	**CA**	10
Total Credits	2	**ESE**	60
		Total	100 Marks
		Duration of ESE: 03 Hrs	

Course Objectives:

1	To understand numerical techniques.
2	To Learn Laplace Transform for Solving differential equation.
3	To learn Partial Differential Equation.

Course Contents

Unit I	**Numerical Method I** Solution of Algebraic and Transcendental Equation: False position method, Newton – Raphson method, Solution of system of simultaneous linear equations: Gauss elimination method,. Gauss Seidel method, Crout's method
Unit II	**Numerical Method II** Numerical Methods (Differential Equations) Numerical solution of ordinary differential equation by Taylor series method, Runge-Kutta method of 4th order, Euler modified method. Runge-Kutta method to solve simultaneous first order Differential Equation.
Unit III	**Laplace Transforms**: Laplace transforms and its properties, Inverse Laplace Transform & its properties, Convolution Theorem, Unit Step Function, Application for Laplace Transform to solve ordinary differential equations.
Unit IV	**Partial Differential equations**: Partial differential equation of first order first degree i. e. Lagrange's form. the Linear homogeneous PDE of nth order with constant coefficient, method of separation of variables. Simple Applications to solve Partial Differential Equations (Wave Equations)
Unit V	**Fourier Series and Fourier Transform (FT)**: Introduction of Fourier Series, Even and Odd functions, change of interval, Half Range Expansions, Fourier transform, Fourier Sine & Cosine transforms, Application of Fourier Transform to solve Integral equation.

Text Books

T.1	Higher Engineering Mathematics by B.S. Grewal, 40th Edition, Khanna Publication
T.2	Advanced Engineering Mathematics by Erwin Kreyszig, 8th Edition, Wiley India
T.3	Applied Mathematics for Engineers & Physicist by L.R. Pipes and Harville.

Reference Books

R.1	A Text Book of applied Mathematics, Volume II, by P.N. Wartikar & J.N. Wartikar,Poona Vidyarthi Griha Prakashan
R.2	Introductory methods of Numerical Analysis, by S.S. Sastry, PHI

Useful Links

1	https://archive.nptel.ac.in/courses/111/107/111107105/
2	https://archive.nptel.ac.in/courses/111/106/111106139/

Course Code	Course Outcomes	CL	Class Sessions
BSH42306.1	**Analyze** numerical techniques to find the roots of equations different types of equations.	**4**	**9**
BSH42306.2	**Apply** the knowledge of Numerical techniques to solve ordinary differential equations in engineering problems.	**3**	**9**
BSH42306.3	**Apply** the concept of Laplace Transform for Solving differential equation.	**3**	**9**
BSH42306.4	**Solve** Partial Differential Equation using appropriate method.	**3**	**9**
BSH42306.5	**Apply** the knowledge of Fourier series and Transform for understanding periodic signals and solve integral equations.	**3**	**9**