SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
(Engineering College), VIDISHA M.P.
(An Autonomous Institute Affiliated to RGPV Bhopal)
Mechanical Engineering Department

Semester/Year		VII/IV		Program				B.Tech.			
Subject Category	DC	Subject Code:		ME-701	Subject Name:			Refrigeration and Air Conditioning			
	Maximum Marks Allotted							Contact Hours			Total Credits
	Theory			Practical			Total Marks				
End Sem	Mid-Sem	Assignment	Quiz	End Sem	Lab-Work	Quiz		L	T	P	
60	20	10	10	30	10	10	150	3	0	2	4

Course Outcomes:

CO.1: Explain all basic concepts of refrigeration, different types of refrigeration systems and refrigeration cycles including air and vapor refrigeration including multi pressure system.

CO.2: Apply knowledge to identify applications of different refrigeration systems and commonly used refrigerants, impact on environment.

CO.3: Analysis psychrometric properties and processes of air, Air-conditioning systems, Human comfort and regulation of human body

CO.4: Solve numerical problems based on air and vapor refrigeration system, psychrometry, air-conditioning processes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	1			1						
CO2	3	2	2	1			2					
CO3	3	3	3	2								1
CO4	3	3	3	3	1							

Contents:

UNITs	Descriptions	Hrs.	CO's
I	**Introduction:** (A) History of refrigeration, Principles and methods of refrigeration, ice, evaporative, liquid gas, dry ice, vortex tube, and thermoelectric refrigeration, unit of refrigeration concept of refrigerator, heat engine, heat pump, co-efficient of performance. (B) Air refrigeration system- reversed Carnot cycle, limitations joule cycle, Boot-strap cycle, reduced ambient cycle and regenerative cooling cycles. Simple numerical problem.	8	1
II	**Vapor compression system:** Vapor compression cycle, p-h and t-s diagrams, deviations from theoretical cycle, sub-cooling and super heating, effects of condenser and evaporator pressure on cop; multi-pressure system: multiple expansion and compression with flash inter cooling; Production of very low temperature, dry ice, production of dry ice, air liquefaction system Numerical on vapor compression system.	8	2
III	**(a) Vapour absorption system:** Theoretical and practical systems such as aqua-ammonia, electrolux and other systems; **Steam jet refrigeration**: Principles and working, simple cycle of operation, description and working of simple system, Desiccant Cooling. **(b) Refrigerants:** nomenclature and classification, desirable properties, common refrigeration, comparative study, leak detection methods, Impact of	8	3

	refrigerants on environment, environment friendly refrigerants		
IV	**Psychrometric**: psychrometric properties and their calculation by table and psychrometric charts; psychrometric processes: sensible heating and cooling, evaporative cooling, cooling and dehumidification, heating and humidification, mixing of air stream, sensible heat factor; bypass factor, principle of air conditioning, requirements of comfort air conditioning, human comfort, effective temperature and chart, human comfort, heat production and regulation of human body.	8	4
V	**Air conditioning loads**: ventilation standards, infiltrated air load, fresh air load calculation of summer& winter air conditioning load, calculation ofsupply air rate&its condition, bypass factor, room sensible heat factor, grand sensible heat factor, effective sensible heat factor, dehumidified air quantity. Problems on design and cooling loadcalculation. Introduction to –cryogenics and other alternative emerging HVAC technology.	8	5
Guest Lectures (if any)			
Total Hours		40	

Suggestive list of experiments:

Text Books-

1. Arora CP; Refrigeration and Air Conditioning; TMH
2. Sapali SN; Refrigeration and Air Conditioning; PHI
3. Ananthanarayan; Basic Refrigeration and Air conditioning; TMH
4. Manohar Prasad; Refrigeration and Air Conditioning; New Age Pub
5. Ameen; Refrigeration and Air Conditioning; PHI
6. Pita; Air conditioning Principles and systems: an energy approach; PHI
7. Stoecker W.F, Jones J; Refrigeration and Air conditioning; McGH, Singapore
8. Jordan RC and Priester GB Refrigeration and Air Conditioning, PHI USA
9. Arora RC; Refrigeration and Air conditioning; PHI Learning

Modes of Evaluation and Rubric

There will be continuous evaluation for during the semester for 40 sessional marks and 60 semester End term Marks. Subjects where laboratory work is prescribed, the practical marks are 50, out of which 30 marks will be awarded for viva voce and 10 marks for lab work and 10 marks for quiz. Out of 40 sessional marks, 20 shall be awarded for Mid semester, 20 marks to be awarded for day to day performance and Quiz/Assignments. For the 60 Marks, there will be a semester – End examination as per the norms of AICTE.

Recommendation by Board of studies on	**Date: 27.05.2025**
Approval by Academic council on	**Date:**
Compiled and designed by	**Dr. Sanjay Katarey**

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
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Mechanical Engineering Department

Semester/Year		VII/IV		Program			B.Tech.			
Subject Category	DE-IV	Subject Code:	ME-702 (A)	Subject Name:			Additive Manufacturing			
	Maximum Marks Allotted									
	Theory			Practical			Total Marks	Contact Hours			Total Credits
End Sem	Mid-Sem	Assignment	Quiz	End Sem	Lab-Work	Quiz		L	T	P	
60	20	10	10	30	10	10	150	3	0	2	4

Course Outcomes:

CO1: Understand the working principle and process parameters of AM processes

CO2: Apply the suitable process for fabricating a given product

CO3: Create parts using design tools for AM

CO4: Explore the application of AM process in various fields.

CO.5: Use suitable post processes based on product application.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1		1							1
CO2	3	3	2	2	1							1
CO3	2	2	3		3							1
CO4	1	2	1	3	1							1
CO5	3	2	1	1								1

Contents:

UNITs	Descriptions	Hrs.	CO's
I	Types of Manufacturing: Introduction of Subtractive, Formative, Additive Manufacturing Additive Manufacturing: AM evolution, Distinction Between AM & CNC machining, Advantages of AM. AM process chain: Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machine setup.	8	1
II	Classification of AM processes: Liquid polymer system, discrete particle system, molten material systems, solid sheet system such as: Steriolithography, Fused Deposition Modeling, Solid Based Curing, Selective Laser sintering, Laminated Object Modeling.	8	2
III	Design for AM: Motivation, DFMA concepts and objectives, AM unique capabilities, Exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports.	8	3

IV	AM Applications: Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models, Rapid tooling, new materials development, Bi-metallic parts, Re-manufacturing. Application examples for Aerospace, defense, automobile, Bio-medical and general engineering industries	8	4
V	**Post processing of AM parts:** Support material removal, surface text improvement, accuracy improvement, aesthetic improvement, preparation for use a pattern, property enhancements using non-thermal and thermal techniques. **Future Directions of AM:** Introduction, new types of products and employment digiproneurship.	8	5
Guest Lectures (if any)			
Total Hours		**40**	

Suggestive list of experiments:

Text Books-

1. Chua Chee Kai, Leong Kah Fai, "Rapid Prototyping: Principles & Applications", World Scientific, 2003.

2. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010

3. Ali K. Kamrani, EmandAbouel Nasr, "Rapid Prototyping: Theory & Practice", Springer, 2006.

4. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001.

Modes of Evaluation and Rubric

There will be continuous evaluation for during the semester for 40 sessional marks and 60 semester End term Marks. Subjects where laboratory work is prescribed, the practical marks are 50, out of which 30 marks will be awarded for viva voce and 10 marks for lab work and 10 marks for quiz. Out of 40 sessional marks, 20 shall be awarded for Mid semester, 20 marks to be awarded for day to day performance and Quiz/Assignments. For the 60 Marks, there will be a semester – End examination as per the norms of AICTE.

Recommendation by Board of studies on	**Date: 27.05.2025**
Approval by Academic council on	**Date:**
Compiled and designed by	**Dr. Pankaj Agarwal**

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
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Semester/Year		VII/IV		Program			B.Tech.				
Subject Category	DE-IV	Subject Code:	ME-702 (B)	Subject Name:			Machine Design -II				
	Maximum Marks Allotted							Contact Hours			Total Credits
	Theory			Practical			Total Marks				
End Sem	Mid-Sem	Assignment	Quiz	End Sem	Lab-Work	Quiz		L	T	P	
60	20	10	10	30	10	10	150	3	0	2	4

Course Outcomes:

CO 1 Understand the Criteria and design of Components used in Power Transmission such as Belt, Ropes, Pulleys, Gears

CO 2 Design the I.C. Engine components like Piston, Connecting Rod etc

CO 3 Design Miscellaneous components like Pressures Vessels, Flanges and Coupling

CO 4 Understand concepts of Optimization and its application used in Machine Design

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2				1			
CO2	3	3	3	3	2				1			
CO3	3	3	3	3	2				1			
CO4	3	1	2	2	1				1			1
CO5	3	2.5	2.75	2.75	1.75				1			0.25

Contents:

UNITs	Descriptions	Hrs.	CO's
I	**Design of Belt, Rope and Chain Derives**: Methods of power transmission, selection and design of flat belt and pulley, selection of V-belts and sheave design, Design of chain drives, roller chain and its selection, Rope drives, Design of rope drives, hoist ropes.	8	1
II	**Spur and Helical Gears:** Force analysis of gear tooth, modes of failure, beam strength, Lewis equation, form factor, formative gear and virtual number of teeth, gear materials, Surface strength and wear of teeth, strength against wear, Design of straight tooth spur and helical Gears. **Bevel Gears**: Applications of Bevel gear, formative gear and virtual number of teeth, Force analysis, Lewis equation for bevel gears, strength against wear, Design of bevel gear.	8	2
III	**Design of I.C. Engine Components:** General design considerations in I.C. engines, Design of cylinder, Design of Piston and Piston-rings, design of connecting rod, design of crank shaft.	8	3

IV	**Design of Miscellaneous components:** Design of Flanged coupling, Rigid coupling, Design of Pressure vessels subjects to internal pressure, external pressure, design of penetration, design of flanges, cone cylinder junctions, materials, fabrication.	8	4
V	**Optimization:** Basic concept of optimization, classification of optimization, classification of optimization, optimization techniques, engineering application of optimization, classical optimization techniques, unconstrained optimization single-variable optimization, multivariable optimization, solution by Langrange-multipliers method.	8	5
Guest Lectures (if any)			
Total Hours		**40**	

Suggestive list of experiments:

Assembly drawing based on machine component drawings, I.C. engine component drawings, and related topics of designing.

Text Books-

1. Shingley J.E.; Machine Design; TMH
2. Bhandari VB; Design of Machine Elements; TMH
3. Sharma CS and Purohit K; Design of machine Elements; PHI Learning.
4. Hall and Somani; Machine Design; Schaum Series; TMH
5. Kulkarni SG; Machine Design; TMH
6. Abdul Mubeen; Machine Design; Khanna Publisher
7. Juvinall RC, Marshek KM; Fundamentals of Machine Component Design; Wiley
8. Norton R; Design of Machinery; TMH

Modes of Evaluation and Rubric

There will be continuous evaluation for during the semester for 40 sessional marks and 60 semester End term Marks. Subjects where laboratory work is prescribed, the practical marks are 50, out of which 30 marks will be awarded for viva voce and 10 marks for lab work and 10 marks for quiz. Out of 40 sessional marks, 20 shall be awarded for Mid semester, 20 marks to be awarded for day to day performance and Quiz/Assignments. For the 60 Marks, there will be a semester – End examination as per the norms of AICTE.

Recommendation by Board of studies on	**Date: 27.05.2025**
Approval by Academic council on	**Date:**
Compiled and designed by	**Prof. Nikhil M. Vyas**
Checked by	**Dr. Pankaj Agarwal**

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Semester/Year		VII/IV		Program				B.Tech.			
Subject Category	DE-IV	Subject Code:		ME-702 (C)	Subject Name:			Product Design & Development			
	Maximum Marks Allotted							Contact Hours			Total Credits
	Theory			Practical			Total Marks				
End Sem	Mid-Sem	Assignment	Quiz	End Sem	Lab-Work	Quiz		L	T	P	
60	20	10	10	30	10	10	150	3	0	2	4

Course Outcomes:

CO 1 Put into practice various steps involved in the design of new product.

CO 2 Realize strategies involved in Industrial design.

CO 3 Understand the importance of economic factors in the product design.

CO 4 Apply principles of value engineering to new product development.

CO 5 Understand Product development cycle, especially Booz Allen & Hamilton new product development cycle & A T A R model in financial analysis

CO 6 To implement principles important from environment conservation point of view in product design

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	1	-	1	-	-	1	-	1
CO2	-	2	2	1	1	-	-	-	-	-	1	1
CO3	1	1	2	2	1	2	-	-	-	-		-
CO4	2	2	3	1	1	1	-	-	-	-	2	-
CO5	2	2	2	2	3	-	-	-	-	2	3	-
CO6	1	2	2	2	2	-	3	-	-	-	1	1

Contents:

UNITs	Descriptions	Hrs.	CO's
I	Introduction, definition, design by innovation, evolution, essential factors of product design, production consumption cycle (pcc), fow and value addition in pcc, morphology of design, primary phases of design, role of allowances, process capability and tolerances in design and assembly.	8	
II	Product design strategies in industry, pricing, quality, utility, luxiriousness, product analysis, simplification, designer and his role, Industrial design considerations, procedures, problems, types of models, role of aesthetics, functional design practices.	8	
III	Economic factors influencing design, product value, economic analysis, profit, competitiveness, break even. Value engineering & product design, value, value analysis job plan, creativity, value analysis tests.	8	

IV	New product development and product management- defining product by nature and demand, New product strategy, product classification, product development & management, product life cycle, Booz Allen & Hamilton new product development cycle, A T A R model applied to financial analysis in business.	8	
V	Product design and development for environment, introduction, importance, factors, scope of impact, global & local issues, guidelines for design, life cycle assessment	8	
Guest Lectures (if any)			
Total Hours		**40**	

Suggestive list of experiments:

S.No.	Experiment List	Course Outcome
1	To deeply understand the pain points, needs, and existing behaviors related to household cleaning, particularly with single-use wipes, from the perspective of the target user.	CO1
2.	To brainstorm innovative solutions and quickly create tangible representations to test core concepts.	CO2
3.	To practical study of value engineering a smart home LED lighting system	CO3
4.	To finalize the product for manufacturing, launch it, and monitor initial market performance.	CO4
5.	To practical study of Designing for Environment (DfE) for a Portable Smart Speaker	CO5

Text Books-

1. K. Chitale, R. C. Gupta, "Product Design and Manufacturing" , PHI Publication, 2013 Reference Books:

2. Karl T. Ulrich, Stephen Eppinger, "Product Design and Development", McGraw Hill Publication, 2012

Modes of Evaluation and Rubric

There will be continuous evaluation for during the semester for 40 sessional marks and 60 semester End term Marks. Subjects where laboratory work is prescribed, the practical marks are 50, out of which 30 marks will be awarded for viva voce and 10 marks for lab work and 10 marks for quiz. Out of 40 sessional marks, 20 shall be awarded for Mid semester, 20 marks to be awarded for day to day performance and Quiz/Assignments. For the 60 Marks, there will be a semester – End examination as per the norms of AICTE.

Recommendation by Board of studies on	**Date: 27.05.2025**
Approval by Academic council on	**Date:**
Compiled and designed by	**Prof. Pankaj Sonkusare**
Checked by	**Dr. Pankaj Agarwal**

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
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Semester/Year		VII/IV		Program			B.Tech.				
Subject Category	DE-V	Subject Code:	ME-703 (A)	Subject Name:			Non-Conventional Energy Sources				
	Maximum Marks Allotted							Contact Hours			Total Credits
	Theory			Practical			Total Marks				
End Sem	Mid-Sem	Assignment	Quiz	End Sem	Lab-Work	Quiz		L	T	P	
60	20	10	10	-	-	-	100	3	0	0	3

Course Objectives: The objective of the course ME-1873 Non-Conventional Energy Sources is to: • Introduce students to the principles and applications of renewable and non-conventional energy sources. • Develop an understanding of the technologies used in harnessing solar, wind, biomass, geothermal, tidal, and other alternative energy sources. • Analyse the environmental and economic aspects of non-conventional energy systems. • Equip students with the knowledge necessary to contribute to sustainable energy solutions and energy security.

Course Outcomes:

1. To analyse global and Indian energy resources and evaluate the need for alternative energy sources in the context of sustainable development.
2. To explain the working principles and applications of solar energy systems, including solar collectors, water heaters, dryers, and photovoltaic systems.
3. To understand the principles, components, and site selection criteria for wind energy systems, and compare the different methods for harnessing ocean energy.
4. To describe biomass conversion processes and geothermal energy systems, and assess their potential for power generation and environmental impact.
5. To evaluate the production, storage, and utilization of hydrogen energy and fuel cell technologies and their applications in sustainable energy systems.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1		1	2	1					1
CO2	2											1
CO3	2		3			3	1	1				1
CO4	2		2		1	1	2					1
CO5	2	2	1			2	1					1

Contents:

UNITs	Descriptions	Hrs.	CO's
I	Introduction: Overview of the course; Global warming; Introduction to Renewable Energy Technologies, Energy Storage: Introduction; Necessity of Energy Storage; Energy Storage Methods.	8	
II	Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Measurement of solar radiation data Solar Thermal systems: Introduction; Basics of thermodynamics and heat transfer; Flat plate collector; Evacuated Tubular Collector; Solar air collector; Solar concentrator; Solar distillation; Solar cooker; Solar refrigeration and air	8	

	conditioning; Thermal energy storage systems		
III	Solar Photovoltaic systems: Introduction; Solar cell Fundamentals; Characteristics and classification; Solar cell: Module, panel and Array construction; Photovoltaic thermal systems	8	
IV	Wind Energy: Introduction; Origin and nature of winds; Wind turbine siting; Basics of fluid mechanics; Wind turbine aerodynamics; wind turbine types and their construction; Wind energy conversion systems Fuel cells: Overview; Classification of fuel cells; Operating principles; Fuel cell thermodynamics	8	
V	Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies; Urban waste to energy conversion; Biomass gasification. Other forms of Energy: Introduction: Nuclear, ocean and geothermal energy applications; Origin and their types; Working principles	8	
Guest Lectures (if any)			
Total Hours		**40**	

Suggestive list of experiments:

Text Books-

1. Sukhatme S.P. and J.K.Nayak, Solar Energy - Principles of Thermal Collection and Storage, Tata McGraw Hill, New Delhi, 2008.

2. Khan B.H., Non-Conventional Energy Resources,Tata McGraw Hill, New Delhi, 2006.

3. J.A. Duffie and W.A. Beckman, Solar Energy - Thermal Processes, John Wiley, 2001.

Modes of Evaluation and Rubric

There will be continuous evaluation for during the semester for 40 sessional marks and 60 semester End term Marks. Subjects where laboratory work is prescribed, the practical marks are 50, out of which 30 marks will be awarded for viva voce and 10 marks for lab work and 10 marks for quiz. Out of 40 sessional marks, 20 shall be awarded for Mid semester, 20 marks to be awarded for day to day performance and Quiz/Assignments. For the 60 Marks, there will be a semester – End examination as per the norms of AICTE.

Recommendation by Board of studies on	**Date: 27.05.2025**
Approval by Academic council on	**Date:**
Compiled and designed by	**Dr. Ashish Manoria**
Checked by	**Dr. Pankaj Agarwal**

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Semester/Year		VII/IV		Program			B.Tech.				
Subject Category	DE-V	Subject Code:		ME-703 (B)	Subject Name:		Unconventional Machining Process				
	Maximum Marks Allotted							Contact Hours			Total Credits
	Theory			Practical			Total Marks				
End Sem	Mid-Sem	Assignment	Quiz	End Sem	Lab-Work	Quiz		L	T	P	
60	20	10	10	-	-	-	100	3	0	0	3

Course Objective: Students undergoing this course are expected to

- The course aims in identifying the classification of unconventional machining processes
- To understand the principle, mechanism of metal removal of various unconventional machining processes
- To study the various process parameters and their effect on the component machined on various unconventional machining processes.
- To understand the applications of different processes.

Course Outcomes:

After completion of the course, students would be able to –

1. Student should be able to understand constructional features and performance of USM, AJM AFM and WJM.
2. Demonstrate the Chemical energy based unconventional machining processes.
3. Student should be able to understand constructional features and performance of EDM, EDWC, EBM, IBM and PAM.
4. Student should be able to understand constructional features and performance of LBM, LC, LD LM, LMM andLENS.
5. Explore the range of 3D printing and Prototyping technologies and their application for industrial, design, and creative field.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1				2	3					2
CO2	3	1				2	3					2
CO3	3	1				2	3					2
CO4	3	1				2	3					2
CO5	3	1				2	3					2

Contents:

UNITs	Descriptions	Hrs.	CO's
I	Introduction - Need for Non-traditional machining process, Comparison between traditional and non-traditional machining, general classification Non-traditional machining processes, classification based on nature of energy employed in machining, selection of non-traditional machining processes, Specific advantages, limitations and applications of non-traditional machining processes. Classification - process economy - Mechanical machining - Types - Ultrasonic machining (USM) - Abrasive Jet Machining (AJM) - Abrasive Flow Machining	10	1

	(AFM) - Water Jet Machining (WJM) - Operating principle - Process parameters - Applications - Limitations.		
II	**Electro chemical machining** - Chemical material removal - Types - Electro chemical machining (ECM) - Electro chemical drilling (ECD) - Electro chemical grinding (ECG) - Electro chemical honing (ECH) - Shaped tube electrolytic machining - Operating principle - Process parameters - Applications - Limitations.	8	2
III	**Thermo-electrical machining** - Types – Electrical discharge machining (EDM) - Electrical discharge wire cutting (EDWC) - Electron beam machining (EBM) - Ion Beam Machining (IBM)-Plasma Arc Machining (PAM) - Operating principle - Process parameters - Applications – Limitations.	9	3
IV	**Laser materials processing** - Laser types - Processes - Laser beam machining (LBM) – Laser cutting (LC) – Laser drilling (LD) - Laser marking and engraving (LM) - Laser micromachining (LMM) - Laser engineered net shaping (LENS) - Applications - Limitations.	9	4
V	**Special processing technologies** - Rapid Prototyping - Methods - Fused Deposition Modeling (FDM) - Laminated Object Manufacturing (LOM) - Selective laser sintering (SLA) - Solid Ground curing (SGC) - 3D printing (3DP) - Processing of integrated circuits - Micro and nano fabrication technologies.	9	5
Guest Lectures (if any)			
Total Hours		45	

Suggestive list of experiments:

Text and Reference Books-

1. Modern Machining Processes by P.C Panday and H. S Shah Tata McGraw-Hill Education, India Pvt.Ltd. 2000
2. Non Traditional Machining by Kestor Praveen Suggi publication 2018.
3. New Technology Dr.Amitabha Bhattacharyya, The Institute of Engineers 2000
4. Abdel, H. and El-Hofy, G. "Advanced Machining Processes", McGraw-Hill, USA, 2005.
5. Wellar, E.J. "Non-Traditional Machining Processes", Society of Manufacturing

Modes of Evaluation and Rubric

There will be continuous evaluation for during the semester for 40 sessional marks and 60 semester End term Marks. Subjects where laboratory work is prescribed, the practical marks are 50, out of which 30 marks will be awarded for viva voce and 10 marks for lab work and 10 marks for quiz. Out of 40 sessional marks, 20 shall be awarded for Mid semester, 20 marks to be awarded for day to day performance and Quiz/Assignments. For the 60 Marks, there will be a semester – End examination as per the norms of AICTE.

Recommendation by Board of studies on	**Date: 27.05.2025**
Approval by Academic council on	**Date:**
Compiled and designed by	**Prof.Jagdish Prasad Shakya**
Checked by	**Prof. Sanjay Jain**

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Mechanical Engineering Department

Semester/Year		VII/IV	Program		B.Tech.
Subject Category	DE-V	Subject Code:	ME-703 (C)	Subject Name:	Drone Technology

	Maximum Marks Allotted							Contact Hours			Total Credits
	Theory			Practical			Total Marks				
End Sem	Mid-Sem	Assignment	Quiz	End Sem	Lab-Work	Quiz		L	T	P	
60	20	10	10	-	-	-	100	3	0	0	3

Course Outcomes: Students undergoing this course are expected to

CO1	Apply the concept of Flight dynamics for building Quadcopter
CO2	Assemble and Program the Quadcopter
CO3	Perform Testing and Control operations on the Quadcopter
CO4	Implement Quadcopter for real world applications
CO5	Design and Develop the Drone

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1								
CO2	3	2	3	2	1				2			1
CO3	3	3	3	1	3							1
CO4	3	3	3	3		3	3	3	2		3	1
CO5	3	3	3	3		3	3	3	3		3	1

Contents:

UNITs	Descriptions	Hrs.	CO's
I	**Flight Dynamics of Aerial Vehicles:** Definition of Drone, UAV, RPA, Quad copters – Basic Components and Categories, Principles of Flight, Flight Maneuvers, Air frames, creating a Frame: Materials, Different Frame Shapes, Building Air frames, Flight dynamics, Applications, Future potential, Comparison with other aerial vehicles.	8	1
II	**Hardware Anatomy of Quad copter:** Power Train – Propellers, Motors, Total Lift, Electronic Speed Controllers, Flight Battery, Transmitter and Receiver, Flight Controller, GPS, Sensors & Actuators, Compass, Camera Assembling for Quad copter, Connectors, Mounting of Propellers and Powering up	8	2
III	**Programming & Control of Quad copter:**Perform programming and configure the flight control board (FCB), Identify, explore and test the interconnectivity of different peripherals with FCB. Establish connection of FCB with motor, GPS, ESC.	8	3

IV	**Testing and maintenance of Quad copter:** Key Flight Safety Rules- Pre-flight Checklist and Flight Log information, Flight instructions, Repair and Maintenance: Crash analysis, Common issues, Voltage testing. Test and troubleshoot Flight Controller Board (FCB), Electronic Speed Controller(ESC), and its associated peripherals.	8	4
V	**Real world applications and case studies:** Beneficial Drones, Aerial Photography, Mapping and Surveying, Precision Agriculture, Search and Rescue, Infrastructure Inspection, and Conservation, Case Studies: Agriculture Weed Classification, Micro drone surveillances.	8	5
Guest Lectures (if any)			
Total Hours		**40**	

Suggestive list of experiments:

Text and Reference Books-

1. Reg Austin, Unmanned Aircraft Systems UAV design, development and deployment". Wiley 2010
2. Robert C. Nelson, Flight Stability and Automatic Control, McGraw – Hill, Inc. 1998
3. Kimon P. Valavanis," Advances in Unmanned Aerial Vehicles: State of the Art and the Road Autonomy", Springer. 2007
4. Paul G Fahlstrom, Thomas J Gleason,"Introduction to UAV Systems", UAV Systems, Inc, 1998

Modes of Evaluation and Rubric

There will be continuous evaluation for during the semester for 40 sessional marks and 60 semester End term Marks. Subjects where laboratory work is prescribed, the practical marks are 50, out of which 30 marks will be awarded for viva voce and 10 marks for lab work and 10 marks for quiz. Out of 40 sessional marks, 20 shall be awarded for Mid semester, 20 marks to be awarded for day to day performance and Quiz/Assignments. For the 60 Marks, there will be a semester – End examination as per the norms of AICTE.

Recommendation by Board of studies on	**Date: 27.05.2025**
Approval by Academic council on	**Date:**
Compiled and designed by	**Dr. Pankaj Agarwal**

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
(Engineering College), VIDISHA M.P.
(An Autonomous Institute Affiliated to RGPV Bhopal)
Mechanical Engineering Department

Semester/Year		VII/IV		Program			B.Tech.				
Subject Category	DE-VI	Subject Code:	ME-704 (A)	Subject Name:			Robotics				
	Maximum Marks Allotted							Contact Hours			Total Credits
	Theory			Practical			Total Marks				
End Sem	Mid-Sem	Assignment	Quiz	End Sem	Lab-Work	Quiz		L	T	P	
60	20	10	10	-	-	-	100	3	0	0	3

Course Objective:

The objective of this course is to impart the fundamental knowledge of robot analysis based on mathematical and design point of view, rather than any detailed concepts of mechatronics, AI/ML, software programming and/or computer based concepts. The course is for students interested in designing, analysis and control of robots.

Course Outcomes: On completion of this course, students will be able to:

CO 1: Describe the elements of a robot along with its classification, usage, economy, safety and applications.

CO 2: Apply mathematical concepts to robotic manipulators for position, orientation, frames and relative mappings.

CO 3: Analyse a robotic manipulator from kinematic point of view.

CO 4: Analyse a robotic manipulator for the velocity and static forces so involved.

CO 5: Learn about robot dynamics, trajectory planning and robot controls.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1									1
CO2	3	2	2									1
CO3	3	3	3	2								1
CO4	3	3	3	2								1
CO5	3	1	2									1

Contents:

UNITs	Descriptions	Hrs.	CO's
I	**Introduction to robotics:** Introduction and brief history of robots, laws of robotics, classification of robots, rules of robot usage, applications of robots, economy & safety of robot usage, robot subsystems: their description, classification, advantages & disadvantages and, applications.	8	1
II	**Mathematical representation of robots:** Descriptions: position, orientation & frames, Mappings: changing description from frame to frame, Operators: translations, rotations & transformation, transformation arithmetic, transform equations, representation of orientations.	8	2

III	**Manipulator kinematics:** Introduction, link description, link-connection description, convention for affixing frames to links, forward kinematics, actuator space, joint space, and Cartesian space, Examples: Forward kinematics of industrial robots, frames with standard names, Inverse kinematics: solvability, algebraic vs. geometric solutions, Examples: Inverse kinematics of industrial robots.	8	3
IV	**Jacobians: Velocities and Static forces:** Notation for time-varying position & orientation, linear and rotational velocities of rigid bodies, angular velocity, motion of the links of a robot, velocity propagation from link to link, Jacobians, singularities, static forces in manipulators, Jacobians in the force domain, Cartesian transformation of velocities and static forces.	8	4
V	**Manipulator dynamics:** Euler-Lagrangian formulation, Newton-Euler formulation, Recursive Newton-Euler formulation. **Trajectory planning**: General considerations in path description and generation, joint-space schemes, Cartesian-space schemes. **Control**: Control techniques, transfer function and state-space representation, position, path velocity and force control systems, computed torque control, adaptive control, and servo system for robot control.	8	5
Guest Lectures (if any)			
Total Hours		**40**	

Suggestive list of experiments: None

Text and Reference Books-

1. Craig, J.J., Introduction to Robotics Mechanics and Control, AddisonWesley, 1999.
2. Saha, Subir Kumar. Introduction to robotics. Tata McGraw-Hill Education, 2014.
3. Spong, Mark W., Seth Hutchinson, and MathukumalliVidyasagar. Robot modeling and control. Vol. 3. New York: Wiley, 2006.

Modes of Evaluation and Rubric

There will be continuous evaluation for during the semester for 40 sessional marks and 60 semester End term Marks. Subjects where laboratory work is prescribed, the practical marks are 50, out of which 30 marks will be awarded for viva voce and 10 marks for lab work and 10 marks for quiz. Out of 40 sessional marks, 20 shall be awarded for Mid semester, 20 marks to be awarded for day to day performance and Quiz/Assignments. For the 60 Marks, there will be a semester – End examination as per the norms of AICTE.

Recommendation by Board of studies on	**Date: 27.05.2025**
Approval by Academic council on	**Date:**
Compiled and designed by	**Prof. Nikhil Mohan Vyas**
Checked by	**Dr. Pankaj Agarwal**

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
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Mechanical Engineering Department

Semester/Year		VII/IV		Program			B.Tech.				
Subject Category	DE-VI	Subject Code:	ME-704 (B)	Subject Name:			Smart & Nano Materials				
	Maximum Marks Allotted							Contact Hours			Total Credits
	Theory			Practical			Total Marks				
End Sem	Mid-Sem	Assignment	Quiz	End Sem	Lab-Work	Quiz		L	T	P	
60	20	10	10	-	-	-	100	3	0	0	3

Course Objective:

This course introduces the fundamental concepts of smart and nano materials, their unique properties, processing techniques, and diverse applications in mechanical engineering. Students will gain an understanding of how these advanced materials can be engineered at the micro and nano scales to exhibit novel functionalities and address contemporary challenges in various industries.

Course Outcomes:

1. Understand the basic principles governing the behavior of smart and nano materials.
2. Identify different types of smart materials and their characteristic properties.
3. Comprehend the synthesis and characterization techniques for nanomaterials.
4. Analyze the applications of smart and nanomaterials in the field of sensors and actuators
5. Discuss the current trends and future directions of smart and nano materials.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										
CO2	3	2	2									
CO3	3	2	3									
CO4	2	3	2									
CO5	2	3	2	1								

Contents:

UNITs	Descriptions	Hrs.	CO's
I	Introduction to Smart Materials: Definition, classification, historical development, Principle of piezoelectricity, types of piezoelectric materials, Principle of magnetostriction, giant magnetostriction,Shape Memory Alloys (SMAs): Martensitic and austenitic phases, pseudoelasticity, shape memory effect, one-way and two-way shape memory.	8	1
II	Introduction to Electro-active Materials, Electronic Materials, Electro-active Polymers, Chromogenic Materials: Photochromic,thermochromic, electrochromic materials and their applications in smart windows, displays.Self-Healing Materials: Concepts of self-healing, intrinsic and extrinsic healing mechanisms, applications in coatings, composites.Bio-inspired Smart Materials: Mimicking nature's designs for developing advanced materials with tailored	8	2

	properties.		
III	Introduction to Nanomaterials: Definition, classification based on dimensionality (0D, 1D, 2D, 3D), unique properties at the nanoscale, Synthesis of Nanomaterials (Top and Bottom Down Approaches), Introduction of Nanocomposites, Nanocoatings and thin films, antifouling surfaces, applications in MEMS/NEMS devices.	8	3
IV	Sensing and Actuation:Introduction,Characterstics, Applications and Principles of electro-magnetic, acoustic, Chemical and Mechanical sensing Actuation. Smart Materials as sensors and actuators. Nanosensors and Nanoactuators: Principles of operation, applications in MEMS/NEMS devices, biomedical sensing.	8	4
V	Introduction of Advanced Topics and Future directions: Biomedical Applications (Bio-implants, Nanomaterials for drug delivery), Energy Applications (Nanomaterials for batteries and solar cells), Environmental Applications (Nanomaterials for water purification, catalysis, air pollution control) Future Trends:Smart manufacturing, additive manufacturing of smart and nano materials, quantum materials. Internet of Nano-Things (IoNT)	8	5
Guest Lectures (if any)			
Total Hours		**40**	

Suggestive list of experiments: None

Text and Reference Books-

1. Smart Materials and Structures: Mel Schwartz, CRC Press
2. Nanomaterials: Synthesis, Properties and Applications: Edelstein, A. S., &Cammarata, R. C., Institute of Physics Publishing.
3. Introduction to Smart Materials: T. V. S. Pillai, Narosa Publishing House.
4. Nanotechnology: Principles and Practices: Sulabha K. Kulkarni, Capital Publishing Company.

Modes of Evaluation and Rubric

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Recommendation by Board of studies on	**Date: 27.05.2025**
Approval by Academic council on	**Date:**
Compiled and designed by	**Dr. Pradeep Singh**
Checked by	**Dr. Pankaj Agarwal**

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Mechanical Engineering Department

Semester/Year		VII/IV		Program			B.Tech.				
Subject Category	DE-VI	Subject Code:		ME-704 (C)	Subject Name:		Surface Engineering				
	Maximum Marks Allotted							Contact Hours			Total Credits
	Theory			Practical			Total Marks				
End Sem	Mid-Sem	Assignment	Quiz	End Sem	Lab-Work	Quiz		L	T	P	
60	20	10	10	-	-	-	100	3	0	0	3

Course Objective:

- To enable the Engineering students about the value of surface engineering • To make the engineering students to understand the importance of surface & its interactions with its environment • To equip the students to understand the various & Advanced surface modification techniques • To develop the skill among the students to evaluate and inspect the surface modified materials for various industrial usages.

Course Outcomes: On completion of course, the students will be able to:

1. Understand different surface properties, wear, and lubrication.
2. Understand the basics of electrodeposition and organic coatings.
3. Learn about the advanced surface deposition techniques (PVD & CVD processes)
4. Understand the fundamentals of corrosion and galvanization
5. Learn about the standards for surface engineering measurements.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										
CO2	3	2	2									
CO3	3	2	3									
CO4	2	3	2									
CO5	2	3	2	1								

Contents:

UNITs	Descriptions	Hrs.	CO's
I	Introduction – Tribology – surface degradation – wear – types of wear – adhesive – abrasive – oxidative –corrosive – erosive and fretting wear – roles of friction and lubrication.	8	1
II	Introduction – principle – parameters of electrodeposition –Faraday's laws of electrodeposition, electrodeposition of copper, nickel, chromium and gold for industrial practices – organic coatings paints-requirements of good paints-constituents of paints-function-formulation of durable paint enamel coatings-special paints-heat resistant and fire retardant paints-electro less coatings conversion coatings.	8	2
III	Introduction –physical vapor deposition-chemical vapor deposition- ion beam process – ion beam assisted vapour deposition – ion implantation – reactive ion	8	3

	sputtering coating – electron beam process – electron beam assisted vapour deposition – laser assisted surface modification – laser alloying – laser melting – laser ablation – laser sprayed deposit – direct metal deposition by lase		
IV	corrosion – types – passivity – mechanism of growth and break down of passive film – corrosion control, Galvanization, Techniques of galvanization, its testing and quality analysis.	8	4
V	Introduction – Terminology – laboratory accreditation – sampling – surface finish evaluation – bare and coated materials – product quality standards for specific coating process – conversion coatings – galvanized coatings – electrodeposited coatings – vapour deposited coatings – standards & ASTM Standards for measurement of surface treated materials – depth – thickness – hardness and friction co-efficient.	8	:5
Guest Lectures (if any)			
Total Hours		**40**	

Suggestive list of experiments: None

Text and Reference Books-

1. Ramnarayanchattopadhyay, advanced thermally assisted surface engineering processes, kluwer academic publishers, 2004

2. Sudarshan T S, Surface modification technologies – an engineer's guide; Marcel Dekkar, Newyork, 1989.

3. Varghese C D, Electroplating and other surface treatments – a practical guide, TMH, 1993.

4. Adamson A W and GastA P, Physical chemistry of surfaces, 6th Ed., John Willey & Sons 1997.

5. Stanley J.Dapkunas, Surface Engineering Measurement Standards for inorganic materials, National institute of standards & technology (special publication,960-9)

Modes of Evaluation and Rubric

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Compiled and designed by	**Dr. Pankaj Agarwal**