GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Mechanical Engineering

Subject Code: DI05019011

Subject Name: Manufacturing Engineering - III

w. e. f. Academic Year:	2026-27
Semester:	5th
Category of the Course:	PCC

Prerequisite:	To successfully engage with this course, the students must have a strong foundation in Manufacturing Engineering-I & II, specifically demonstrating proficiency in the conventional machining operations like turning, milling and drilling. Competency in Computer-Aided Design (CAD) is essential for creating and interpreting 3D geometric models, while a fundamental understanding of Engineering Materials ensures proper material selection for various production processes. The prior workshop experience with machining tools, equipment and safety practices will help in effective learning of the manufacturing operations.
Rationale:	Manufacturing Engineering – III provides knowledge and practical understanding of modern manufacturing methods used in present-day industries. The course covers gear and thread manufacturing, jigs and fixtures, press tools, non-conventional machining processes, advanced manufacturing systems and additive manufacturing technologies. It also introduces students to automation, flexible manufacturing systems, MEMS and Industry 4.0 concepts used in the smart manufacturing environments. The course develops the ability to select suitable manufacturing processes based on the material, required accuracy, productivity and cost requirements. This course helps in bridging the gap between conventional and advanced manufacturing technologies and prepares the students for modern manufacturing industries aligned with the vision of "Make in India."

Course Outcomes:

After completion of the course, the student will be able to:

No	Course Outcomes
01	Design a jig/fixture/press tool layout for a given simple component.
02	Select suitable gear and thread manufacturing processes based on accuracy, production rate and application.
03	Select appropriate non-conventional machining processes and apply basic MEMS concepts in engineering applications.
04	Identify suitable advanced manufacturing systems to improve a given conventional production setup for better productivity and efficiency.

05	Select suitable additive manufacturing processes/materials/parameters for simple component.

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE(E)	PA(M)	PA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	**Production Tooling: Jigs, Fixtures & Press Tools** **Principles of Location and Clamping** 1.1 Need for jigs and fixtures 1.2 Degrees of freedom and 3-2-1 location principle 1.3 Locator (pin, button, V, nest locator) and Clamps (strap and C-clamp) **Jigs:** 1.4 Types, construction and applications (plate, box, leaf and channel jig) 1.5 Drill bushes: Types (fixed and renewable) and applications **Fixtures:** 1.5 Milling, turning, welding and assembly fixtures. **Press Tools:** 1.6 Construction, working and application of press tool 1.7 Sheet metal operations (shearing, blanking, piercing and bending) 1.8 Types of dies: simple, compound and progressive	**10**	**22**
2	**Gear & Thread Manufacturing Processes** **Gear Manufacturing Processes** 2.1 Types and applications of gears 2.2 Gear terminology 2.3 Classification of gear manufacturing 2.4 Gear Forming Processes • Gear milling using form milling cutter. (Principle, indexing, advantage and limitations)	**09**	**20**

	2.5 Gear Generating Processes • Gear hobbing and gear shaping using pinion cutter (Working principle, tool geometry, application, advantage and limitation) 2.6 Gear Finishing Processes (need and types) 2.7 Gear shaving and grinding (principle, applications, achievable accuracy) **Thread Production Processes** 2.8 Thread terminology and application 2.9 Thread cutting • By single-point cutting tool • By taps and dies 2.10 Thread rolling • By flat-die • By cylindrical-die		
3	**Non-conventional and Advanced Methods of Machining.** 3.1 Need of non-conventional machining and comparison between conventional & non-conventional machining methods. 3.2 Classification, working principles, application and working parameters of the following non-conventional machining methods: • Electro chemical machining (ECM). • Electro discharge machining (EDM) including wire cut and dies sinking. • Ultrasonic machining (USM). • Laser beam machining (LBM). • Abrasive jet machining (AJM). • Plasma arc machining (PAM) • Water jet machining (WJM) 3.3 Criterion for selection of non-conventional machining methods. 3.4 Introduction to MEMS and its characteristics 3.5 Materials used in MEMS 3.6 Basic micro-fabrication techniques (lithography, etching, deposition) 3.7 Applications of MEMS in engineering and industry	**10**	**22**

4	**Advanced Manufacturing Systems** **4.1 Group Technology and Cellular Manufacturing** 1. GT - concept, definition & benefits. 2. GT Layout - concept, need, benefits, comparison with conventional layout with examples 3. Part features - concept, types and examples. 4. Part family - concept, approach to form cell using part families. **4.2 Computer Integrated Manufacturing (CIM)** 1. CIM concept: Need, block diagram and functional areas covered and their importance **4.3 Flexible Manufacturing Systems (FMS)** 1. FMC & FMS: Concept, definition, advantages. 2. FMS layouts: Types and comparison 3. Major elements of FMC / FMS (limited to basic concept and functions): i. Tool handling system. ii. Material handling system. iii. Automated guided Vehicles (AGV). iv. Automated storage and retrieval system (AS/RS). v. Main frame computer.	**08**	**18**
5	**Additive Manufacturing & Modern Trends** 5.1 Introduction to Additive Manufacturing 5.2 Principle, AM Process Chain, STL File Format (Concept), AM Materials Overview 5.3 Polymer-Based AM Processes: Fused Deposition Modelling (FDM), Stereolithography (SLA). 5.4 Metal AM Processes: Selective Laser Sintering (SLS), Wire Arc Additive Manufacturing (WAAM). 5.5 Industry 4.0 and Smart Manufacturing • Industry 4.0: definition, four industrial revolutions, nine pillars — awareness • Internet of Things (IoT) in manufacturing: smart sensors, machine connectivity, real-time monitoring • Digital Twin: Definition and concept of Digital Twin, Difference between physical system and digital model, Applications in manufacturing • Artificial Intelligence (AI) in Manufacturing: defect detection,	**08**	**18**

	predictive maintenance, process optimization — introduction		
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	24	26	00	00	00

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

Sr. No	Title of Book	Author	Publication with place, year and ISBN
1	Manufacturing Science	Amitabha Ghosh & A. K. Mallik	East-West Press, New Delhi
2	Modern Machining Processes	P.C. Pandey & H.S. Shan	McGraw Hill Education, New Delhi, Latest Edition,
3	Machine tools technology	G. S. Kandasami	Khanna Publishers
4	Workshop Technology I & II	Raghuwanshi	Dhanpat Rai and Company Pvt. Limited
5	Production Technology (Manufacturing Process)	Dr. P.C. Sharma	S. Chand
6	Advanced Machining Processes	V. K. Jain	Allied Publishers, New Delhi
7	Rapid Prototyping Technology	C. P. Paul	McGraw Hill, India
8	Computer Integrated Manufacturing	K. K. Singh	Khanna Publishing House, India
9	Production Technology	R. K. Jain and S. C. Gupta	Khanna Publishers
10	Elements of Workshop Technology Volume No. II Machine Tools	Hajra Choudhary, Bose S. K., Roy Nirjhar	Media Promoters and Publishers Pvt. Limited

Sr. No	Title of Book	Author	Publication with place, year and ISBN
11	M.E.M.S.: Fundamental Technology and Application	Vikas Choudhary, Krzysztof Iniewski	CRC Press
12	Production Technology	Hindustan Machine Tools) HMT	Tata Mcgraw-Hill Publishing Co.
13	Workshop Technology - Part I	Dr. W. A. J. CHAPMAN	2011 by Routledge
14	All about Machine Tools	HEINRICH GERLING	New Age International Private Limited

Open Source Software and Websites:

i. https://www.youtube.com/watch?v=7yzvno4AvKw
ii. https://www.youtube.com/watch?v=vOo2MCYPsm4
iii. https://nptel.ac.in/courses/112105127
iv. http://nptel.iitm.ac.in/video.php?subjectId=112105126
v. http://nptel.iitm.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Manuf%20Proc%20II/pdf/LM-01.pdf
vi. https://www.youtube.com/watch?v=tiarT1YS-lM
vii. https://nptel.ac.in/courses/112104181
viii. https://nptel.ac.in/courses/112/105/112105126/
ix. https://nptel.ac.in/content/storage2/courses/112105127/pdf/LM-32.pdf
x. https://nptel.ac.in/content/storage2/courses/112105127/pdf/LM-31.pdf
xi. https://nptel.ac.in/courses/112/104/112104028/
xii. https://archive.nptel.ac.in/courses/112/104/112104289/
xiii. https://www.me.iitb.ac.in/~ramesh/courses/ME338/non_trad.pdf
xiv. http://home.iitk.ac.in/~nsinha/Non-traditional-machining.pdf
xv. http://www.youtube.com/watch?v=bmooEZyivxo
xvi. http://www.youtube.com/watch?v=mWy9awGv6so
xvii. http://www.youtube.com/watch?v=mKES5Fyz9l0
xviii. http://www.youtube.com/watch?v=BgGXQUeYNKw
xix. ihttp://www.youtube.com/watch?v=eaeEn1Gs4aQ
xx. http://www.youtube.com/watch?v=49GpJ7yhecg
xxi. http://www.youtube.com/watch?v=XfYXelZ4IaY
xxii. http://www.youtube.com/watch?v=pI1QGpmKqow
xxiii. https://www.youtube.com/watch?v=NkC8TNts4B4
xxiv. https://www.youtube.com/watch?v=KJj8CfnC0Ek
xxv. https://onlinecourses.nptel.ac.in/noc21_me115/p

Suggested Course Practical List:

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx Hrs. Required
1	**Production Tooling: Jigs, Fixtures & Press Tools** Design a jig/fixture/press tool layout for a given simple component and prepare the related drawings.	1	08
2	**Gear cutting:** Prepare a simple spur gear using milling operation including use of the indexing head. The student will also prepare a report including: **a.** Drawing of the job Gear. **b.** Equations to find module, pitch circle diameter, outside diameter, circular pitch and the number of teeth. **c.** Produce spur gear on milling machine using indexing head. Calculate/select, set, observe and record the cutting parameters. **d.** List the cutting tools and work holding device you have used. Also state the specifications of each.	2	08
3	**Non-Conventional Manufacturing Processes** Prepare a case study on any component which are manufactured by using any Non-Convectional manufacturing processes. • Neat sketch or drawing of the component. • Working principle of the selected manufacturing process. • Materials used for the component and tool/equipment. • Process parameters used during manufacturing. • Advantages and limitations of the selected process	3	04
4	**Advanced Manufacturing Systems** Analyze a given case study of a conventional manufacturing unit and suggest suitable AMS elements (GT cell, CIM integration, or FMS) to improve productivity and efficiency. E.g. A small auto component manufacturer in Rajkot produces 15	4	04

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx Hrs. Required
	different shaft variants on 8 conventional machines arranged in a process layout. Set-up times are high, WIP inventory is large and lead time is 12 days. Suggest how AMS concepts can improve this situation. Prepare a case study report.		
5	**Additive Manufacturing (AM)** Prepare a simple job on 3D Printer/ Additive Manufacturing (AM) **a.** To develop CAD models using 3D Scanner/Software for 3D printer. **b.** Use slicing software. **c.** To select a specific material for the given application. **d.** To produce a simple product using 3D printing or Additive Manufacturing (AM)	5	06
		Total	**30**

List of Laboratory/Learning Resources Required:
These major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to user in uniformity of practical in all the institutions across the state.

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1.	Milling Machine with Dividing/Indexing Head	
2.	Spur Gear Milling Cutters (Different Modules)	
3.	Jig and Fixture Models	
4.	Press Tool / Die Models	
5.	EDM Machine / Demonstration Setup	
6.	CAD/CAM Software	
7.	3D Printer (FDM Type Preferred)	
8.	PLA/ABS Filament Materials	
9.	Slicing Software for 3D Printing	
10.	MEMS Demonstration Kit / Charts	

Suggested Student Activities:

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course. The students should perform the following activities in groups and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

1. Prepare a working sketch/model of a simple jig or fixture.
2. Visit nearby manufacturing industry/tool room and prepare an industrial visit report.
3. Perform indexing calculation and spur gear cutting on a milling machine.
4. Prepare seminar/presentation on the non-conventional machining processes.
5. Develop case study on EDM/ECM/WJM industrial applications.
6. Conduct group discussions on the advantages of FMS and CIM.
7. Design a simple CAD model and manufacture using 3D printer.
8. Prepare a chart/model showing Industry 4.0 concepts and smart manufacturing systems.
9. Prepare comparative studies of conventional and additive manufacturing methods.
10. Prepare a report/presentation on latest trends in additive manufacturing such as WAAM and metal 3D printing.

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