

Contents

UNIT I: INTRODUCTION TO PROCESS PLANNING 1.1 – 1.75

1.1. Introduction.....	1.1
1.1.1. What is meant by Process Planning?	1.1
1.1.2. Process Planning Defined	1.1
1.1.3. Importance of Process Planning.....	1.2
1.2. Process Planning: The Design/Manufacture Interface (Technological View of Process Planning).....	1.2
1.2.1. Product Design and Manufacture Cycle	1.2
1.2.2. Process Planning: Link Between Design and Manufacturing.....	1.5
1.2.3. Responsibilities of Process Planning Engineer.....	1.6
1.3. Process Planning Activities	1.7
1.3.1. Drawing Interpretation.....	1.9
1.3.2. Material Evaluation and Process Selection.....	1.9
1.3.3. Selection of Machines, Tooling and Workholding Devices	1.10
1.3.4. Selecting Process Parameters.....	1.11
1.3.5. Selecting Quality Assurance Methods	1.12
1.3.6. Cost Estimating.....	1.12
1.3.7. Process Planning Documentation	1.13
1.3.8. Communicate Process Knowledge	1.15
1.3.9. Inputs and Outputs of Process Planning	1.15
1.4. Process Planning Methods (Approaches to Process Planning).....	1.16
1.5. Manual Process Planning.....	1.17
1.5.1. Traditional Approach.....	1.17
1.5.2. Workbook Approach.....	1.18

1.5.3.	Advantages of Manual Process Planning.....	1.18
1.5.4.	Disadvantages of Manual Process Planning	1.18
1.6.	Computer Aided Process Planning (CAPP)	1.19
1.6.1.	Benefits of CAPP.....	1.19
1.6.2.	Approaches of CAPP.....	1.20
1.7.	Retrieval (or Variant) CAPP System	1.20
1.7.1.	Procedure for Using Retrieval CAPP System.....	1.20
1.7.2.	Advantages of Retrieval CAPP System.....	1.21
1.7.3.	Drawbacks of Retrieval CAPP System.....	1.22
1.8.	Generative CAPP Systems	1.22
1.8.1.	Components of a Generative CAPP System.....	1.23
1.8.2.	Advantages of Generative CAPP.....	1.23
1.8.3.	Drawbacks of Generative CAPP System	1.23
1.9.	Selection of Process Planning System	1.23
DRAWING INTERPRETATION		1.24
1.10.	Introduction.....	1.24
1.11.	A Brief on Engineering Drawing.....	1.25
1.11.1.	Types of Drawing	1.25
1.12.	Information on the Drawing Sheet Required for Process Planning (Critical Processing Factors).....	1.30
1.12.1.	Dimensions	1.31
1.12.2.	Material Specifications	1.31
1.12.3.	Special Material Treatments	1.31
1.12.4.	Tolerances, Limits and Fits.....	1.31
1.12.5.	Geometrical Tolerancing	1.33
1.12.6.	Surface Finish	1.34
MATERIAL SELECTION AND EVALUATION.....		1.35
1.13.	Introduction.....	1.35

1.14. Overview of Engineering Materials for Manufacture	1.35
1.14.1. Classification of Materials for Manufacture	1.35
1.14.2. Metals and their Classification.....	1.38
1.14.3. Polymers	1.40
1.14.4. Engineering Ceramics.....	1.41
1.14.5. Composites	1.42
1.15. Material Selection Process and Methods	1.43
1.15.1. Material Selection Process.....	1.43
1.15.2. Material Selection Methods	1.44
1.16. Material Evaluation Method	1.44
1.16.1. Shape or Geometry Considerations	1.45
1.16.2. Material Property Requirements	1.46
1.16.3. Manufacturing Considerations.....	1.47
PROCESS SELECTION	1.47
1.17. Introduction Process Selection	1.47
1.17.1. Classification of Manufacturing Processes.....	1.47
1.18. Factors in Process Selection	1.49
1.18.1. General Guidelines for Process Selection.....	1.50
1.19. Process Selection Method (Steps in Process Selection)	1.51
1.19.1. Stages of Process Selection.....	1.51
PRODUCTION EQUIPMENT AND TOOLING SELECTION	1.57
1.20. Introduction to Production Equipment and Tooling Selection	1.57
1.21. Factors in Equipment Selection	1.58
1.21.1. Technical Factors.....	1.59
1.21.2. Operational Factors.....	1.61

1.22. Machine Selection Method	
(Steps in Machine Selection)	1.62
1.22.1. Stages of Machine Selection.....	1.63
1.23. Factors in Tooling Selection	1.64
1.23.1. Constraints on Tool Selection.....	1.66
1.23.2. Operating Requirements for Tool Selection	1.67
1.23.3. Factors affecting Tooling Performance	1.68
1.24. Tooling Selection Method	1.69
<i>Review and Summary</i>	1.71
<i>Review Questions</i>	1.74

UNIT II: PROCESS PLANNING ACTIVITIES	2.1 – 2.64
---	-------------------

2.1. Introduction	2.1
PROCESS PARAMETERS CALCULATION	2.1
2.2. Process Parameters (What are Process Parameters?)	2.1
2.3. Cutting Speed	2.2
2.3.1. Factors Affecting the Selection of Cutting Speed.....	2.2
2.3.2. Calculation of Cutting Speed	2.4
2.3.3. Spindle Speeds and Stroke Speeds	2.7
2.4. Feed and Feed Rate	2.10
2.4.1. Factors Affecting Feed Rate	2.10
2.4.2. Selection of Feed Rate	2.11
2.5. Depth of Cut	2.13
2.5.1. Selection of Depth of Cut	2.14
2.5.2. Machining Time Calculations.....	2.14
SELECTION OF JIGS AND FIXTURES	2.15
2.6. Introduction	2.15
2.6.1. Workholding Device.....	2.15
2.6.2. Jigs.....	2.16

2.6.3.	Fixtures	2.16
2.6.4.	Jigs Vs. Fixtures.....	2.17
2.7.	Reasons for Using Jigs and Fixtures (Purpose and Advantages of Jigs and Fixtures)	2.17
2.8.	Elements of Jigs and Fixtures	2.18
2.9.	Principles of Jigs and Fixture Design (Factors Influencing Jigs and Fixtures Design)	2.18
2.10.	General Factors in Workholder Design and Selection .	2.21
2.11.	Types of Jigs and Fixtures	2.21
2.11.1.	Types of Jigs	2.21
2.11.2.	Types of Fixtures	2.22
2.11.3.	Standard Parts for Jigs and Fixtures.....	2.23
	SELECTION OF QUALITY ASSURANCE METHODS	2.23
2.12.	Introduction	2.23
2.12.1.	What is Quality and TQM?.....	2.24
2.12.2.	Basic Principles/Concepts of TQM	2.25
2.12.3.	TQM Framework (Elements of TQM).....	2.25
2.13.	Basic Quality Strategies (Detection Vs Prevention Strategy)	2.26
2.13.1.	Detection Strategy.....	2.26
2.13.2.	Prevention Strategy	2.27
2.14.	Seven Statistical Tools of Quality (Q-7 Tools)	2.27
2.15.	Statistical Quality Control	2.28
2.15.1.	What is Statistical Quality Control?	2.28
2.15.2.	Assignable and Chance Causes of Variations.....	2.29
2.16.	Control Charts	2.30
2.16.1.	What is a Control Chart?	2.30
2.16.2.	Types of Control Charts.....	2.31
2.17.	Control Charts for Variables	2.31

2.18. Control Charts for Attributes.....	2.32
2.19. Process Capability.....	2.33
2.19.1. Process Capability Indices (Measures of Process Capability)	2.33
2.19.2. Process capability Index C_{pk}	2.34
2.20. Inspection and Measurement.....	2.35
2.20.1. Objectives of Inspection	2.35
2.20.2. Stages of Inspection (or Inspection Locations).....	2.35
2.20.3. Methods of Inspection	2.36
2.20.4. Types of Inspection.....	2.37
2.21. Measurement Instruments	2.38
2.21.1. Measurement Instruments Used for Variables Inspection .	2.38
2.21.1. Measurement Instruments Used for Attributes Inspection.	2.39
2.22. Selecting Measuring Instruments (Factors to be Considered for Selecting Measuring Instruments)	2.40
2.23. Set of Documents Required for Process Planning (Information Required for Process Planning).....	2.41
ECONOMICS OF PROCESS PLANNING.....	2.42
2.24. Introduction.....	2.42
2.25. Break-Even Analysis.....	2.43
2.25.1. What is it?	2.43
2.25.2. Aims of Break-Even Analysis	2.43
2.25.3. Break-Even Point.....	2.44
2.25.4. Determination of Break-Even Point.....	2.44
2.26. The Algebraic Method.....	2.44
2.26.1. Contribution.....	2.45
2.26.2. P/V Ratio (i.e., Profit – Volume Ratio)	2.46
2.27. The Graphical Method (Break-Even Chart).....	2.46
2.27.1. Margin of Safety	2.47

2.27.2. Break-Even Analysis for Process Selection.....	2.50
2.27.3. Machine Break Points (Equipment Selection).....	2.54
2.27.4. Break-Even Analysis for Make or Buy Decisions.....	2.55
2.28. Case Study.....	2.57
<i>Review and Summary</i>	2.59
<i>Review Questions</i>	2.63

UNIT III: INTRODUCTION TO COST ESTIMATION 3.1 – 3.117

3.1. Introduction.....	3.1
COST ESTIMATING	3.2
3.2. Definition and Concept of Cost Estimating.....	3.2
3.3. Importance of Cost Estimating.....	3.3
3.4. Objectives of Cost Estimation.....	3.3
3.5. Functions of Cost Estimation.....	3.4
3.6. Types of Estimates.....	3.4
3.6.1. Classification of Cost Estimates Based Upon Design Level.....	3.6
3.7. Methods of Estimating.....	3.7
3.7.1. Note on Parametric and Statistical Estimation.....	3.9
3.8. Data Requirements for Cost Estimating.....	3.10
3.8.1. Data Sources.....	3.11
3.9. Importance of Realistic Estimates.....	3.12
3.10. Elements of Cost Estimation (Components of a Job Estimate) (Constituents of Estimation).....	3.13
3.11. Cost Estimating Procedure.....	3.15
3.12. Estimate Form.....	3.17
COSTING OR COST ACCOUNTING	3.19
3.13. Definition and Concept.....	3.19
3.14. Objectives of Cost Accounting.....	3.19

3.15.	Importance of Costing	3.20
3.16.	Difference between Estimating and Costing	3.21
3.17.	Methods of Costing	3.22
	CLASSIFICATION & ELEMENTS OF COST	3.24
3.18.	Classification of Cost	3.24
3.18.1.	Classification of Cost According to Elements	3.25
3.18.2.	Classification of Cost According to Function.....	3.25
3.18.3.	Classification of Cost According to Variability.....	3.26
3.18.4.	Classification of Cost into Direct and Indirect Costs.....	3.27
3.18.5.	Classification of Cost According to Capital and Revenue	3.27
3.19.	Elements of Cost	3.27
3.20.	Materials Cost	3.28
3.20.1.	Direct Materials Cost.....	3.28
3.20.2.	Indirect Materials Cost.....	3.28
3.21.	Labour Cost	3.29
3.21.1.	Direct Labour Cost.....	3.29
3.21.2.	Indirect Labour Cost.....	3.29
3.22.	Expenses	3.30
3.22.1.	Direct Expenses	3.30
3.22.2.	Indirect Expenses (Overhead Expenses).....	3.31
3.23.	Analysis of Overhead Expenses	3.31
3.23.1.	Factory Expenses	3.31
3.23.2.	Administrative Expenses	3.32
3.23.3.	Selling Expenses	3.32
3.23.4.	Distribution Expenses	3.33
3.24.	Components of Cost	3.33
3.24.1.	Prime Cost	3.34
3.24.2.	Factory or Works Cost.....	3.34

3.24.3. Production or Manufacturing or Office Cost	3.34
3.24.4. Total Cost.....	3.34
3.24.5. Selling Price.....	3.35
3.25. Ladder of Cost.....	3.35
ESTIMATION OF MATERIALS COST	3.37
3.26. Determination of Materials Cost	3.37
3.27. Formulae Summary.....	3.37
3.27.1. Densities of Materials	3.43
<i>Illustrative Examples.....</i>	<i>3.44</i>
ESTIMATION OF LABOUR COST	3.50
3.28. Determination of Direct Labour Cost.....	3.50
3.28.1. Set up Time.....	3.50
3.28.2. Operation Time	3.51
3.28.3. Tear Down Time.....	3.51
3.28.4. Miscellaneous Allowances.....	3.51
3.29. Allowances in Cost Estimation & Calculating of Standard Time.....	3.52
3.29.1. Need for Allowances	3.52
3.29.2. Calculation of Standard Time	3.54
ESTIMATION OF OVERHEADS AND VARIOUS COST COMPONENTS	3.56
3.30. Determination of Overheads and Various Cost Components	3.56
<i>Illustrative Examples.....</i>	<i>3.57</i>
ALLOCATION OF OVERHEAD EXPENSES	3.79
3.31. Introduction.....	3.79
3.32. Methods of Allocation of Overhead Expenses.....	3.79
3.32.1. Allocation by Percentage on Prime Cost	3.79
3.32.2. Allocation by Percentage on Direct Labour Cost	3.81

3.32.3. Allocation by Percentage on Direct Material Cost	3.82
3.32.4. Allocation by Man-hour Rate	3.83
3.32.5. Allocation by Machine Hour Rate	3.84
3.32.6. Allocation by Combination of Man-hour and Machine-Hour Rate.....	3.87
3.32.7. Allocation by Unit Rate	3.87
DEPRECIATION.....	3.88
3.33. Definition and Concept of Depreciation.....	3.88
3.34. Causes of Depreciation	3.89
3.35. Methods of Depreciation	3.89
3.35.1. Straight Line Method (or Fixed Instalment Method).....	3.90
3.35.2. Diminishing Balance (or Reducing Balance) Method	3.92
3.35.3. Sinking Fund Method	3.95
3.35.4. Annuity Method.....	3.96
3.35.5. Sum of the Year's Digit Method.....	3.98
3.35.6. Insurance Policy Method	3.100
3.35.7. Machine Hour Method.....	3.100
3.35.8. Production Unit Method	3.101
3.35.9. Revaluation (or Regular Valuation) Method	3.102
3.35.10. Retirement Method	3.102
<i>Review and Summary.....</i>	3.103
<i>Review Questions.....</i>	3.108
<i>Problems for Practice.....</i>	3.110

UNIT IV: PRODUCTION COST ESTIMATION	4.1 – 4.107
--	--------------------

ESTIMATION IN FORGING SHOP.....	4.1
4.1. Forging.....	4.1
4.2. Types of Forging	4.1
4.3. Forging Processes.....	4.2

4.4.	Forging Operations.....	4.3
4.5.	Estimation of Material Losses in Forging.....	4.4
4.6.	Estimation of Forging Cost.....	4.6
	<i>Illustrative Examples.....</i>	4.9
	ESTIMATION IN WELDING SHOP.....	4.33
4.7.	Welding.....	4.33
4.8.	Types of Welding.....	4.34
4.9.	Types of Weld Joints.....	4.34
4.10.	Estimation of Welding Cost.....	4.37
	ESTIMATION OF GAS WELDING COST.....	4.38
4.11.	Gas Welding.....	4.38
4.12.	Gas Welding Technique.....	4.38
4.12.1.	Leftward or Forward Welding.....	4.38
4.12.2.	Rightward or Backward Welding.....	4.39
4.13.	Estimation of Oxy-Acetylene Welding.....	4.39
4.14.	Gas Cutting.....	4.41
4.15.	Estimation of Gas Cutting Cost.....	4.41
	ESTIMATION OF ELECTRIC ARC WELDING COST.....	4.58
4.16.	Electric Arc Welding.....	4.58
4.17.	Estimation of Electric Arc Welding Cost.....	4.59
	ESTIMATION IN FOUNDRY SHOP.....	4.70
4.18.	Foundry.....	4.70
	ESTIMATION OF PATTERN COST.....	4.70
4.19.	Pattern.....	4.70
4.20.	Pattern Allowances.....	4.71
4.20.1.	Contraction or Shrinkage Allowance.....	4.71
4.20.2.	Draft Allowance.....	4.72
4.20.3.	Machining Allowance.....	4.72
4.20.4.	Distortion Allowance.....	4.72

4.20.5. Shake Allowance	4.72
4.21. Estimation of Pattern Cost.....	4.73
ESTIMATION OF FOUNDRY COST.....	4.73
4.22. Estimation of Foundry Cost.....	4.73
<i>Illustrative Problems</i>	<i>4.76</i>
<i>Review and Summary.....</i>	<i>4.96</i>
<i>Review Questions.....</i>	<i>4.97</i>
<i>Problems for Practice.....</i>	<i>4.99</i>

UNIT V: MACHINING TIME CALCULATION	5.1 – 5.90
---	-------------------

5.1. Introduction.....	5.1
5.1.1. What is meant by Machining Time?.....	5.1
5.1.2. Terms Used in the Study of Machining Time.....	5.1
CALCULATION OF MACHINING TIME FOR LATHE OPERATIONS	5.3
5.2. Turning Operation.....	5.4
5.3. External Relief Turning	5.11
5.4. Chamfering.....	5.12
5.5. Facing.....	5.14
5.6. Knurling.....	5.15
5.7. Drilling.....	5.17
5.8. Boring.....	5.19
5.9. Reaming.....	5.22
5.10. Tapping.....	5.23
5.11. Threading (or Screw Cutting).....	5.26
<i>Problem on Taper Turning</i>	<i>5.29</i>
<i>Additional Special Problems</i>	<i>5.31</i>
ESTIMATION OF MACHINING TIME FOR SHAPING, PLANNING AND SLOTTING OPERATIONS.....	5.58

5.12. Estimation of Machining Time for Shaping, Planning and Slotting Operations	5.58
<i>Problems Involving Shaping Operations</i>	5.60
<i>Problems Involving Planning Operations</i>	5.63
ESTIMATION OF TIME FOR MILLING OPERATIONS	5.65
5.13. Estimation of Time for Milling Operations	5.65
5.13.1. Determination of Added Table Travel.....	5.66
ESTIMATION OF TIME FOR GRINDING OPERATIONS	5.76
5.14. Estimation of Time for Grinding Operations.....	5.76
<i>Review and Summary</i>	5.82
<i>Review Questions</i>	5.84
<i>Problems for Practice</i>	5.85
Solved Anna University Question Papers.....	SQ 1 to 99
TWO MARKS Q&A.....	T.1 – T.31
MODEL QUESTION PAPERS	MQ.1 – MQ.8
INDEX	
REFERENCES	