APPENDIX - I

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SCHEME OF TEACHING

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FOURTH SEMESTER

LIST OF ELECTIVES

Students will opt for 4 elective courses out of which 2 to 3 elective courses will be in online mode

CONTACT MODE

MMT-601: MANUFACTURING TECHNOLOGY I

	L	P
Maximum marks: 50		
Time Allowed: 3 hours	**4**	**--**

Rationale: The Manufacturing Technologist must be endowed with the knowledge of different metal forming and joining processes and should have a thorough knowledge of the tooling and equipment required to carry those processes.

DETAILED CONTENTS

PART A

1. Rolling of Metals **(6 hrs)**

- 1.1 Rolling process and equipment
- 1.2 Shape-Rolling Operations
- 1.3 Production of Seamless Tubing and Pipe
- 1.4 Continuous Casting and Rolling
- 1.5 Calculation of blank size and no of passes
- 1.6 Forces in rolling

2. Forging of Metals **(6 hrs)**

- 2.1 Forging process and equipment
- 2.2 Metal flow in forging
- 2.3 Forging die design principles
- 2.4 Forging defects
- 2.5 Economics of forging

3. Extrusion and Drawing of Metals **(10 hrs)**

- 3.1 Extrusion Process
- 3.2 Hot and cold Extrusion
- 3.3 Impact Extrusion
- 3.4 Hydrostatic Extrusion
- 3.5 Extrusion Defects
- 3.6 Drawing Process
- 3.7 Multistage drawing
- 3.8 Deep Drawing
- 3.9 Stretch forming
- 3.10 Forces in drawing process
- 3.11 Economics of drawing process

PART B

4. Processing of Powder Metals and Ceramics **(10 hrs)**

- 4.1 Production of Metal Powders
- 4.2 Compaction of Metal Powders
- 4.3 Sintering

4.4

4.4

MMT-603: ADVANCED MANUFACTURING METHODS

	L	P
Maximum marks: 50		
Time Allowed: 3 hours	**4**	**--**

Rationale: The knowledge of this subject is required for precision machining of hard and tough materials. With the advent of new materials Manufacturing Technologist is facing many challenges to cut materials. This subject will equip him to solve such challenging situations.

DETAILED CONTENTS

PART A

1. Introduction to New Technology **(6 hrs)**

- 1.1 Need for New Technology
- 1.2 Classification of New Technology
- 1.3 Historical Background of New Technological Processes
- 1.4 Definitions and Applications of Various Processes
- 1.5 Comparative Analysis of Various New Technological Processes.

2. Mechanical Processes **(8 hrs)**

- 2.1 Abrasive Jet Machining
  - 2.1.1 Fundamental Principles
  - 2.1.2 Application Possibilities
  - 2.1.3 Process Parameters.
  - 2.1.4 Schematic Layout of Machine Tool
- 2.2 Ultrasonic Machining
  - 2.2.1 Range and Application Possibilities of Ultra-sonic Machining
  - 2.2.2 Fundamental Principles
  - 2.2.3 Process Parameters
  - 2.2.4 Slurry and Selection of Abrasive
  - 2.2.5 Tool Design
  - 2.2.6 Tool Feeding Mechanism
  - 2.2.7 Transducers
  - 2.2.8 Analysis for Metal Removal Rate
  - 2.2.9 Design of Horn (Velocity Transformer)
  - 2.2.10 Analysis of Process Parameters

3. Chemical Machining **(4 hrs)**

- 3.1 Fundamental principles
- 3.2 Process Parameters
- 3.3 Classification and Selection of Material
- 3.4 Selection of etchants

4. Electro-Chemical Processes **(10 hrs)**

- 4.1 Electro-Chemical Machining
  - 4.1.1 ECM Process
  - 4.1.2 Fundamental Principles of ECM
  - 4.1.3 Classification of ECM Processes

MMT-604: INDUSTRIAL AUTOMATION AND CONTROL

	L	P
Maximum marks: 50		
Time Allowed: 3 hours	**4**	**--**

Rationale: Industrial automation is widely employed now-a-days, using pneumatic, hydraulic, electrical, electronics and computer systems. The modern engineering is incomplete without the knowledge of automation and control systems.

DETAILED CONTENTS

PART A

1. Introduction **(4 hrs)**

1.1. Concept and Scope of A

A

6.4. Microcontrollers

7. Industrial Robotics **(6 hrs)**

7.1. Classification and Basic Motions
7.2. Components Joints, Links, Sensors, Actuators
7.3. Forward and Inverse Position Analyses
7.4. Robot Languages & Programming
7.5. Robot Applications

BOOKS:

1. David G. Alciatore, Michael B. Histand

MMT-605: MANUFACTURING TECHNOLOGY II

Maximum marks: 50	**L**	**P**
Time Allowed: 3 hours	**4**	**--**

Rationale: The Manufacturing Technologist must be endowed with the knowledge of different metal cutting processes and should have a thorough knowledge of tooling required to carry those processes. He should be able to analyze these processes for efficient production work.

DETAILED CONTENTS

PART A

1 Introduction

MMT-606: DESIGN FOR CONSUMER

Maximum marks: 50	**L**	**P**
Time Allowed: 3 hours	**4**	**--**

Rationale: For manufacturing any component / product the Manufacturing Technologist needs the knowledge of design, its approach, and detailed procedure according the needs of the consumer. By going through this subject he will be able to design any component very efficiently and economically.

DETAILED CONTENTS

PART A

1. Ergonomics

7.2 Effect on Environment
7.3 Life
7.4 Reliability
7.5 Safety
7.6 Protection From Foreign Bodies
7.7 Standardization
7.8 Assembly
7.9 Maintenance
7.10 Costs
7.11 Quantity
7.12 Legal Matters
7.13 Patents
7.14 Appearance
7.15 Materials and Manufacturing Processes
7.16 Energy considerations

8. Decision Making in Design (4 hrs)

8.1 Decision Matrix
8.2 Decision Trees
8.3 Optimization methods Search techniques, Linear Programming and Geometric Programming

9. Effect of Material Properties on Design (8 hrs)

9.1 Stress concentration
9.2 Designing for static strength, simple axial loading, torsional loading, bending and combined load
9.3 Designing with high strength low toughness materials
9.4 Designing against fatigue

10. Effect of Manufacturing Processes on Design (4 hrs)

10.1

PART B

4. Work Holding Devices (6 hrs)

4.1 Basic requirements of work holding devices

4.2 Location : Principles, methods and devices

4.3 Clamping : Principles, methods and devices

5. Drill Jigs (6 hrs)

5.1 Definition and types of Drill Jigs

5.2 Chip Formation in Drilling

5.3 General Considerations in the Design of Drill Jigs

5.4 Drill Bushings

5.5 Drill Jigs, and Modern Manufacturing

6. Design of Fixtures (8 hrs)

6.1 Fixtures and Economics

6.2 Types of Fixtures

6.3 Milling Fixtures

6.4 Boring Fixtures

6.5 Broaching Fixtures

6.6 Lathe Fixtures

6.7 Grinding

7. Tool Design for Numerically Controlled Machine Tools (4 hrs)

7.1 Fixture Design for Numerically Controlled Machine Tools

7.2 Cutting Tools for Numerical Control

7.3 Tool-holding Methods for Numerical Control

BOOKS:

1. Cyril Donaldson, George H. Lecain, V. Goold -McGraw Hill, 4th Edition, 2012
2. N K Mehta, Metal Cutting and Design of Cutting Tools, Jigs & Fixtures t Edition, 2014
3. -McGraw Hill, 3rd Edition, 2010.
4. Fundamentals

MMT-608: DIGITAL MANUFACTURING

Maximum marks: 50	**L**	**P**
Time Allowed: 3 hours	**4**	**--**

Rationale: This subject will enable the students to understand the transformation taking place, throughout the world, in design and manufacturing of products through digital manufacturing a shift from paper-based processes to digital processes in the manufacturing industry.

DETAILED CONTENTS

PART A

1. Introduction **(6 hrs)**

1.1. Types of manufacturing systems and their characteristics

1.2. Computer aided Manufacturing (NC, CNC, DNC and adaptive control systems)

1.3. Computer Network architectures and protocols

1.4. Industry 4.0 Concept and elements

2. CNC Machines **(8 hrs)**

2.1. Constructional details

2.2. Design features

2.3. Safety devices

2.4. Manual part programming

2.5. Computer aided part programming using APT

3. Computer Aided Process Planning **(6 hrs)**

3.1. Planning function

3.2. Retrieval and generative process planning systems

3.3. Benefits of CAPP aureatPrput Tm[3.5.)]TJETBT/F5 12 Tf1 0 0 1 93.125 439.271 0 0 1 4JETBT/F

3.4. Machinability Data Systems

3.5. Computer

6.2. Rapid Prototyping Principles and Classification:

6.3. Steps in Additive Manufacturing

6.4. Benefits and Applications

7. Cloud Based Design & Manufacturing (8 hrs)

7.1. Internet of Things

7.2. Data Storage and Analytics

7.3. Cloud computing

7.4. Networked manufacturing

BOOKS:

1. Groover M. P. and Zimmers E. W. omputer Aided Design and Manufacturing Pearson Education, New Delhi, 2003

2. omputer Aided Manufacturing Pearson Education, New Delhi, 2015

3. P. Radhakrishnan, S. Subramanyan, V. Raju New Age International, 2008

4. C.K. Chua, K.F. Leong, C.S. Lim Rapid Prototyping: Principles And Applications 3rd Edition, World Scientific Publishing Co Pte Ltd, 2008

5. Apress, 2016

REFERENCE BOOKS

6. Alp Ustundag, Emre Cevikcan
Springer Series in Advanced Manufacturing, 2017

7. Zude Zhou, Shane Shengquan Xie,

MMT-701: MANUFACTURING LAB I

L	P
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Note: The internal evaluation of the work done by the student will be based on a file documenting the practical work carried out during the course followed by a viva-voce examination.

PRACTICE TASKS

1. Study of rolling and forging processes.
2. Effect of draw force on wire diameter.
3. Study of any one RPT process in an industry.
4. Metal Removal Rate and Tool wear studies in Spark Erosion Machining.
5. Study of process parameters in Electro-Chemical Machining.
6. Functioning of hydraulic/pneumatic actuators and valves.
7. Automation exercises on Ladder logic programming of PLCs.
8. Control of an articulated robot using teach-pendent and programming.

MMT-702: MANUFACTURING LAB II

L	P
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MMT-652: COMPUTER AIDED DESIGN FOR MANUFACTURING

	L	P
Maximum marks: 50		
Time Allowed: 3 hours	**4**	**--**

Rationale: The role of computers in product design is becoming increasingly important due to competitive pressures. Therefore, the knowledge of fundamentals and various hardware/software

6 Pressure Measurements (4 hrs)

6.1 Moderate and High Pressure Measurement

6.2 Low Pressure (Vacuum) Measurement

7 Temperature Measurements (4 hrs)

7.1 Electrical and Non-electrical Methods

7.2 Radiation Methods (Pyrometery)

8 Flow Measurements (4 hrs)

8.1 Primary or Quantity Meters

8.2 Secondary or Rate Meters

9 Condition Monitoring (6 hrs)

9.1 Vibration and Noise Monitoring

9.2 Temperature Monitoring

9.3 Wear Behaviour Monitoring

9.4 Corrosion Monitoring

9.5 Performance Trend Monitoring

9.6 Selection of Condition Monitoring Techniques

BOOKS:

1.

2.

3. th

Reprint, 2009.

4. nd Edition, 2007.

5. C. S. Rangan

2001.

MMT-654: WELDING TECHNOLOGY

Maximum marks: 50	**L**	**P**
Time Allowed: 3 hours	**4**	**--**

Rationale: Welding is a versatile fabrication process widely used in manufacturing industry. The knowledge of various types of welding techniques and their applications helps a manufacturing technologist select suitable type of welding technique for a given application.

DETAILED CONTENTS

PART A

1. Introduction (4 hrs)

1.1 Classification of Welding Processes

1.2 General survey

2. Fusion Welding Processes (12 hrs)

2.1 Oxfuel Gas Welding

2.2 Arc Welding Processes : Consumable Electrode

2.3 Electrodes: Classification, Specification and selection of process parameters.

2.4 Arc Welding Processes : Non consumable Electrode

2.5 Thermit Welding

2.6 Electron Beam Welding

2.7 Laser-Beam Welding

2.8 Cutting

2.9 Welding Safety

3. Solid State Welding Processes (12 hrs)

3.1 Cold welding

3.2 Ultrasonic welding

3.3 Friction welding

3.4 Resistance welding

3.5 Explosion welding

3.6 Diffusion bonding (Welding)

3.7 Diffusion bonding/superplastic forming

PART

MMT-655: OPTIMIZATION TECHNIQUES

Maximum marks: 50	**L**	**P**
Time Allowed: 3 hours	**4**	**--**

Rationale: Manufacturing Technologist needs to optimize the various manufacturing processes for the best utilization of men, materials and machines in any manufacturing activity.

DETAILED CONTENTS

PART A

1. Numerical Techniques **(8 hrs)**

1.1

5.4 Direct Search for Constrained Minimization : Variable elimination, Complex search and Random search methods.

5.5 Linearized Search Techniques: Frank-Wolfe method, Cutting plane method, Feasible Direction Method, Generalized Reduced Gradient Method, Gradient Projection Method.

BOOKS:

1. Sastry S.S,
2.
Edition, 2009
3.

MMT-656 : INDUSTRIAL PROJECT MANAGEMENT

Maximum marks: 50	**L**	**P**
Time Allowed: 3 hours	**4**	**--**

Rationale: Project management is the application of knowledge, skills, tools and techniques to bring about the successful completion of specific engineering project goals and objectives. This course provides project management fundamentals and techniques with focus on Mechanical Engineering Industry.

DETAILED CONTENTS

PART A

1. Introduction to Industrial Projects **(6 hrs)**

- 1.1 Introduction
- 1.2 Projects and Different types of Projects
- 1.3 Requirement Specification
- 1.4 Steps in project planning
- 1.5 Management Control

2. Project Evaluation **(6 hrs)**

- 2.1 Evaluation / Assessment of projects
- 2.2 Strategic Program Management
- 2.3 Cost-benefit Analysis
- 2.4 Cash flow forecasting

3. Project Approach **(4 hrs)**

- 3.1 Selection of an appropriate project technology
- 3.2 Project Structuring

4. Activity Planning **(6 hrs)**

- 4.1 Objective of Planning
- 4.2 Project Schedule
- 4.3 Activities Sequencing and Scheduling
- 4.4 Time Estimation
- 4.5 Critical Path and Activities

5. Risk Management **(4 hrs)**

- 5.1 Bottlenecks
- 5.2 Identification

PART B

6. Resource Management **(6 hrs)**

- 6.1 Resources
- 6.2 Nature of Resources
- 6.3 Resource Requirement

6.4 Allocation, Monitoring and Control

7. Project Time Management **(6 hrs)**

7.1 Time Representation: Gantt Chart and Network Diagram

7.2 Network Techniques: CPM, MPM, PERT, GERT, VERT

7.3 CPM: Activity Scheduling and Float Analysis

8. Managing People and Organizing Teams **(6 hrs)**

8.1 Associating human resource with job

8.2 Decision Making

8.3 Health and Safety

9. Introduction to P.M Softwares **(4 hrs)**

9.1 M.S Projects

9.2 GANTT Project

9.3 Some Case Studies

BOOKS:

1.

2. Publications, 2006

3. Stefano Tonc

MMT-657: RESEARCH METHODOLOGY

Maximum marks: 50 **L**

MMT-658: TECHNOLOGY MANAGEMENT

Maximum marks: 50	**L**	**P**
Time Allowed: 3 hours	**4**	**--**

Rationale: Manufacturing Technologist needs to learn technology management principles for the integrated planning, design, optimization, operation and control of technological products, processes and services.

DETAILED CONTENTS

PART A

1. Introduction to Technology Management **(4 hrs)**

1.1 Technology management fundamentals

2. Bussiness strategy for new technologies **(6 hrs)**

3. Technology forecasting

4. Spyros Maksidakis & Steven C. A 1982.
5. C. 2002.
6. David Hutchins st Edition, 1995.

MMT-659: METAL CASTING

Maximum marks: 50	**L**	**P**
Time Allowed: 3 hours	**4**	**--**

Rationale:
Metal castings are integral to virtually all manufacturing activities. Castings are used to produce a majority of all manufactured goods and nearly all manufacturing machinery. Therefore, manufacturing technologist needs to learn the process, tools and applications of metal casting.

DETAILED CONTENTS

PART A

1. **Mould Silica and Clay** **(10 hrs)**
   - 1.1. Structure of silica and different types of clays
   - 1.2. Bonding mechanism of silica water-clay systems
   - 1.3. Swelling of clays
   - 1.4. Sintering adhesion and colloidal clay
   - 1.5. Silica grain shape and size distribution
   - 1.6. A.F.S. permeability number
   - 1.7. Characteristics, Ingredients and Additives of Mould & Core Sands
2. **Solidification of Metals** **(10 hrs)**
   - 2.1. Nucleation, free energy concept, critical radius of nucleus
   - 2.2. Nucleation and growth in metals and alloys
   - 2.3. Constitutional super cooling.
   - 2.4. Columnar equi-acquiesced and dendritic structures
   - 2.5. Freezing of alloys centreline feeding resistance
   - 2.6. Rate of solidification, time of solidification, mould constant
   - 2.7. Fluidity of metals
   - 2.8. Volumes redistribution in casting
   - 2.9. Analysis of the process

PART B

3. **Design Considerations in Casting** **(10 hrs)**
   - 3.1. Riser design shape, size and placement
   - 3.2. Effect of appendages on risers
   - 3.3. Effective feeding distances for simple and complex shapes
   - 3.4. Use of chills
   - 3.5. Gating design
   - 3.6. Aspiration of gases
   - 3.7. Top, bottom and inside gating
   - 3.8. Directional solidifications stresses in castings
   - 3.9. Metal mould reactions
   - 3.10. Expansion scale and metal penetration

4. Moulding And Casting Processes **(8 hrs)**

4.1. Hot box, cold box process

4.2. Investment casting, shell moulding, full mould process

4.3. Die casting

4.4. Ceramic shell mould

4.5. Vacuum moulding

4.6. Die Casting of non-ferrous metals and alloys

5. **Defects in Castings** **(2 hrs)**

5.1. Residual stresses

5.2. Hot tears and cracks in castings

5.3. Stress relief

5.4. Defect remedies

BOOKS:

1. Richard A. Fli Fundament Addison Wesley.
2. McGraw Hill India.
3. Benjamin W. Niebel & Alan B. Draper Product Design & McGraw Hill Education
4. , Pitman Publishing
5. ASM Metals Handbook: Casting