GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Branch: Robotics and Automation
Subject Code: BE04041031
Subject Name: Manufacturing Processes for Robotics

w. e. f. Academic Year:	2025-26
Semester:	4
Category of the Course:	Professional Core Course

Prerequisite:	Nil
Rationale:	Manufacturing processes related to conventional manufacturing machines are included in this course to understand the basic concepts in machining science. Also The Manufacturing Technology designed to acquire theoretical and practical knowledge in foundry, metal forming and metal joining. The manufacturing program provides relevant industrial experience within the academic environment to apply theoretical and practical concepts to improve manufacturing processes and mechanical or manufacturing components.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Apply various machine tools and metal cutting mechanism for industrial applications.	Apply
2	Illustrating different cutting parameters and calculation of machining time for different metal cutting operations.	Analyse
3	Apply the knowledge of metal casting for different requirements and Design gating and risering system for metal casting	Remembrance, Apply
4	Study of welding and metal joining processes for manufacturing.	Remembrance, understanding

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL*	Total no of hours per semester		ESE (E)	PA / CA (M)	PA/CA (I)	PBL (I)	ESE (V)	
45	0	30	45	120	4	70	30	20	30	50	200

*** Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.**

Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Metal cutting Principles and Machine Tools:** Machine tools classification, working and auxiliary motions in machine tools, Primary cutting motions in machines tools, Elements of Metal cutting, Orthogonal and Oblique cutting, Classification of tools and tool Materials. Systems of Cutting- Tool Nomenclature, Concept of different forces in metal cutting: Merchant circle diagram, Concept of Tool life, Tool Wear, cutting fluid, Machinability and Economics of metal cutting.	04	9
2.	**Metal Cutting Lathes:** The Lathe and its working Principle, Types, Different Parts of Lathe, Lathe Accessories and Attachments, Change of speed and Speed ratios. Feed Mechanism and change gears, Apron and Apron Mechanism. Estimating machining time calculations. Safety Precautions associated in Lathe. **Shapers, Slotters and Planers:** Classification of Shapers, Slotters, and Planer Machine, Different Parts and Tooling requirements. Working Principle and Mechanism, Machining time calculations.	12	27
4.	**Drilling, Reaming and Boring Machines:** Purpose and field of application of drilling machines, Classifications of Drills, Twist drill, Twist drill parts and terminology. Drilling and allied operation, Estimating of machining time, Reaming: Reamer terminology, Types of reamer, reaming operations. Boring Machine: Classification of Boring Machines, Operations performed on Boring machines. Mechanism of working for drilling, reaming and boring machines.	05	11
5.	**Milling Machines:** Working Principles, Types of Milling machines, Different types of milling operations, milling cutters and attachments extending the processing capabilities. Cutting Speed and Feed. Estimating machining time. Mechanism of working of milling machine.	04	9
6.	**Abrasives and Grinding Machines:** Classification of grinding machines, Grinding operations. Types of grinding machine and grinding operations. Mechanism of working of grinding machine.	02	5
7	**Foundry Technology:** Patterns practices: Types of patterns, allowances and material used for patterns, moulding materials, moulding sands, Moulding	06	13

	sands; properties; grain fineness; moisture content, clay content and permeability test, core materials and core making, core print; core boxes, chaplets, gating system design. Moulding practices: Green, dry and loam sand moulding, pit and floor moulding; Casting practices: Fundamental of metal casting, Investment casting,Permanent mould casting, Pressure casting, Die casting, Centrifugal casting, Casting defects, Gating system design, and riser design. Melting furnaces-rotary, Pit electric, Tilting and cupola. Applications of Robotics in metal casting industries.		
8	**Metal Joining Processes:** Principle of welding, soldering, Brazing and adhesive bonding. Classification of welding and allied processes. Gas welding and gas cutting, Principle, Oxyacetylene welding equipment, Flame cutting. Arc welding, Power sources and consumables, Resistance welding, Principle and Equipment, Spot, Projection and seam welding process, TIG, MIG, welding, Electrodes and Electrode Coatings, Welding positions. Automation in welding	06	13
9	**Forming and Shaping Processes:** Metal working, Elastic and plastic deformation, Concept of strain hardening, Hot and cold Working, Rolling: Principle and operations, Roll pass sequence, Extrusion, Wire and tube drawing processes. Forging: Method of forging, Forging hammers and presses, Cold working processes: Shearing, Drawing, Squeezing, Blanking, Piercing, deep drawing, Coining and embossing,	06	13
	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	**20**	**30**	**20**	**5**	**5**

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

References/Suggested Learning Resources:

(a) Books:

a. Fundamentals of Machining and Machine tools, by Geoffery Boothroyd and Winston. Taylore & Francis Publication
b. A Textbook of Production Engineering, by P C Sharma, S Chand Publication.
c. Workshop technology (Manufacturing Processes) by S K Garg, University science press.
d. Processes and Materials of Manufacture; Lindberg Roy A.; Prentice-Hall India.

e. Principles of Manufacturing Materials and Process, J S Campbell
f. Production technology, by R.K. Jain, Khanna publishers
g. Production Technology by P.C. Sharma S Chand & Co Ltd.
h. Manufacturing Technology Vol-II, By P.N. Rao, Tata McGraw Hill.
i. Manufacturing Engg. And Technology By S. Kalpakajain, PHI/Pearson.
j. Welding technology, by O.P.Khanna, DhanpatRai publishers.

(b) Open-source software and website:

1. NPTEL
2. Machining Process videos, Casting, Metal forming videos

List of Experiments:

1. Joining Processes: Students should practice for joining processes, such as Soldering, Brazing and welding (any two models on each).
2. Machining Practice: Students should practice for machining operations (turning, milling, and drilling) on sample work pieces to develop their machining skills.
3. Sheet Metal Fabrication: Students should practice for Sheet metal operations for preparing frustum of cone, cylinder and tray. (Optional)
4. Casting and Molding: Students should practice to prepare different patterns to pour molten metal by using sand casting.

Major Equipment:

1. Lathe Machine
2. Milling Machine
3. Drilling Machine
4. Shaper/Planner/Slotter Machine
5. Grinding Machine
6. Lathe tool Dynamometer
7. Welding- Gas ,Arc, TIG and MIG
8. Press working

List of Open Source Software/learning website:

1. http://nptel.ac.in/courses/

- **List of suggested activities for Problem Based Learning:**

Sr. No	Name of the Activity	No. of Hours	Evaluation Criteria
1	Manufacturing Industry (Machine tools) visit	Visit: 5h, Report preparation: 5h Total: 10h	Based on the report submitted. Report should contain observations and calculations based on Industry/ lab data.
2	Technical Video based	Duration of video: 5h Report	Report /presentation based

	learning related to the subject	preparation: 5h Total: 10h	on the video learning outcomes.
3	Assignment writing Numerical based assignment is preferable.	5 assignments of 4h each. Total:20h	Based on the assignment submitted.
4	Problem solving/Coding using c, c++, Pyhon, SCILAB, MATLAB, MS-EXCEL or any other relevant software	5 small coding based assignments of 2h each. Total: 10h	Based on the coding solution submitted.
5	Self-learning on-line course	Minimum duration of the course should be 10h.	Examination based assessment at the end of course. Based on the certificate produced.
6	Complex problem solving	Maximum 2 problems. Study of the problem and solution finding. Total: 10h/ problem	Based on the depth of the solution submitted.
7	Videos on Industrial safety/Disaster Management aspects based on subject	Duration of video: 5h Report preparation: 5h Total: 10h	Based on quiz report submitted
8	Discussion on research paper based on relevant subject	5 research paper : 20h	Summarize research paper and evaluation critical parameters
9	Poster/chart/PowerPoint preparation on technical topics	Duration:6 h	Based on poster/chart preparation and presentation skills
10	Working/non-working model on technical topics	Working : 12h Non-working: 8 h	Based on inter department/external evaluation
11	Industrial exposure for 2-3 days to observe and provide tentative solutions on society /environment/health/other issue	Duration: 15 h for industrial exposure Problem identification and tentative solution: 10h Total:25 h	Based on evaluation of critical problems and solutions
12	Group Discussion on emerging/trending technical topics based on subject	Duration: t h each	Based on performance in group discussion, technical depth, knowledge etc.
13	Real world case studies-based learning	Duration of data collection/study: 5h Report preparation: 5h Total: 10h	Based on in-depth study, technical depth, data collected, fact finding, etc.
14	Application Software development	Duration: 10 h	Depending on the complexity of the Application/Software

15	Depending on the complexity of the Application/Software	Duration 2 hrs. For attending the lecture/session - 2 hrs. and for report writing 2 h.	Based on the proof of attendance and report submitted
16	Blog or Technical Article Writing	10h (Research - 6h, Writing - 4h)	Based on originality, technical content, references cited, and clarity of communication.
17	Annotated Video Explanation of Concept / Problem	10h (Preparation * Recording + Submission)	Based on accuracy of explanation, clarity, and presentation style.
18	Online Technical Quizzes/Simulations	Multiple quizzes summing up to 10h	Based on quiz scores and reflection report after each quiz.
19	Tech Blog/YouTube Channel Curation	10h (Content curation * Analysis)	Summary report on curated content and learning outcomes.
20	Patent Search and Innovation Gap Identification	10h (Search + Report)	Based on number of relevant patents analyzed and identification of innovation scope.
21	Maintenance or Troubleshooting Logbook	10h (For example: lab instruments, computer hardware)	Based on documented cases, approach, and resolution.

Activity Note

- All activities should be related to the subject.
- The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity. However, the total number of hours is fixed.
- For a course, min 3 activities must be carried out as per the availability of faculties and students. There is no limit to the maximum number of activities.
- Rubrics for the evaluation can be prepared by the respective faculty members.
- Subject teachers can add the relevant activities from the above list other than those mentioned in the syllabus, with the consent of the head of the department and DQAC.
- Subject coordinator shall identify activities from the above list as per the subject needs, they will also declare a list of activities wise hours, evaluation scheme and rubrics to students at the beginning of the semester.

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