**APPENDIX - I** 

# SYLLABI and SCHEME OF TEACHING

## **MASTER OF ENGINEERING**

IN

## MECHANICAL ENGINEERING (MANUFACTURING TECHNOLOGY)

## **MODULAR & REGULAR PROGRAMME**

(2023 2025)



MECHANICAL ENGINEERING DEPARTMENT

NATIONAL INSTITUTE OF TECHNICAL TEACHERS TRAINING & RESEARCH

## CHANDIGARH

May 2023

## **Instructions to Paper Setter**

1. The examiner shall set <u>eight</u> questions, taking <u>four</u> questions each from <u>Part-A</u> and **Part-B** of the syllabus. The candidate is required to attempt **five** 

#### **STUDY & EVALUATION SCHEME**

#### M.E. MECHANICAL ENGINEERING (MANUFACTURING TECHNOLOGY) 6 <u>REGULAR</u> <u>PROGRAMME</u>

#### FIRST SEMESTER

CODE SUBJECT

## FOURTH SEMESTER

CODE	C1	DECT	SCHEDULE FOR TEACHING		CDEDITS	MARKS			
CODE	SUBJECT		L	Р	TOTAL	CREDITS	Internal Assessment	University Examination	TOTAL
MMT 752	Thesis		-	30	30	15	100*	100	200**
	* Internal assessment		is based	l on the	following	g criterion:			
	Grade			C	Condition				
	A+	Publication fr	om Thes	sis in SC	I indexed j	journal			
	А	Publication fr	om Thes	sis in Sco	opus index	ed journal			
	B+	Publication fr	om Thes	sis in UC	GC journal	OR Scopus	indexed confe	erence procee	dings
	В	from Thesis in International Conference							
	C+	om Thes	sis in Na	tional Con	ference				

## LIST OF ELECTIVES

#### **MMT-602: COMPUTER BASED PRODUCTION MANAGEMENT**

### Maximum marks: 50 Time Allowed: 3 hours

**Rationale**: Due to automation, there is a need to computerize the entire gamut of production activities both direct and indirect on the shop floor. The latest production management techniques of this subject will definitely help the manufacturing technologist to understand all the aspects of production planning and control.

#### **DETAILED CONTENTS**

#### PART A

#### 1. Production Planning and Control

- 1.1 Traditional PPC and its problems
- 1.2 Symptoms of poor PPC system
- 1.3

(4 hrs)

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6.	Just	In Time	(4 hrs)
	8.1	Introduction and its comparison with MRP	
	8.2	Pull and push system	
	8.3	Kanban-Types, benefits and calculation	
7.	Shop	Floor Control and Computer Process Monitoring	(6 hrs)
	7.1.	Functions of SFC	
	7.2.	SFC system	
	7.3.	Operation scheduling and techniques of operation scheduling	
	7.4.	Factory Data Collection system	
	7.5.	Computer Process Monitoring	
8.	Supp	oly Chain Management	(4 hrs)
	8.1.	Introduction and model of SCM	
	8.2.	Benefits and Performance measures in SCM.	
9.	Ente	rprise Resource Planning	(4 hrs)
	9.1.	Main features	
	9.2.	Generic Model	
	9.3.	Selection of ERP system	

9.4. Problems in ERP implementation

#### **BOOKS:**

- 1. Mukhopadhyay, S. K.. õRtqf wevkqp Rıcppkpi cpf Eqpvtqıö. Rtgpvkeg J cm qh Kpf kc. Vj ktf Edition, 2015
- 2. Adams, Everett E. (Jr.), Ebert, Ronald J., õProduction and Operations Management: Concepts, Models and Behaviorö. Rtgpvkeg J cmqh Kpf kc. Hknj Gf kkqp. 3; ; 8
- 3. P ctuko j cp. UNO O eNgcxg{. F OY 0 & Dkmki vqp0 ROD õRtqf wevkqp Rncppkpi cpf Kpxgpvqt{ Eqpvtqnö. Rtgpvkeg J cmqh Kpf kc. P gy F gnj k 4<sup>nd</sup> Edition, 1995.
- 4. Ukpij. P cpwc. õU{uvgo u Crrtqcej vq Eqorwıgt Kpvgitcvgf F gukip cpf O cpwhcewtkpiö. Iqjp Wiley & Sons, New York, 1996.
- 5. I tqqxgt O 0 R0 õC wqo cvkqp. Rtqf wevkqp U{uvgo u cpf Eomputer Aided Manufacturingö. Prentice Hall of India, New Delhi, 2000.
- 6. TcxkMwo ct. õKpf wuvtkenGpi kpggtkpi cpf O cpci go gpvö. I cni qvkc Rwdnkecvkqp. P gy F gnj k 3<sup>st</sup> Edition, 2000.

### 6.4. Microcontrollers

#### 7. Industrial Robotics

(6 hrs)

- 7.1. Classification and Basic Motions
- 7.2. Components ó Joints, Links, Sensors, 0 0 1 165.98 7064 841/tuatorq0.000008873 0 595.44 841.92 reW

#### **MMT-606: DESIGN FOR CONSUMER**

Maximum marks: 50	L	Р
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.	Ergo	Ergonomics		
	1.1	Need for Ergonomics		
	1.2	Areas of Study in Ergonomics		
	1.3	Criteria in Assessing Ergonomic Problems and Solutions		
	1.4	Human Characteristics Relevant to Ergonomics		
2.	Арри	roaches and Models in Ergonomics	(4 hrs)	
	2.1	How and Where Ergonomics is used?		
	2.2	Models and Approaches in Ergonomics		
	2.3	Systems Approach		
	2.4	Various aspects of the System Design Process		
	2.5	Workstation Analysis		
3.	The 2	Design of Displays, Controls and Panels	(4 hrs)	
	3.1	Design Criteria		
	3.2	Types		
4.	Prod	uct Development	(4 hrs)	
	4.1			

- 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 **Decision Making in Design** (4 hrs) 8.1 **Decision Matrix** 8.2 **Decision Trees** 8.3 Optimization methods ó Search techniques, Linear Programming and Geometric Programming **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

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		PART B	
4.	Wor	k 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.	Desig	gn 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	
BOO	KS:		

- 1. Cyril Donaldson, George H. Lecain, V. Goold. õVqqn F guki pö. Vcvc-McGraw Hill, 4<sup>th</sup> Edition, 2012
- 2. N K Mehta, õMetal Cutting and Design of Cutting Tools, Jigs & Fixturesö. HktuvGf kkqp. 4236
- 3. Iquj kR0J 0 õIki u cpf Hz wtguö. Vcvc-McGraw Hill, 3<sup>rd</sup> Edition, 2010.
- 4. Htcpm Y 0 Y knqp. õFundamentals of Tool Designö. CUVO G Manufacturing Engineering Series, Literary Licensing, LLC, 2012.

#### **MMT-608: DIGITAL MANUFACTURING**

# Maximum marks: 50LPTime Allowed: 3 hours4--

**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 ó 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 6 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	
	3.4. Machinability Data Systems	
	3.5. Computer ó Generated Time Standards	
4.	Group Technology and Cellular Manufacturing	(8 hrs)
	4.1. Parts classification and part coding ó approaches and systems	
	4.2. Benefits of group technology	
	4.3. Cellular manufacturing-basics, layout considerations	
	4.4. Cell formation approaches and evaluation of cell designs	
	4.5. Planning and control in cellular manufacturing	

#### PART B

## 5. Flexible Manufacturing Systems

- 5.1. FMS and its Components
- 5.2. Layout considerations in FMS
- 5.3. Material Handling in FMS
- 6. Rever

(6 hrs)

6.2. Rapid Prototyping ó Principles and Classification:

(8 hrs)

- 6.3. Steps in Additive Manufacturing
- 6.4. Benefits and Applications

### 7. Cloud Based Design & Manufacturing

- 7.1. Internet of Things
- 7.2. Data Storage and Analytics
- 7.3. Cloud computing
- 7.4. Networked manufacturing

#### MMT-702: MANUFACTURING LAB II

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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 chip formation during turning, milling and drilling processes.
- 2. Study of different types of dynamometers and their usage.
- 3. Measurement of surface roughness of machined surfaces.
- 4. Gauge design for an industrial component.
- 5. Design of a drill jig.
- 6. Operation and programming of CNC machine.
- 7. Study and programming of an FMS.
- 8. 3D printing of a component from its CAD model.

### **MMT-651: COMPUTER PROGRAMMING AND APPLICATIONS**

#### 5. Applications of MATLAB/Simulink

- 5.1 Matrix creation and manipulation
- 5.2 Plotting and curve fitting
- 5.3 Solving Tool-Life equation
- 5.4 Search techniques and linear programming
- 5.5 Modeling and simulating machine scheduling problems
- 5.6 Modeling and simulation of first order and second order dynamic systems

#### **BOOKS:**

- 1. Twf tc Rtcvcr. õGetting Started with MATLABö. Qzhqtf Wpkxgtukv{ Rtguu. 422;
- 2. F wcpg J cpugno cp cpf Dtweg Nkwrghkgrf. õO cuvgtkpi O CVNCDö. Rgctuqp Gf wecvkqp. 422;
- 3. U0L0Ej cr o cp. õRtqi tco o kpi kp MATLAB hqt Gpi kpggtuö. DtqqmulEqrg Vj qo uqp Ngctpkpi . 2004.
- 4. Ci co Mwo ct V{ci k õMATLAB cpf Uko wrkpmhqt Gpi kpggtuö. Qzhqtf Wpkxgtukw{ Rtguu. 4234

- 2. I tqqxgt O 0 R0 õCwqo cvkqp. Rtqf wevkqp U{uvgo u cpf Eomputer Aided Manufacturingö. Pearson Education, New Delhi, 2015
- 3. Ibrahim Zeid, R Sivasubramanian. õECF IECO ó Vj gqt { cpf Rtcevkegö. Vcvc-McGraw Hill Ltd., New Delhi, 2009
- 4. Moaveni. õHkpkg Grgo gpv Cpcn{uku Vj gqt { Cpf Crrnlecvkqp wkj CPU[Uö. Rgctuqp Education, 2011

#### **MMT-653: INDUSTRIAL INSTRUMENTATION**

Maximum marks: 50	L	Р
Time Allowed: 3 hours	4	

**Rationale**: The Manufacturing Technologist must be endowed with the knowledge of instrumentation in order to monitor and control the manufacturing process. This subject will help him in the selection and use of measuring instruments.

#### **DETAILED CONTENTS**

#### PART A

#### **1** Fundamental Concepts

- 1.1 Applications of the Instrument Systems
- 1.2 Functional Elements of a Measurement System
- 1.3 Classification of Instruments
- 1.4 Standards and Calibration

#### 2 Static and Dynamic Characteristics of Instruments

5.

(4 hrs)

6	Pressu	ure Measurements	(4 hrs)
	6.1	Moderate and High Pressure Measurement	
	6.2	Low Pressure (Vacuum) Measurement	
7	Temp	erature 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	Condi	ition 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	
BOO	KS:		
1.	J qm a	cp0L0R0 õGzrgtko gpvcnOgy qf u hqt Gpi kpggtu õ. Vcvc O eI tcy J km 4208.	
2.	Fqgdg	gdqp G0Q0 õO gcuwtgo gpvU{uvgo uö. Vcvc O eI tcy J km 42330	

- 3. Pente epf Ejewfjt{. õKpuvtwo gpvevkqp. O geuwtgo gpvepf Cpen{ukuö. Veve O eI tey J km 9<sup>th</sup> Reprint, 2009.
- 4. I gqti g I 0Dctgn{. õKpvgnki gpv Kpuvtvo gpvc kqpö. Rtgp keg J cmqh Kpf kc. 4<sup>nd</sup> Edition, 2007.
- 5. E0U0Tcpi cp cpf X0U0X0O cpk õKpuvtwo gpvcvkqp f gxkegu cpf u{uvgo uö. Vcvc O eI tcy J km 2001.

#### **MMT-654: WELDING TECHNOLOGY**

#### Maximum marks: 50 **Time Allowed: 3 hours**

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

- 1.1 **Classification of Welding Processes**
- 1.2 General survey

#### 2. **Fusion Welding Processes**

- 2.1 **Oxfuel Gas Welding**
- Arc óWelding Proc8552.8749265867abht0HE4t02abh4E527145E14000008976.00995086960U595.00080 2.2

(4 hrs)

(12 hrs)

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- 5.2 Soldering
- 5.3 Adhesive bonding
- 5.4 Mechanical fastening
- 5.5 Joining plastics

#### 6. Welding Practices

- 6.1 Plasma arc welding
- 6.2 Submerged arc welding
- 6.3 Welding of materials like aluminium, copper, steel
- 6.4 BIS code on welding
- 6.5 Inspection of welds and welded joints
- 6.6 Welded defects & their causes

#### **BOOKS:**

- 1. Men enllep. Ugtqr g epf Uej o kf. Uvgxgp. T. õO epwheewtkpi Gpi kpggtkpi & Vgej pqnqi {ö. Prentice Hall, Fifth edition, 2002.
- 2. Tkej ctf Nkwrg. õY grf kpi cpf Y grf kpi Vgej pqrqi {ö. Vcvc O eI tcy J km P gy F grj k 42270
- 3. J O V. õRtqf wevkqp Vgej pqnqi {ö. Vcvc O eI tcy J km P gy F gnj k 42260
- 4. R. L. Agarwal. õY grf kpi Gpi kpggt kpi ö, Khanna Publishers, Delhi, 2011.
- 5. O. P.

#### (8 hrs)

## **MMT-655: OPTIMIZATION TECHNIQUES**

	6.4	Allocation, Monitoring and Control	
7.	Proje	ect 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.	Man	aging People and Organizing Teams	(6 hrs)
	8.1	Associating human resource with job	
	8.2	Decision Making	
	8.3	Health and Safety	
9.	Intro	duction to P.M Softwares	(4 hrs)
	9.1	M.S Projects	
	9.2	GANTT Project	
	9.3	Some Case Studies	
BOOI	XS:		

- 1. Rtcucppc Ej cpftc. õRtqlgevu Rcppkpi. Cpcn{uku. Ugrgevkqp. Hkpcpekpi. Korngo gpvcvkqp cpf Tgxkgy ö. Vcvc O eI tcw Hill, 2000
- 2. Ightg{ MORkpvq. õRtqlgevOcpci go gpvö. Rgctuqp Publications, 2006
- 3. Uvghcpq Vqpej kc. õKpf wurt kcnRtqlgevOcpci go gpvö. Ur tkpi gt. 422:

### **MMT-657: RESEARCH METHODOLOGY**

Maximum marks: 50	L	Р
Time Allowed: 3 hours	4	

## Rationale

#### **MMT-658: TECHNOLOGY MANAGEMENT**

# Maximum marks: 50LPTime Allowed: 3 hours4--

**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**

		<u>PART A</u>	
1.	Intro	eduction to Technology Management	(4 hrs)
	1.1	Technology management fundamentals	
2.	Buss	iness strategy for new technologies	(6 hrs)
3.	Tech	nology forecasting	(6 hrs)
	3.1	Techniques of Forecasting	
	3.2	Technology Forecasting-Relevance	
	3.3	Strategic alliance and Practicality and Technology transfer.	
4.	Man	agement of research, development and innovation	(6 hrs)
	4.1	Technology mapping	
	4.2	Comparison of types of R&D project and development approaches ó rad platform and Incremental projects,	ical
	4.3	Innovation process.	
		<u>PART B</u>	
5.	Man	agement of intellectual property rights	(6 hrs)
	5.1	Strategic value of patents	
	5.2	Trade secrets and licensing	
6.	Man	aging scientists and technologists	(6 hrs)
	6.1	Identification	
	6.2	Recruitment	
	6.3	Retention	
	6.4	Team work and Result orientation	
7.	Man	agement roles and skills for new technology	(4 hrs)
8.	Tech	nology for managerial productivity and effectiveness	(6 hrs)
	8.1	Just	

- 4. Spyros Maksidakis & Steven C. Y j ggny tki j v. õVj g J cpf book of Forecasting ó A O cpci gtøu I wkf gö. Iqj p Y kg{ & Uqpu. 1982.
- 5. C. Octng Etcy hqtf. õP gy Rtqf wevu Ocpci go gpvö. O eI tcy J kmGf wecvkqp. 2002.
- 6. David Hutchins. õLxuvkp Vko gö. Lekeq Rwdrkuj kpi J qwug. 3<sup>st</sup> Edition, 1995.

#### **MMT-659: METAL CASTING**

#### Maximum marks: 50

#### Time Allowed: 3 hours

#### **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

- 1.1. Structure of silica and different types of clays
- 1.2. Bonding mechanism of silica ó 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

- 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

- 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

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(10 hrs)

(10 hrs)

#### 4. Moulding And Casting Processes

- 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

- 5.1. Residual stresses
- 5.2. Hot tears and cracks in castings
- 5.3. Stress relief
- 5.4. Defect remedies

#### **BOOKS:**

- 1. Richard A. Flipp. õFundamentenı qhO gvenı Ecuvkpi ö. Addison Wesley.
- 2. Richard W. Heine, Carl R. Loper & Rj krkr E0 Tqugpyj cn õRtkpekr ngu qh O gvcn Ecuvkpi ö. McGraw Hill India.
- 3. Benjamin W. Niebel & Alan B. Draper õProduct F guki p & Rtqeguu Gpi kpggtkpi ö. McGraw Hill Education
- 4. Y 0J 0Ucm qp & Gtke P qto cp Uko qpu. õHqwpf t { Rtcevkegö, Pitman Publishing
- 5. ASM Metals Handbook: Casting

(2 hrs)