23UGMDM1-ME307L MULTIDISCIPLINARY MINOR-1 (3D CAD MODELLING)

Lectures : **2 Hr./week**
Credits : **2**

Examination Scheme
ISA : **50 Marks**

Course Objectives: The objective of the course is to
1. Develop an ability to create constrained 2-D Sketches. 2. Create 3D Part models of industrial components. 3. Prepare Assemblies comprising various Part models. 4. Transform 3D views into Orthographic views.

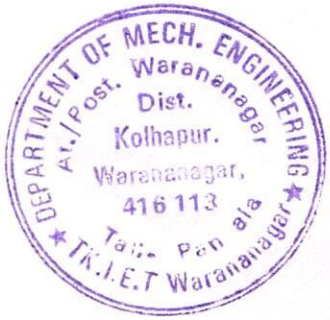
Course Outcomes:

COs	**After the successful course completion, student will be able to**	**Blooms Taxonomy**
CO1	Sketch a 2D drawing compatible for 3D modeling.	Remember Understand
CO2	Create Part models from 2D drawings.	Remember Understand
CO3	Create Assemblies containing Parts and Sub-assemblies.	Remember Understand
CO4	Generate Orthographic views from 3D Part model & Assembly.	Remember Understand

Description:

The concept of 3D CAD Modeling is applicable to almost all the branches of Engineering, as the constituent components of any system, small or large, has to be modelled and manufactured, which makes this subject essential. This Course has been offered by Mechanical Engineering Program as one of the Multidisciplinary MINOR (MDM) courses and is one of the courses to be studied by Third Semester students pertaining to the Program other than Mechanical Engineering. The Course contains Five Units namely, Introduction to CAD, Sketcher Workbench, Part Design Workbench, Assembly Design Workbench and Drafting Workbench.

Prerequisites:	1:	Fundamentals of Engineering Drawing
	2:	Basic AutoCAD skills



Unit 1	**Introduction to CAD**	
	Introduction to the concept of CAD, CAM and CAE, Applications of CAD in view of CAM and CAE, 2D Drawings and 3D CAD Model, Importance of CAD data, Various CAD Softwares and their specific domain, Introduction to CATIA-GUI, Specification Tree, Sketch planes, Navigations through various Workbenches.	**02 Hrs.**
Unit 2	**Sketcher Workbench**	
	Profile Toolbar: Line, Circle, Rectangle, Profile line. **Operation** Toolbar: Trim, Extend, Fillet, Offset, Mirror **Constraint** Toolbar: Geometrical Constraints: Tangent, Parallel, Perpendicular. Dimensional Constraints: Length, Radius, Diameter, Angle, etc.	**03 Hrs.**
Unit 3	**Part Design Workbench**	
	Sketch-based Features: Pad, Pocket, Shaft, Grove **Dress-up Features:** Draft, Fillet, Chamfer **Transformation Features:** Pattern (Rectangular & Circular)	**05 Hrs.**
Unit 4	**Assembly Design Workbench**	
	Building assembly using existing Part models Building Assembly as a part of another Assembly. Manipulation and Constraints	**03 Hrs.**
Unit 5	**Drafting Workbench**	
	Setting up Sheet for Drafting, Inserting Primary View, Inserting additional views, Dimensions, Title blocks	**02 Hrs.**

TERMWORK:

No.	Topic	Hrs.	Bloom's Taxonomy
1	An Assignment on Intro. to 3D CAD Modeling	2	Remember, Understand
2	2 Exercises on Part Modeling (Prints on A4 sheet)	4	Apply, Create
3	1 Exercise on Assembly Modeling (Contg. at least 5 parts) (Print on A3 sheet)	2	Apply, Create
4	2 Exercises on Drafting (Prints on A4 sheet)	4	Apply, Create

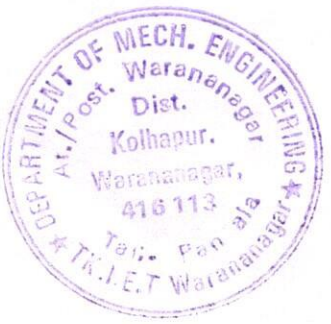
Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	3	2	2	-	3	1	-	-	3	1	3	2	1	-	1
CO2	3	2	2	-	3	1	-	-	3	1	3	2	3	-	3
CO3	3	2	2	-	3	1	-	-	3	1	3	2	3	-	2
CO4	3	2	2	-	3	1	-	-	3	1	3	2	3	-	3

References:

Text Books	
1	CATIA V5R20 for Engineers and Designers, Shyam Tickoo &Deepak Maini, Dream-Tech Press.
2.	CAD/CAM and Automation, Farazdak Haideri, Nirali Prakashan
3.	CAD/CAM Theory and Concepts, Kuldeep Sarin, Chandandeep Grewal, S. Chand
Reference Books	
1.	CAD/CAM- Theory and Practice by Ibrahim Zeid, R. Sivasubramanian, McGraw-Hill, India
2.	Respective Software manuals.

Sr. No.	Description	Signature
1	Name of Faculty: *Prof. Krishnakumar D Joshi*	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	



23UGMDM2-ME406L MULTIDISCIPLINARY MINOR-2

MATERIALS AND APPLICATIONS

Lectures: 2 hrs / week
Credits: 2

Evaluation Scheme:
ISA: 50 marks

Course Objectives: The objective of the course is to
1) Understand the relationship between the structure of materials at atomic or molecular scales and their macroscopic properties. 2) Develop the ability to select appropriate materials for various engineering applications.

Course Outcomes:

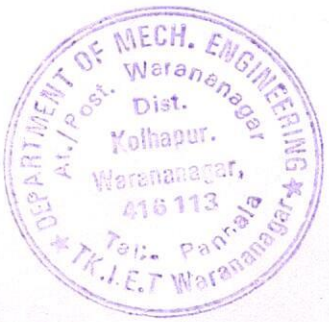
Co's	At the end of successful completion of the course, the student will be able to	**Blooms Taxonomy**
CO1	Understanding Metals and Metallic Bonds, Crystal Structures and Imperfections	Understanding
CO2	Relate the composition of materials to their mechanical properties.	Apply
CO3	Describe the role of material specifications and standards in engineering design and manufacturing.	Apply
CO4	Explain Properties and applications of Smart Materials	Understanding
CO5	Explain Properties and applications of Magnetic Materials	Understanding
CO6	Discuss the various stages of techniques used in manufacturing ofPowder Metallurgy components.	Understand

Description:

This course introduces the fundamental concepts of materials science and engineering. Topics include the structure of materials, their properties, and how they can be manipulated and used in engineering applications.

Prerequisites:	1:	Basic Mechanical Engineering
	2:	Engineering Physics
	3:	Engineering Chemistry

	Section - I	
Unit 1	**Introduction to Metals and alloy systems**	
	Crystal structure (SC, BCC, FCC, HCP), Imperfections in crystals , Alloy formation by crystallization, Nucleation and growth, Cooling curves, Dendritic structure and coring. Solid solutions and intermediate phases, Phases and Gibbs phase rule Construction of equilibrium diagrams from cooling curves,	**05Hrs**
Unit 2	**Ferrous Alloys**	
	Fe-Fe3C Diagram, Plain carbon steels, Steel Specifications based on -IS, BS, SAE, AISI Alloy steels- Free cutting steels, HSLA high carbon low alloy steels, maraging steels. creep resisting steels, Stainless steels- different types. cast iron	**05 Hrs**
	Section - II	
Unit 3	**Introduction to Non Ferrous metals**	
	Alloys of Copper, Aluminum, other alloys of lead, zinc, Bearing alloys	**03 Hrs**
Unit 4	**Smart Materials**	
	Introduction to Smart Materials, Classification of Smart Materials, Properties of Smart Materials, Applications of Smart Materials	**05 Hrs**
Unit 5	**Magnetic Materials**	
	Introduction to Magnetic Materials, Classification of Magnetic Materials, Properties of Magnetic Materials, Applications of Magnetic Materials	**05 Hrs**
Unit 6	**Powder Metallurgy:**	
	Advantages, Limitations and Applications of Powder Metallurgy Powder manufacturing types- Mechanical, Physical, Chemical and Electro-Chemical Mixing/ Blending. Compaction- types- Conventional, Powder rolling andextrusion. Sintering- Types liquid stage and solid stage sintering	**03 Hrs**



Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	3						1								
CO2	3	2													
CO3	3	2													
CO4	2	2													

References:

Text Books	
1	S.H. Avner, "Introduction to physical metallurgy", Mcgraw Hill Book Company Inc, Edition, 2nd, 1974.
2	Vijendrasingh, "Physical metallurgy", Standard Publishers Delhi
3	Materials Science and – An Introduction by William D. Callister Jr. and David G.Rethwisch, Wiley, Tenth Edition, 2010.
4	V.D. Kodgire, "Material science and metallurgy for engineers", Everest Publishers Pune,12th Edition
5	T.V. Rajan / C.P. Sharma, "Heat Treatments Principles and Practices", Prentice Hall of India Pvt Ltd, New Delhi
6	V Raghwan, "Material Science and Engineering", Prentice Hall of India Pvt. Ltd., New Delhi ,3rd Edition, 1995.

Reference Books	
1	V. Raghvan, "Materials Science & Engineering", PHI 5th Edition, Prentice-Hall of India (P) Ltd.
2	W. Callister, "Materials Science & Engineering", John Wiley & sons
3	R.A. Higgins, "Engineering Metallurgy", Viva Books Pvt. Ltd., New Delhi, 1 st Edition
4	Foundations of Materials Science and Engineering by William F. Smith, Mc Graw Hill, Third Edition, 2004.
5	Elements of Materials Science and Engineering by H. Van Vlack, Addison – Wesley, Fifth Edition, 2006.
6	Introduction to Materials Science for Engineers by James F. Shackelford, Pearson,Eighth Edition, 2015.
7	Characterization of Materials by P. K. Mitra, PHI Learning, 2014.
8	Mechanical Metallurgy by George E. Dieter, Tata McGraw Hill, 3rd edition, 2013.

Sr. No.	Description	Signature
1	Name of Faculty Dr. M. R. Jadhav	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING
At./Post. Warananagar
Dist. Kolhapur.
Warananagar, 416113
Tal.: Panhala
TK.I.E.T Warananagar

23UGMDM3-ME505 MACHINING PROCESSES WITH CNC

Lectures : 3 hrs/ week
Practical : 2
Credits : 4

Evaluation Scheme-
ESE : 60 marks
ISE : 40 marks

Course Objectives: The objective of this course is to

1) Understand turning and milling operations
2) Introduce basics of CNC lathe
3) Study the Components of CNC Vertical Machining Centre
4) Introduction to tool setting
5) Know selection of tools
6) Train students into Basic CNC Turning Programming

Course Outcomes:

COs	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Demonstration of Lathe machine and Milling Machine.	Knowledge
CO2	Explain applications and advantages of CNC machines and technology.	Understand
CO3	Demonstration of CNC and VMC with elements,power drives and spindle drives.	Apply
CO4	Prepare programs , demonstrate , simulate and operate CNC lathe machines for various machining operations.	Apply Analyze
CO5	Prepare programs , demonstrate , simulate and operate CNC milling machines for various machining operations.	Understand Apply
CO6	Demonstration of tooling and work holding devices.	Analyze

Description:

Today's manufacturing utilizes innovative technologies, including sophisticated Computer numerical control (CNC), Computer Aided Manufacturing (CAM) software and specialty industry materials to develop and build the products of tomorrow. Students will be walked through all aspects of CNC machining, how to import a CAD model in to CAM software, how to get it ready for machining and how to apply machining techniques to machine that part. At the end students will spend some time on the machine learning how to machine a part on a CNC milling machining center. This last step is critical to put together pieces of the puzzle, so that one can understand the whole process. Students will be applying machining techniques in the virtual world and then apply and see how a virtual object comes in to reality on a CNC machine.

	1:	Workshop Technology

Prerequisites :	2:	Manufacturing Processes
	3:	Tool Engineering
	4:	Auto CAD

	Section-I	
Unit 1	**Lathe and Milling Machine Basics:** a) **Lathe:** Introduction, Working principle, types, specifications, principle parts, accessories, attachments, and various lathe operations. b) **Milling Machine:** Types- Horizontal, Vertical milling machines, Milling cutters, construction and working of column and knee type, milling operations, simple and compound indexing.	**7 Hrs.**
Unit 2	**Introduction to CNC Machine Tools :**Conventional Vs. non-conventional machine tool, History & development of CNC technology, Classification of NC & CNC Machine Tools, CNC Machine Components, Co-ordinate systems, Working Principle of Various CNC Systems, Direct Numerical Control, Adaptive Control, Concept of ATC & APC, Advantages of CNC machine tools, Limitations of CNC , CNC Safety Practices	**7 Hrs.**
Unit 3	**Drives and Control:** **Spindle drives** – DC shunt motor, 3 phase AC induction motor, **Feed drives** –Stepper motor, servo principle, DC and AC servomotors, **Control system-** Types of encoders, absolute and incremental optical encoders, synchro, synchro-resolver, gratings, moire fringe gratings, inductosyn, laser interferometer.	**7 Hrs.**
	Section-II	
Unit 4	**CNC Machining -Lathe:** Basics of CNC Programming, Plan and optimize programs for CNC turning operations, Implementation of 'G' codes & 'M' codes of Turning, Calculate parameters like speed, feed, depth of cut etc. and set a references for the various operations. Prepare operation and operation sequence for the lathe operations like turning, grooving etc. Modern CNC Systems.	**7 Hrs.**
Unit 5	**CNC Machining -Milling:** Basics of CNC Programming on Milling. Plan and optimize programs for CNC milling operation, Implementation of G codes & M codes of milling	**5 Hrs.**
Unit 6	**Tooling and Work Holding Devices:** Introduction to cutting tool materials – Carbides, Ceramics, CBN, PCD–inserts classification, qualified, semi qualified and pre-set tooling, tooling system for Machining centre and Turning centre, work holding devices for rotating and fixed work parts, modular fixtures, economics of CNC, maintenance of CNC machines.	**7 Hrs.**

Mapping of Pos & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	1	-	-	-	-	-	-	1	-
CO2	3	3	2	1	-	-	2	-	-	-	-	-	-	2	-
CO3	3	2	2	1	-	-	2	-	-	-	-	-	-	3	-
CO4	2	2	3	1	-	-	2	-	-	-	-	-	-	3	-
CO5	2	2	2	1	-	-	2	-	-	-	-	-	-	3	-
CO6	1	3	2	1	-	-	1	-	-	-	-	-	-	2	-

References:

Text Books	
1	Rao, P.N. (2013). Manufacturing Technology: Metal Cutting and Machine Tools (Vol. 2). New Delhi: McGraw Hill Education. ISBN: 978-1259029561.
2	Hajra Choudhury, S.K., & Hajra Choudhury, A.K. (2009). Elements of Workshop Technology: Volume II (Machine Tools). New Delhi: Media Promoters & Publishers Pvt. Ltd. ISBN: 978-8174092328.
3	Pabla, B.S., & Adithan, M. (2008). CNC Machines. New Delhi: New Age International Publishers. ISBN: 978-8122427180.
Reference Books	
1	Ghosh, A., & Mallik, A.K. (2010). Manufacturing Science. New Delhi: East-West Press Pvt. Ltd. ISBN: 978-8185938795.
2	Kundra, T.K., Rao, P.N., & Tewari, N.K. (1987). Numerical Control and Computer-Aided Manufacturing. New Delhi: Tata McGraw-Hill. ISBN: 978-0070087477.

Web Links/Video Lectures:

1) **https://archive.nptel.ac.in/courses/112/105/112105211/**

2) **https://youtu.be/_5r2XR1h1aQ?si=38jR_PmkbB8anYUf**

Sr. No.	Description	Signature
1	Name of Faculty: M. V. Jadhav	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING
At./Post. Warananagar
Dist. Kolhapur.
Warananagar, 416113
Tal.- Panhala
TK.I.E.T Warananagar

23UGMDM4-ME606L GD&T Techniques in Engineering

Lectures: 2 hrs/ week
Credits: 2

Evaluation Scheme:
ISA: 50 Marks

Course Objectives: The objective of this course is to

1. Understand GD&T principles including the importance of tolerances, datum references, and geometric controls.
2. Learn to interpret engineering drawings that utilize GD&T symbols and annotations accurately.
3. Apply GD&T Symbols and Concepts: Develop proficiency in applying GD&T symbols and concepts to engineering drawings.

Course Outcomes:

COs	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Identify different GD&T symbols.	Understand
CO2	Understand limits fits and tolerance and Taylor's principle of gauging	Understand
CO3	Understand MMC, LMC and RFS concepts	Understand
CO4	Assess the significance and selection of datum & datum features	Apply Analyze
CO5	Apply Geometric characteristics of feature	Understand Apply
CO6	Interpret the geometrical features using different measuring instruments.	Analyze Apply

Description:

Geometric Dimensioning and Tolerancing (GD&T) is a comprehensive system used in engineering and manufacturing to define and communicate the allowable variations in the geometry of parts and assemblies. It uses symbols, terms, and definitions to provide a clear and precise description of a component's design and its allowable deviations.

Students will become familiar with the various GD&T symbols used to represent different geometric characteristics, such as straightness, flatness, circularity, cylindricity, profile, orientation, and runout.

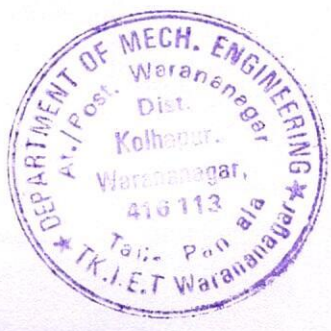
They will develop the skills to read and interpret GD&T annotations on engineering drawings, enabling them to accurately understand design requirements.

Prerequisites:	1:	Computer Aided Engineering Drawing
	2:	Machine Drawing & Geometric Modeling

Section-I		
Unit 1	**Introduction to GD&T** Introduction to dimensioning and tolerancing, Terms and symbols used in GD&T, Benefits of GD&T, advantages of GD&T, applications of GD&T	**4 Hrs.**
Unit 2	**Measurement and Limits fits and tolerances** Introduction to measurement, International standards of length, line and end measurement, IS specifications of limits, Unilateral and bilateral tolerances, Types of Fits, Taylor's principle of gauging.	**5 Hrs.**
Unit 3	**MMC, LMC & RFS** Maximum Material Condition (meaning & use); Least Material Condition (meaning & use); Regardless of Feature Size How to read a Feature Control Frame, Rules, concepts, characteristics, and untoleranced dimensions: types of datums individual or related datum's, material Conditions; untoleranced dimensions.	**5 Hrs.**
Section-II		
Unit 4	**Size Control Form and datum** Rules, concepts, characteristics, and untoleranced dimensions: types of datums individual or related datum's, material Conditions; untoleranced dimensions.	**4 Hrs.**
Unit 5	**Geometric characteristics of feature** **Form** (straightness, flatness, circularity,cylindricity) **Orientation** (parallelism, perpendicularity, angularity) **Location** (position,concentricity,symmetry) **Profile** (profile of line, profile of surface) **Runout** (circular runout, total runout)	**5 Hrs.**
Unit 6	**Measuring Instruments for Checking Geometric Features** Use of measuring instruments to check the geometrical features of the component like dial indicator, Pneumatic gauge. Use of CMM for the measurement of Geometric characteristics of industrial component.	**5 Hrs.**

Mapping of Pos & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	2	2	1	1	2	-	-	-	-	-	-	-	2	-	-
CO2	2	3	2	1	2	-	-	-	-	-	-	-	2	-	-
CO3	2	2	1	1	2	-	-	-	-	-	-	-	2	-	-
CO4	2	2		1	2	-	-	-	-	-	-	-	2	-	-
CO5	3	2	2	2	2	-	-	-	-	-	-	-	2	-	-
CO6	3	2	2	2	1	-	-	-	-	-	-	-	2	-	-



References:

Text Books	
1	Fundamentals of GD&T, 3rd edition by Krulikowski
2	Advanced Geometric Dimensioning and Tolerancing (GD&T) by Bipinkumar Singh
3	P S Gill, "Geometric Dimensioning and Tolerancing", S K Kataria & sons
Reference Books	
1	Dimensioning and Tolerancing: Applications and Techniques for Use in Design: Manufacturing, and Inspection, by James D. Meadows, CRC Press
2	GD & T: Based on ASME-Y 14.5-2009 by Ashok Kumar, Azuko Publishing

Video Lectures

1. **https://nptel.ac.in/courses/112106179**
2. **https://nptel.ac.in/courses/112104250**
3. **https://www.youtube.com/watch?v=rbk28swIiHU**
4. **https://www.youtube.com/watch?v=flsTBgNgNhQ**

Sr. No.	Description	Signature
1	Name of Faculty Mr. A.R.Shinge	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING
At./Post. Warananagar
Dist. Kolhapur.
Warananagar, 416 113
Tal. Pan ala
TK.I.E.T Warananagar

23UGMDM5-ME706L MULTIDISCIPLINARY MINOR-5
ADDITIVE MANUFACTURING (3D PRINTING)

Lectures: 2 hrs / week
Credits: 2

Evaluation Scheme:
ISA: 50 marks

Course Objectives: The objective of the course is to

1) To develop a design for additive manufacturing skill set for CAD and CAM methodologies to produce successful 3D prints
2) To provide knowledge of additive manufacturing processes, materials, and capabilities, and to understand the software tools and techniques used

Course Outcomes:

Co's	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Understand the basic principles and significance of additive manufacturing and CAD in modern manufacturing.	Understanding
CO2	Understand the entire data preparation process for 3D printing.	Understanding
CO3	Select and operate appropriate 3D printing software to configure and manage 3D printers	Apply
CO4	Choose and utilize appropriate 3D printing materials for various applications	Apply
CO5	Analyze different solid-based 3D printing processes and to determine their suitability for various applications	Analyse
CO6	Analyze different liquid-based 3D printing processes, such as Stereolithography (SLA) and Digital Light Processing (DLP)	Analyse

Description:

Additive Manufacturing (AM), commonly known as 3D Printing, is a process of creating three-dimensional objects from a digital model by sequentially adding material layer by layer.AM builds up parts directly from raw materials, which can include plastics, metals, ceramics, and composites. This technology enables the production of complex geometries, reduces material waste, and allows for customization and rapid prototyping, making it highly valuable in industries such as aerospace, healthcare, automotive, and consumer goods.

Prerequisites:	1:	3D CAD Modeling
	2:	Materials and Applications
	3:	GDT Techniques in Engineering

Section - I		
Unit 1	**Additive Manufacturing Introduction and CAD**	
	Introduction, Additive v/s Conventional Manufacturing processes, Overview of Additive Manufacturing Processes, Introduction Solid Modeling, CAD Modeling example using SOLID Works Software, Process Chain for 3D Printing, Reverse Engineering for 3D Printing	**05Hrs**
Unit 2	**Data Preparation for 3D Printing**	
	STL file format and Associated Operations, Part orientation and Support Generation, Slicing and Deposition Path Generation	**04 Hrs**
Unit 3	**3D Printers and Software**	
	Constructional Details of a 3D Printer, Understanding Accuracy, Precision, and Tolerance in 3D Printing,3D Printer software	**04Hrs**
Section - II		
Unit 4	**3D Printing Materials**	
	Materials: The building block for 3D printing, Solid-based materials for 3D printing, Powder-based materials for 3D printing, Liquid based materials for 3D printing	**05 Hrs**
Unit 5	**Solid based 3D Printing Processes**	
	Basic principle of Solid based 3D printing processes; Constructional details, Basic Principle and working of fused deposition modeling (FDM) process; Post Processing of FDM and other Solid based 3D Printed components. Troubleshooting Common Issues, Applications of FDM, DED and SL	**05 Hrs**
Unit 6	**Liquid based 3D Printing Processes**	
	Basic principle of Liquid based 3D printing processes; Photo Polymerization-Principle and working of stereo lithography apparatus- SLA based 3D printing processes-Curing processes; Applications; Post Processing	**03 Hrs**

Note : Minimum Six (6) Assignments on Above Six units.

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	2	2			2										2
CO2	2	2			3										2
CO3	2	2			3										2
CO4	3	2													2
CO5	3	3			2										3
CO6	3	2			3										3

Books and References:

1	Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing, Andreas Gebhardt, Hanser Publisher, 2011 ISBN: 156990507X, 9781569905074
2	3D Printing and Design, Sabrie Soloman, Khanna Publishing House, Delhi ISBN: 9789386173768
3	3D Printing and Rapid Prototyping- Principles and Applications, C.K. Chua, Kah Fai Leong, World Scientific, 2017 ISBN: 9789813146754
4	Getting Started with 3D Printing: A Hands-on Guide to the Hardware, Software, and Services Behind the New Manufacturing Revolution, Liza Wallach Kloski, Nick Kloski,Make Community, LLC; 2nd edition, 2021 ISBN: 9781680450200

Sr. No.	Description	Signature
1	Name of Faculty Dr. M. R. Jadhav	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

DEPARTMENT OF MECH. ENGINEERING
At./Post. Warananagar
Dist. Kolhapur.
Warananagar, 416113
Tal.- Panhala
TK.I.E.T Warananagar

23UGMDM6-ME804L Automation and Robotics in Manufacturing

Lectures: 2 hrs/ week
Credits: 2

Evaluation Scheme:
ISA: 50 marks

Course Objectives: The objective of this course is to
1) Introduce fundamental aspects of Automation and Robotics in Manufacturing. 2) Apply the fundamental manufacturing processes in Automation and Robotics environment. 3) Understand the applications of Automation and Robotics developed in Manufacturing. 4) Study the concept of Automation and Robotics developed in Manufacturing

Course Outcomes:

COs	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	State and define the different types of Automation and Robotics	Knowledge
CO2	Describe the principles of Automated manufacturing systems	Understand
CO3	Apply Various vibratory and non-vibratory devices for feeding and orientation	Apply
CO4	Determine different Various process tools as end effectors in robotics.	Apply Analyze
CO5	Understand the Fundamentals of Industrial Robots.	Understand
CO6	Analyze the Robot programs a Path in space.	Analyze

Description:

Automation and robotics in Manufacturing is offered as the Multidisciplinary Minor (MDM) course. This course contains basic principles and applications of Automation and robotics in Mechanical Engineering. In this course students will learn about fundamentals, principles and applications of Automation and robotics in industries. Students will get new design techniques for the analysis and control of discrete event system. This course has six units namely i) Introduction to Automation ii) Industrial Control and Transfer Line iii) Assembly Automation iv) Fundamentals of Industrial Robots v) Robotic End Effectors and Sensors vi) Robot Teaching.

Prerequisites:	1:	Engineering Mathematics
	2:	Manufacturing processes.
	3:	Machine tools
	4:	Basic Mechanical Engineering

Section-I		
Unit1	**Introduction to Automation:** Automated manufacturing systems, Fixed/programmable/flexible, Automation, and Need of automation, Basic elements of automated systems- Power, program and control. Low cost automation, Economic and social aspects of automation, Advanced automation functions, Levels of automation.	**4 Hrs.**
Unit2	**Industrial Control and Transfer Line:** A) Industrial control systems in process and discrete manufacturing industries, Continuous and discrete control; Computer process control.	**4 Hrs.**
	B) Fundamentals of transfer lines, Configurations, Transfer mechanisms, Storage buffers, Control, Applications.	
Unit3	**Assembly Automation:** Assembly Automation, Types and configurations, Parts delivery at workstations, Various vibratory and non-vibratory devices for feeding and orientation, Product design for automated assembly.	**5 Hrs.**
Section-II		
Unit4	**Fundamentals of Industrial Robots:** Specifications and Characteristics, Criteria for selection, Robotic Control Systems, Drives, Robot Motions, Actuators, Power transmission systems, Robot controllers, Dynamic properties of robots-stability, Control resolution, Spatial resolution, Accuracy, Repeatability, Compliance, Work cell control, Interlocks.	**4Hrs.**
Unit5	**Robotic End Effectors and Sensors:** Transducers and sensors, Sensors in robotics and their classification, Touch(Tactile)sensors, Proximity and range sensors, Force and torque sensing, End Effectors-Types, grippers, Various process tools as end effectors; Robot End effectors interface, Active and passive compliance, Gripper selection and design	**4 Hrs.**
Unit6	**Robot Teaching:** Introduction, Various teaching method, Task programming, Survey of Robot level programming languages, A Robot programs a Path in space, Motion interpolation, WAIT, SIGNAL and DELAY commands, Branching, Robot language structure, Various textual robot, Languages such as VALII, Typical programming examples such as palletizing, Loading a machine etc., Application of Robot	**5 Hrs.**

Mapping of Pos & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	1	-	-	-	-	-	-	1	-
CO2	3	3	2	1	-	-	2	-	-	-	-	-	-	2	-
CO3	3	2	2	1	-	-	2	-	-	-	-	-	-	3	-
CO4	2	2	3	1	-	-	2	-	-	-	-	-	-	3	-
CO5	2	2	2	1	-	-	2	-	-	-	-	-	-	3	-
CO6	1	3	2	1	-	-	1	-	-	-	-	-	-	2	-

References:

Text Books	
1	"Automation, Production Systems and Computer Integrated Manufacturing", Groover, M.P., Pearson Education, ISBN: 81-7808-511-9 2nd Edition (2004).
2	"Industrial Robotics, Technology, Programming and Applications", Groover, M.P.; Weiss, M.; Nagel, R.N. and Odrey, N.G. , McGraw Hill Intl. Edition, ISBN: 0-07-024989- X.
3	"Introduction to Robotics, Analysis, Control and Applications", Niku, Saeed B., Willey Publication, ISBN 9788126533121, 2nd Edition.
4	"Robotics-Control, Sensing, Vision and Intelligence", Fu, K.S.; Gonzalez, R.C. and Lee, C.S.G., McGraw Hill Intl. Ed., ISBN: 0-07-100421-1.
Reference Books	
1	"Robot Technology Fundamentals", Keramas, James G, Thomson Learning–Delmar ISBN: 981- 240-621-2, (1998).
2	Handbook of Robotics", Noff, Shimon Y., John Wiley and Sons.
3	"Introduction to Robotics, Analysis, Systems and Applications", Niku, saeedB. (2002) , Prentice Hall of India.
4	"Robotics for Engineers", Koren, Yoram, Tata McGraw Hill.,(2003)
5	"Fundamentals of Robotics, Analysis and Control", Schilling.

Video Lectures

1. **https://archive.nptel.ac.in/courses/112/104/112104288/**
2. **https://www.youtube.com/watch?v=xrwz9IxpMJg**

Sr. No.	Description	Signature
1	Name of Faculty A. V. Patil	
2	Syllabus Structure and Content of Course Verified	
3	Approval of Board of Studies Chairman	

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:
Term Work: Minimum six assignments on Six units.

TATYASAHEB KORE INSTITUTE OF ENGINEERING & TECHNOLOGY ★ Autonomous Warananagar

Member Secretary
Board of Studies

Chairman
Board of Studies

Board of Studies
MECHANICAL ENGG. DEPT
Tatyasaheb Kore Institute of Engg.
& Technology (Autonomous)
Warananagar, Dist. Kolhapur

Academic Dean
T.K.I.E.T., Warananagar

Dean, Academic
Tatyasaheb Kore Institute of Engg.
& Technology (Autonomous)
Warananagar, Dist. Kolhapur

Principal
T.K.I.E.T., Warananagar

PRINCIPAL
Tatyasaheb Kore Institute of Engg.
& Technology (Autonomous)
Warananagar, Dist Kolhapur