Curriculum for Diploma in Production Engineering

(IV TO VI SEMESTER)

Implemented from 1995-96
(Based on Semester System)

Curriculum revision work done by

Polytechnic Development Unit
(Under Indo-German Project)

In assistance with

Curriculum Development Centre
M.P. Board of Technical Education, Bhopal
Office Complex, Block A/IV, Gautam Nagar, Bhopal -462-023 (M.P.)

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Curriculum

for

Fourth Semester

Diploma in Production Engg.

(Under Indo-German Project)

Implemented from 1995-96
(Based on Semester System)

M.P. Board of Technical Education,
Office Complex, Block A/IV, Gautam Nagar, Bhopal - 462-023

type of shaper

Know the different types of shaper.

- List type of shaper according to type of mechanism.
- State names of at least two types of shapes and their specific field of use.

4.3 Specification of shaper. (One hour) 4.4 + 4.5

Know the specification of shaper.

- State parameters considered to specify a shaper machine such as length of stroke, type of drive, power input, ratio of cutting and idle stroke, no. of speed steps.

4.4 Cutting tool for shaper

Understand a single point cutting tool used on shaper.

- List cutting angles of single point tool.
- Sketch cutting tools perpendicular to work surface for machining.
- Explain use of cutting angles for machining.
- etc.

4.5 Crank and slotted link mechanism (One hour)

Understand details parts of mechanism and function of each part.

- List parts of quick return mechanism such as ram, screw shaft, bevel gear, ------ link, rocker arm ------, bull gear, bull gear slide.
- Sketch the mechanism.
- State the principle of quick return crank mechanism and function of each part.
- Explain the method of adjustment of length of stroke and position of stroke.
- etc.

M. P. BOARD OF TECHNICAL EDUCATION, BHOPAL

FOURTH SEMESTER DIPLOMA IN PRODUCTION ENGG. **(REVISED, IMPLEMENTED FROM 1995-96 AT BHOPAL & INDORE)**

S. No.	Name of Subjects	Scheme of study			Scheme of Examination										
		THEORY	LAB	TOTAL	SESSIONALS		PROGRESSIVE ASSESSMENT		BOARD EXAMINATION						REMARK
					TERM WORK	Lab. WORK	I	II	THEORY PAPER	DURATION	MARKS	PRACT.	DURATION	MARKS	
1.	Metrology & Quality Control (P.C. 2061)	4(64)	4(64)	8(128)	20	30	10	10	I	3HRS	100	I	3HRS	50	
2.	Workshop Technology (Manufacturing Tech.-II) (P.C. 2062)	4(64)	4(64)	8(128)	20	30	10	10	I	3HRS	100	I	3HRS	50	
3.	Production Drawing (P.C. 2063)	12(192)	-	12 (192)	20	50	10	10	I	4HRS	100	I	3HRS	50	
4.	Elective (any one)														
	a. Engg. Maths (Basic +Higher Maths) (P.C. 2064)	8(128)	-	8(128)	50	-	10	10	I	3HRS	100	I	3HRS	50	Viva
	b. Steel Fabrication Tech. (P.C. 2065)	4(64)	4(64)	8(128)	20	30	10	10	I	3HRS	100	I	3HRS	50	
	c. Plastic Technology (P.C. 2066)	4(64)	4(64)	8(128)	20	30	10	10	I	3HRS	100	I	3HRS	50	
5.	TCPC Training marks of four weeks after third semester.	-	-	-	-	-	-	-	-	-	-	I	3HRS	100	
	TOTAL	28/24	8/12	36 (576)	80/ 110	140/ 110	40	40	4	-	400	4	-	200 + 100	

NOTE:

1. No. of theory paper:04
2. Total theory marks: 400
3. No. of Practical: 04
4. Total Practical Marks: 200
5. In-plant Training Marks: 100
7. Ratio of theory marks and total of: 400:600 sessional, Prog. Assess., Pract. and i.e.1:1.5 In-plant training
8. Total marks: 1000
9. Passing marks for
   a. Theory: 33%
   b. Practical : 40%
   c. Sessional: 60%
   d. Inplant training: 50%

Total marks of Sessionals, Prog. Assessment, Pract. & In-plant training: (220+40+40+200+100=600)

NOTE: All students have to undergo TCPC training of FOUR weeks immediately after FOURTH semester examination.

Amendment for Phase-III training as approved in the Board of Studies meeting held on 6/6/2000:

All students have to undergo **Training of FOUR WEEKS (two weeks TCPC and two weeks Industrial Training)** immediately **after FOURTH semester examination.**

PROGRAMME: DIPLOMA IN PRODUCTION ENGG.
SCHEME: REVISED, IMPLEMENTED FROM 1995-96
SEMESTER: FOURTH
COURSE: Metrology & Quality Control **(P.C. 2061)**

Rationale

This subject has gained importance in the curriculam of Diploma Course in Mechanical Engineering (Production) due to growing awarences for Inspection and Quality Control in the Industries and cost-effective production

The curriculam attempts to achieve the following objectives:

To aquaint the students with activities of Metrology and Quality Control Department of Industries.

To develop the knowledge skill in using handly of meaning instruments, and their working principle.

To develop awarences about Quality Control techniques used in jobbing and mass production industries.

To develop awarences about internation quality standards (950-9000)

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Content

Sl.No.	Topic	TH. HRS.	PR. HRS.
1.	Basic concept of Metrology and Inspection	6	5
2.	Study of Limit, fits and tolerances system	8	Nil
3.	Linear measurement	8	12
4.	Angular measurement	8	9
5.	Testing of geometrical irregularties	8	9
6.	Assesment of surface roughness	7	-
7.	Screw thread measurement	8	3
8.	Gear measurement	5	3
9.	Importance and need of quality control	9	-
10.	Control charts	10	15
11.	Acceptance sampling testing	6	-
12.	I.S.O. - 9000	7	-
	Total	84	56

Sl.No.	Topic/Sub Topic	Intended Learning Objectives	Remark
1.	Basic concept of metrology a inspection	Understand the basis concept at metrology & Inspection - State the meaning of term metrology & Inspection - Define the terms metrology as inspection - Give examples from day to day life hibers measurement & inspection are carried out - Give examples from indsutrial situation where metrology & Inspection in are applied.	
1.1	Types at Inspection i) Centralised ii) decentralised	Know the centralised & decentralised inspection - Define centralised & decentralised inspection - Illustrate with examples - Know the inspection stages in production - List the inspection stages	
1.2	Methods of inspection 100% inspection sampling inspection	- Explain each stage of Inspection - Illistrate each stage with some industrial examples - Understand the inspection method - Explain types of inspection methods - Know the criteriew for selecting correct method of inspection - Illustrate with industrial examples - Understand metrology terminalogies	Industrial visit to be arrange for reinfor cement of concept
1.3	Terminalogy used in metrology measurement, gauging, comparison, accyracy, precision, error, specification, standard, calibration, inter changeability leastcount range	- Define each term - Explain each term example	

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2.	Limits, fits & tolerance nominal size basis size actual size limits tolerance allowance fits upper & lower deviation- Basic shaft & basic hole, unilateral & lilateral syster, Hole a shaft basis system, Zero line, grade of tolerance position of tolerance zone designation of shaft hole and fits 50 & Not 50 limits, fundamental deviation	- Understand the various terms related to study of limits, fits & tolerance - State the varios terms such as linits fits, Tolerance & allowance etc - Explain with suitable example - Compute the toleerances allowance, deviations from the giving values - Read the related charts - Select tolerance grade	
2.1	selection of fit		
2.2	Usage of deciding tolerance		
2.3	Indiar standard for limit, fit, tolerance		
3.	Linear measurement		
3.1	concept of linear measurement	- Understand the concept of the linear measurement - Explain the term linear measurement - Illustrate with industrial examples	
3.2	Measurinmg instrument 1) scale 2) Vernier callipers 3) vernier height guage 4) Vernier depth guage 5) Outside micrometer 6) Inside micrometer 7) Dial callipers 8) span width micrometer 10) deptth micrometer- 11) Dial indicator 12) Thickness guage 13) slip gauge blocks	- Understand the working of each of them easuring instrument such as scale, vernier callipers etc (as listed in topic column) - Explain the specific application of each of the instruments -Select the instrument under a given condition - Demonstrate the use of each of the instruments as to measure ther dimensions on a given job - Explain the usage procedure slip guage blocks - Explain the concept of wringing of slip guage block	Visit to suitable small scale industries to Show the application

3.3.1	Type of comparators 1. Dial indicator 2. Reed type comparator 3. Sigma compaprator etc.	- Know the function of comparator - State the fuinction of comparator - Illustrate the application of comparators with industrial examples - Know mechanical comparators the types of comparators - Understand the workig of mechanical comparator - List the different types of comparators Demonstrate with - State the meaning of mechanical comparator with - explain the workig and constructional details of each of the different type of the mechanical comparator - Illustrate the application with exarples	
4.	Angular measurement	Understand the angular concept of angular measurement - Define the term angular measurement - Illustrate with industrial examples	
4.1	Angular measuring Protractors, Bevel Protractors, combinatioon set, sinebar & assesories	Understand the working of each of the anguilar measuring instruments - State the procedure to use each of the instruments - Know the specific application of each of the angular measuring instruments - Give situation where each of these angular measuring instrument are used	Demonstrate each instruments for measurement the angular of a given job Visit to industries and the application of each of the instrument on site (workstation) Demonstrate the methods to illustrate the procedure
4.2	Indirect method for angular to suit the different geometries	Understand the indirect methods at angular measurement and their importance - State the uses of indirect method - State the procedure to concluce the angular values from given geometrical condition	

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		- List the parameteres requried to conclude the angular values - Explain the importance of indirect method of angular measurement
.0	Testing of Geometircal irregularities	Understand the concept of geometrical irregularities - State the meaning of geometric irregularities & geometrical accuracy - Explain the importanc of geometrical accuracy and - Illustrate with suitable example
.1	Testing of straightness	Know the terms straightness and straightness error - Define strightness and straightness error
.2	Straightness testing method Standard edge method, wedge method, sprit level method	Understand the principle of each of straightness testing method - state the parameter require to conclude the straightness error - compute the straightness error from each method - state the specific application of each of the methods Demonstrate each method and illustrate the procedure to conclude the straightness error
.3	Testing of flatnes	Know the flatness and flatness error - define the flatness and flatness error Demonstrate each methodand illustrate the procedure to conclude the flatness error
.4	Flatness testing methods i) High spot method ii) Dial indicator method iii) Liquid level method	Understand the principle of each of flatness testing methods - State the parameters required to conclude the flatness error - Compute the flatness error from each of the methods - State the specific application of each method

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5.5 Testing of squareness

5.6 Squareness testing methods :-

(i) Try square method
(ii) Dial Indicator Method

- Know the squareness and squareness error
  * Define squareness and squareness error

- Understand the principle of each of the squreness testing method

  * State the parameter required to conclude the squreness error
  * Compute the squreness error from each of the methods.
  * State the specific use of each method.

Demonstrate each method and illustrate the procudure to conclude the squreness error.

5.7 Concept of roundness, circularity and concentricity.

5.7 Roundness, testing methods

- Understand the concept of roundness circularity and concentricity.

  * Define roundnessand roundness error.
  * Explain the term circularity with suitable examples.
  * Explain the term concentricity with suitable examples.

- Understand the principle of method of tesing of roundness with the help of V - block and dial indicator.

V-block & dial indicator method, concentricity tester method.

- State the paprmeters required to conclude the roundness error compute.
  * Compute the roundness errror from each of the methods.
  * State the specific application of each of the methods.

Demonstrate each method and illustrate the procedure to conclude the roundness error.

5.8 Radius measurment

5.9 Radius measurement methods.
(i) Roller & surfactr plate method for concave & convex surface.

Understand the concept of radius of curvature.
* Explain the importance and application of radius measurment.
* Explain the concepts of centre of curvature

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- Understand the principle of each of the methods.

(ii) fixed roller instrument method.
(iii) V-plate method
(iv) Radial arm-method.

* State the parameters required to compute th radius of currature
* Describe the procudure for each of the methods.
* Compute the radius of currature from ech of the methods.
* State the specific application of each of the methods.

Demonstrate each method & illustrate the procedure to find out the radius of currature.

6. Assesment of surfacr roughness

6.2 Importance of surface roughness

6.1 Surface terminology
(i) Primary texture
(ii) Secondary texture
(iii) 1st, 2nd, 3rd, 4th order of irregularities.

- Understand the importance of surface roughness
* Explain the importance of surface roughness.
* Illustrate with example the importance of surface roughness.
- know the surface roughness
* State the various terms related with the surface roughness i.e. primary & secondry texture 1st, 2nd, 3rd, 4th orderof irregularities.

6.2 Methods for assessment of surface roughness
(i) Touch method
(ii) Instrumental method such as
(a) Profilograph
(b) Tomilson profile recorder
(c) Tolysurf surface finish recorder.

6.3 CLA & RMS values.

- Understand the principle of assessment of surface roughness
* State the principle of each method.
* Explain the procedure of each of the mthods
* Explain the functioning of each of these instrument
* Give the parametres required to assess the roughness.
Understand the concept of CLA & RMS
* Define CLA & RMS values
* Explain the importance of CLA & RMS values
* Know th procedure to compute the CLA & RMS values
- Know about the screw thread measurement
* List the various types of screw threads
- State the various elements of V-thread

d. Nominal diameter

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e. Effective diameter
f. Major diameter
g. Minor diameter

7.2 Terms related with screw thread
i. Truncation
j. Fundamental triangle
k. Start of thread
l. Lead

* Define the following terms
(a) Start of thread
(b) Lead

Elaborate with suitable examples:

7.3 Methods for measurement of major diameter by :
a. Micrometer with V anvils
b. Bench Micrometer

7.4 Method for measurement fo minar diameter by :
a Micrometer with v anvils
b Bench Micrometer

- Understand the methods of major diameter measuremeter of screw thread

* Explain the procedure of measuring the major diameter by
a Bench Micrometer
b Micrometer

- Understand the methods of measurement of minar diameter of screw thread

* Explain the procedure of measuring the minar diameter by
a Micrometer with v anvils
b Bench Micrometer

Demonstration of the procudure fo each of the method

Demonstrate the procedure of each method.

7.5 Method of measurement effective diameter by :
(i) Three wire method
(iiO Thread micrometer

- Understand the related concepts and methods measuremont of effective

* Define effective diameter.
* Explain the procedure for measuring the effective diameter with
(a) Three wire method
(b) Thread micrometer

* State the parameters required to compute the effective dia. for

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each of the methods.
* Compute the effective dia from each of the method.
* State the limitations of each of the methods.

Demonstrate and the procedure of each method in laboratory.

7.6 Pitch measuremetn by pitch gourge pitch measuring machine and tool room microscope

- Understand the method of pitch measurement
* List the various mthods of pitch measurement
* Explain the procedure of the each method for pitch measurement
* State th limitations of each of the methods.

Demonstration the procedure of each of the methods in laboratory.

7.7 Thread angle measurement by :
(i) Tool room microscope
(ii) Profile projector

- Understan the method of thread angle measurement
* List the varioud method for thread angle measurement
* Explain the procedure of each of the methods.

* State the limitation of each of the methods.

Demonstration the procedure of each of the method

8. Gear Measurement

8.1 Elements of spur gear

- Understand the concept of spur gear

* Explain the terms associated with the gear measurement suc as.

a Base circle
b Pitch circle
c Pitch circle diameter
d Module
e Diameter pitch
f Cicrular pitch
g Adeendum/Dedendum
h Clearness
1 Blank diameter
j Tooth thickness
k Base ptich
l Pressure angle etc.

Demonstration the spur gear to be made to explain the different elements

8.2 Techniques of gear inspection
(i) Functional testing

8.0 Analytical testing

8.2.1 Functional testing

- Understand the concept of gear testing
* Define the functional testing
* Define the analytical tepting
* State the specific application of gear inspection techniques

- Understand the principle of functional testing
* State the principle of functional testing
* Explain the procedure for functional testing by :

(a) Parkinson gear roller tester

8.2.2 Study of analytical testing

- Understand the concept of analytical testing
* State the principle of analytical testing
* List the elements of gear to be checked such as :
a Blank diameter
b Gear tooth thickness
c Cicrular pitch
d Base pitch
e Backlash

8.3 Tooth thickness measurement

- Understand the methods of tooth thickness measurement

* Explain the constructional & working of gear tooth caliper
* Explain the procedure to measure the tooth thickness by :
a Constant chord method
b Chordal thickness method

Demonstrate the procedure to measure the gear tooth thickness

8.5 Measuremetn of :

- Circular pitch
- Base pitch
- Blank diameter
- Backlash
- Concentricity

- Understand the methods of measurement of the following elements

a Circular pitch
b Base pitch
c Blank diameter
d Backlash
e Concentricity

* Explain the methods to measure each of the elements

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Demonstrate & illustrate method to measure each elements

9. Importance & need of quality control
9.1 Concept of quality & quality control

9.2 Concept of statistical quality control (S.Q.C)

- Understand concept of quality and quality control

- Explain the terms quality and total quality : (quality of desing quality of confirmity)

- Illustrate with industrrial examples
- Explain the terms quality control
- Differentiate between inspection and quality control

Understand the concept of S.Q.C.

- Recall the sampling inspection.
- Know the importance of sampling inspection.

- Explain the term S.Q.C
- Illustrate with suitable examples
- State that variation due to natural causes is unavoidable
- Recall the knowledge of statistics measure of central rendency, measure of dispersion, frequency distriusion etc.
- Explain that the natural variation is the basic of S.Q.C

- Differentiate between natural and assignable causes for variation
- State that S.Q.C arms at maintaining quality by recognising and removing

9.3 Variable and attribute characterstics of quality

9.4 Statistical data collection and calculation of average (X) and standard) deviation (o)

assignable cause for variation

Know variable and attribute characterstics of quality

- Define variable and attribute characterstics of quality
- Give examples of variable and attributes
- State that both variable and attributes are controlled through SQC

- Understand statistical data collection
- Record actual observations of data of given jobs.

- Tabulate the recorded date in specified proforma
- Calculate average (x) and standard deviation (o)

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10. Control charts

10.1 Control chart for variable X & R chart, process capability of machine and calculation of tolerance of assembly.

10.1.1 X & R chart

Understand X & R chart.

- Explain how process behave when nature causes are present
- Explain how process behave when assignable causes are present
- Explain that control charts for X and R ensure that a process is behaving normally, and that no assignable causes are present.
- Given data, construct the X and R chart

Record of data to based on observation taken from the real life product, if possible.

- Explain why X is to be used along with R chart
- Interpret the inferences about process behaviour

For calculating control limits stand and table should be used as to find the nature of constants A2, D2, D3 and D4.

10.1.2 Process capability

- State the symptoms on the X and R chart which indicate 1 trend 2 shift 3 Extreme variation
- Identify the reasons for the particular configuration.
- Suggest remedial measures based on the analysis of X and R charts
- Understand the concept of process capability of machine
- Explain the term process capability.

10.1.3 Tolerance of assembly (statistical tolerancing)

- Given data, calculate the process capability
- understand the concept of the tolerance of assembly
- Explain the relationship between standard deviation of components of an assembly and the standard deviation of an assembly.

10.2 Control charts for attributes
P chart, Pn chart and C charts

- Given required data about components calculate the values of statistical tolerances of assembly.
- Understand the concept of attribute charts
- Explain the terms defect and defective
- Illustrate with examples
- State that attribute charts are useful in controlling quality characteristics.

- Given data construct p and np charts.

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- Interpret the inferences about process behaviour.
- Given data about defects of assembly/product construct c chart
- Interpret c chart for the process behaviour

11 Acceptable sampling
- Understand the concept of sampling inspection and sampling technique.
- Explain the term sampling inspection
- List the advantages and limitation of sampling inspection as compared to 100% inspection
- List the factors which influence the success of sampling technique such as randomness of sample, size of sample, quality characteristics tested, acceptance criteria and lot size.

11.1 Sampling plan single sampling plan double sampling plan

11.1.1 Acceptance Quality Level (A.Q.L.)

- Understand single sampling plan and double sampling plan.
- Explain the working procedure of the single sampling and double sampling plan with the help of a line diagram.

- Understand the concept of A.Q.L. explain the term A.Q.L.
- Design single sampling and double sampling plan on the basis of given lot size.

11.2 Operating characteristic curve (O.C. curve). Producer's risk, consumer's risk, and Lot tolerance percent defective (LTPD), Average outgoing quality never (AOQL)

- Know O.C. curve and related terminology vised in sampling plan
- Define O.C. curve
- Explain an ideal O.C.
- Explain O.C. curve
- State how O.C.curve helps in qualifying inherent risk (rejecting good lots, accepting bad lots) in any plan.

Explain the term AQL producer's risk, consumer's risk, LTPD, AOQL etc, on the basis of O.C. curve.

Required charts to be used.

12.Concept ISO and its application in metrology

- Understand the concept at ISO
Explain the requirements of ISO for industries.

- State the ISO 9000
Explain ISO 9002 and 9003.

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List of practicals (Experiments)
In
Metrology
&
Quality Control

1. Study about the metrology laboratory.
2. Handling of instruments and their care
3. Study the various linear measuring Insts.
4. Measurement of gap by means of slip of gauges
5. To measure the dia of spigot (cylinder) by using slip gauges
6. To compare the length of pins by using mechanical comparator
7. To determine the external taper of a given job by sine gar method
8. To check the angle of tapered hole by indirect method
9. To determine the included angle at internal dovetial
10. To find the radius of curvature of a concave surface by roller surface plate method
11. To find the radius of curvature of a concave surface by surface pla a roller method
12. To check the strainghtness of an edge by wedge methods
13. To check the effective dia of screw thread by three wire method
14. To check preform the functional testing at gear by parkinson gea roll tester.

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Practical (SQC)

15. Construct and interpret the X and R chart on the basis of required given data or on the basis of actual observations on the jobs (with measuring instruments)
16. Construct and Interpret the P chart on the basis of required given data or on the basis of actual observation on the jobs (with 60 & no 60 guages)
17. Construct and interpret the PN chart on the basis of required given data on the basis of actual observation on the jobs (with 60 & no 60 guage)
18. Construct and interpret the 'C' chart on the basis of required given data or on the basis of actual observation on the jobs
19. Determine process capability of lathe m/c of workshop by collecting data on job prepared on this m/c

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Reference Book

1.	Statistical Quality contral	E.L.Grant
2.	Statistical Quality control	R.C.Gupta
3.	Quality control	I.I.T. Madras
4.	Industrial Engineering	S.C.Sexena
5.	Industrial Engineering and management system	Dr. D.S. Dalela Dr. Mansur Ali
6.	Engineering Metrology & Quality control	R.K. Jain
7.	Practical Metrology	Hume & Sharp
8.	Engineering Metrology	I.C. Patel
9.	Engineering Metrology	Taber
10.	Engineering Metrology	R.K. Pajput
11.	Engineering Metrology (Hindi Edition)	H.K. Pareek

PROGRAMME: DIPLOMA IN PRODUCTION ENGG.
SCHEME: REVISED, IMPLEMENTED FROM 1995-96
SEMESTER: FOURTH
COURSE: Workshop Technology (Manufacturing Tech.-II) (P.C. 2062)

Topic No.	Details of Topic	Total Theory Periods	Practical Periods
1.	Elements of Machining	6	-
2.	Lathe	10	23
3.	Drill	4	6
4.	Shaper	7	9
5.	Planer	4	9
6.	Slotter	4	6
7.	Milling	12	15
8.	Grinding	10	9
9.	Mechanical Working of metal	20	-
10.	Press Work	7	7
	Total	84	84

SUBJECT - MANUFACTURING ~~PROCESS~~ Tech. II (MECHANICAL WORKING OF METALS)

Sl.No	Topics	Intended learning out comes (ILOs)	Remarks
1.	Elements of Machining		
1.1	Metals cutting by hand tools (2 Hrs.)	Understand the similarity of use of wedge cutting tools in a machining process and hand tools * List hand cutting tools such as chisel, wedge tool, hot and cold chisel, shears punches * Sketch the above tools and show rake angle and clearance angle in each case * Explain force acting through the cutting wedge and importance of narrow wedge angle to obtain greater forces for cutting. * Explain development of cutting forces which widen the notch and lead to crack formation for cutting * Explain chip formation in case of hacksaw, machining and chipping chisel. * Explain use of knife edge pillar to shear cut the metals. * Discuss the use of clearance space provided in hand tools as space to accommodate chips as in case of hacksaw tap * etc.	
1.2	Introduction to metal machining by machine tools (1 Hr.)	Understand machining of metal on machine tools by cutting tools * Know mechanics of cutting and chip formation by single point cutting tool.	

		• Sketch shear plane, rake angle, clearance angle on a tool for machining. • Explain formation of shear zone and its importance in metal cutting & in producing chips • etc.
1.3	Tool Geometry of cutting tools used on machine (1 Hr.)	Understand tool geometry and functions of tool angles. • List the cutting angles of single point tool such as top rake angle, side rake angle, side clearance angle, front clearance angle, side relief angle, end relief angle, nose radius. • Sketch single point cutting tool and show the above angles. • Explain the purpose of top rake angle and side rake angles • etc
1.4	Characteristics of cutting tool materials (one hours)	Understand the basic requirement of cutting tool material • List the required property of cutting tool materials such as hardness wear resistance, hot hardness, toughness. frictional coefficient cost and easiness in fabrication. • Define the above proportion. • Explain influence of these properties on choice of cutting tool material. • etc
1.5	Cutting fluid (One hours) (1.6 x 1.7)	Know properties of a good cutting fluid • List the purpose of cutting fluid.

		• List the properties of a good cutting fluid. • Name come commonly used cutting fluids and their scope of use • etc
1.6	Type of cutting fluid	Understand the different types of cutting fluid used in machining. • List dry and wet cutting fluid and their importance. • Explain selection of cutting fluid for different metal machining process • etc
2.	Lathe Machine	
2.1	Principle of machining used in lathe work (1 Hr.)	Understand the basic principle of machining on lathe machine. • State the principle of machining on lathe as metal removal parallel to axis of rotation. • Define the cutting variables such as cutting speed, feed and depth of cut. • Give examples of certain products produced on lathe as bolt, axle, pulley , flange • etc
2.2	Type of lathe (1 Hr.)	Know the different type of lathe. • List type of lathe, speed lathe, engine lathe, bench lathe, tool room lathe, capstan and turret lathe, special purpose lathe, automatic lathes. • etc

2.3	Centre lathe (1 Hr.)	Understand the constructional details and parts of a lathe. • List different unit/parts of a lathe such as bed, head stock, tailstock, carriage, cross slide, swivel, compound rest, tool post, lead screw. • Explain the function of each part. • Sketch the diagram or lathe machine • etc
2.4	Specification of lathe (2 Hrs.)	Know how the size of lathe is specified. • State the parameters considered in specifying a lathe machine such as center height over bed, gap bed, swing diameter over bed, length between centers, maximum bar diameters, length of bed speeds headstock, speeds with back gear, range of speeds.
2.5	Spindle speeds (1 Hr.)	Understand arrangement of spindle speed and methods to obtain them. • Explain difference in spindle speed and cutting speed in terms of small and large diameter of work and need for variation of spindle speed. • List direct speed and indirect speed. • Describe the back gear arrangement to obtain indirect speeds and necessity to reduce speeds to cut threads.
2.6	Lathe accessories and attachments (1 Hr.)	Know the accessories used on lathe machine to hold work. • List accessories used on head stock to hold the work such as chucks, (three jaw, four jaw, magnetic and collect) Angle plate, face plate, dog carries.

		device to hold the work. • Explain steady rest and follower rest use to support a long work piece between centers. • etc
2.7	Lathe operations ( )	Understand different operations performed on lathe. • List different operations performed on lathe by cutting tool clamped on tool post such as turning, taper turning, chamfering, facing, knurling, grooving, spinning thread cutting, tape turning parting off • etc • Explain each operation with sketch. • List operations performed by tool fixed in tail stock such as drilling, reaming, boring, counter boring, tapping.
2.8	Standard taper (1 Hr.)	Understand the different types of standard taper. • List standard tapers such as morse, brown and sharpe, metric tapers, standard taper numbers. • Explain use of standard tapers to facilitate interchangeability and advantage of morse and metric tapers.
2.9	Methods of taper turning (1 Hr.)	Understand different methods used on lathe for taper turning and their limitations. • List methods of taper turning such as form tool, compound rest swivel, tail stock set over and taper turning attachment. • Explain the above methods and their limitations with length of work.

- Calculate taper angles and amount of set over of tail stock.
- Sketch taper turning attachment and explain how tool is guided to cut taper on long work.

2.10 Thread cutting (Two hours)

Understand the principle of thread cutting.

- Know the thread nomenclature such as major diameter, minor diameter, pitch diameter, pitch of thread, thread angle.
- List the principle of thread cutting as a ratio between spindle rotation and longitudinal feed of tool to cut threads.
- Determine ratio between spindle rotation & longitudinal feed of tool to cut thread.
- Sketch spindle, change gear, lead screw and explain calculation for change wheels to obtain a definite ratio of pitch of work and pitch of lead screw.
- Calculate change gear to cut metric threads on a lathe with an english pitch lead screw.
- Explain the use of thread chasing dial for cutting odd number and fractional pitch on lathe machine.

3. Drilling Machine

3.1 Principle of machining (One hour) 3.1 x 3.2

Understand the principle of machining a hole by drill

- Explain principle of drilling machine to make hole by a rotation of cutting tools called drill.

3.2	Type of drilling machine	Know different type of drilling machine • List different type of drilling machine such as bench drilling, pillar drilling, radial drilling, gang drilling, multiple spindle drilling, deep hole drilling. • State the difference between the different types of drilling machines
3.3	Pillar type drilling machine (One hour)	Understand the functions of the parts of drilling machine. • Sketch the diagram of pillar drilling machine. • List the parts of drill machine such as base, column, table, motor, cone pulley drill head. • Explain function of parts of drill machine. • Explain cutting speed, feed and depth of cut in machining of drill.
3.4	Tools Geometry of drill (One hour)	Understand tool geometry of drill • Sketch a twist drill and list different angles and other elements such as rake angle, chisel edge angle, lip angle, land, heel, helix angle, flute length, body clearance, shank, tang. • List different type of drill such as flat, straight flute, twist drill, parallel shank, taper shank, oil tube, center drill.
3.5	Indian standard system of drill (One hour)	Understand drill size in metric and British system and Indian standard system. • List number size system of British such as No.1 to No.8

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		• List length size of drill range from A To Z. • State that fractional size of drill range from 1/64" to 5"in step of 1/6" upto 1-3/4" • Specify a drill bit to place a purchase order Understand the Indian standard system of drills. • Explain I.S..Number and materials of the drill, Drill type N for normal H for hand and S for soft. • State design requirement and material to be cut by the drill. • Specially a drill bit to place a purchase other
4.	Shaper	
4.1	Principle of machining on shaper (One hour)	Understand the basic principle of machining on shaper machine. • Explain the principle of machining on shaper . • Define cutting stroke and return storke and speed ratio. • etc.
4.2	Crank type shaper	Understand the parts of crank type shaper. • List the parts of shaper such as column, cross rail, saddle,table, ram, tool head. • Sketch the diagram of shaper. • Explain the function of each part of shaper. • etc.

type of shaper

		Know the different types of shaper. • List type of shaper according to type of mechanism. • State names of at least two types of shapes and their specific field of use.
4.3	Specification of shaper. (One hour) 4.4 + 4.5	Know the specification of shaper. • State parameters considered to specify a shaper machine such as length of stroke, type of drive, power input, ratio of cutting and idle stroke, no. of speed steps.
4.4	Cutting tool for shaper	Understand a single point cutting tool used on shaper. • List cutting angles of single point tool. • Sketch cutting tools perpendicular to work surface for machining. • Explain use of cutting angles for machining. • etc.
4.5	Crank and slotted link mechanism (One hour)	Understand details parts of mechanism and function of each part. • List parts of quick return mechanism such as ram, screw shaft, bevel gear, ------ link, rocker arm ------, bull gear, bull gear slide. • Sketch the mechanism. • State the principle of quick return crank mechanism and function of each part. • Explain the method of adjustment of length of stroke and position of stroke. • etc.

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4.6	Hydraulic shaper (One hour)	Understand the principle of hydraulic shaper • List the parts of hydraulic shaper such as oil pump, throttle valve, rack, cylinder, piston rod, direcion reversal of lever, relief valve etc. • Sketch the hydraulic shaper mechanism. • Explain the principle of hydraulic controlled shaper. • State function of throttle and relief valve • etc.
4.7	Work holding devices (One hour)	Know the use of work holding devices • List work holding devices such as vices, clamps, toe dogs, V block • State their application • etc.
5.	Planer	
5.1	Principle of machining on planer (One hour) 5.1 x 5.2	Understand the basic principle of machining on planer machines. • State the principle of machining of planer. • Explain that table reciprocates during cutting and return stroke. • etc.
5.2	Types of planing machine (One hour)	Know the different types of planer. • List the different types of planer. • Explain use of different types of planer.

5.3	Double housing planer (One hour)	Understand constructional detail and function of parts of planer. • List the part of a planer such as bed, table, cross rail, housing, tool head, driving and feed mechanism. • State function of major parts and units
5.4	Principle of table drive mechanism (one hour)	Understand the principle of quick return mechanism of table drive. • Sketch the belt driven mechanism • Explain the principle of table drive for cutting stroke and return stroke (idle stroke).
6.	Slotter	
6.1	Principle of slotting machine (One hour) 6.1 x 6.2	Understand the basic principle of slotting machine. • State the principle of slotting machine. • Explain movement of tool in vertical direction (Upward and downward motion).
6.2	Types of slotting machine	Know the types of slotting machine. • List the different types of slotter machine. • Explain use of different types of slotter.
6.3	Slotting machine parts and their function (One hour)	Understand constructional detail and parts of slotter. • Sketch a slotting machine. • Identify & list the parts of slotting machine such as base, feed gear, column, ram, bull gear, cone pulling, feed shaft, pawl actuating crank.

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		• State the function of major part & units of a slotter machine
6.4	Whitworth Quick return mechanism (one hour)	Understand quick return mechanism for vertical motion. • State the principle of whitworth quick return mechanism. • Sketch quick return mechanism • Explain movement of tool downward stroke (cutting stroke) and upward stroke (idle and quick) motion.
6.5	Tools Geometry for slotter (One hour)	Understand tool geometry of single point tool used on slotter. • State cutting angles of tool • Sketch the diagram or cutting tool • Explain the difference in rake angle and clearance angle in terms of slotter as pressure during cutting acts in vertical plans • etc.
7.	Milling machine	
7.1	Principle of basic milling process (One hour) 7.1 & 7.2	Understand the principle of milling process. • State the principle of milling machine in which multipoint cutter removes metal as work is fed against rotating cutter. • Explain wide application of use of multi point cutter as it removes metal at a very fast rate.
7.2	Type of milling machine	Know the different types of milling machine. • List the different types of milling machine.

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		• Explain use of different type of milling machine for specific requirement.
7.3	Column & knee type machine (One hour)	Understand the construction detail and function of parts of milling machine. • List the parts of milling machine such as base, elevating screw, knee saddle, table, column, overarm arbour, cutter, gear box, table spindle etc. • Sketch the machine showing above parts. • Explain function of each part. • etc.
7.4	Universal milling machine (One hour)	Know universal milling machine construction and its scope of use. • List main difference in plain and universal milling machine. • Explain importance of universal milling machine to cut helical bevel gears etc.
7.5	Specification of milling machine (One hour)	Know the specification of milling machine. • List the size of machine based on table length, width of table, maximum length of longitudinal, cross and vertical travel of table, number of spindle speeds, numbers of feeds, power, minimum distance between table and column.
7.6	Operations on milling machine (One hour)	Know the different operations performed on milling machine. • List the operation such as plain milling, face milling, side milling, straddle, Gang, Angular, form profile, saw milling, gear cutting, helical, cam, thread, keyway, groove and slots. • Explain the difference among these operations • etc.

7.7	Types of milling cutters (One hour)	Understand different type of milling cutters and their use for different operations :- * List different types of milling cutters * Explain use of different milling cutter for different operation. * State & explain construction of solid and throw among tip milling cutters * Name the material of milling cutter * etc.
7.8	Elements of milling cutter (One hour)	Understand angles of milling cutter and their importance in metal cutting. * List the different cutting angles, such as rake, relief, clearance (primary and secondary) lip angle, face and back of tooth. * Explain the effect of cutting angles to remove metal efficiently.
7.9	Milling methods (One hour)	Understand peripheral milling methods to produce surface parallel o axis of rotation of cutter. * List methods of milling such as up milling, down milling, * Sketch up milling and down milling methods and show maximum size of chip removed in down milling method. * Explain importance of down milling method to produce good surface finish. * Explain the difference among the two methods of milling * etc.

7.10	Cutting speed, feed and time of machining (One hour)	Know about cutting speed, feed and depth of cut of machining in milling machine. * Define the terms for milling machine. * Calculate machining time for milling a job and total quantity of swarf removal.
7.11	Principle of dividing head (One hour)	Understand the principle of dividing head. * List the parts of dividing head such as worm gear, spindle, pionion index plate, index crank, bevel gears , change gears. * Sketch and show the parts of divicing head. * Explain principle of dividing head and function of each part * State the uses of dividing head.
7.12	Indexing methods (One hour)	Know the different indexing methods. * List the indexing methods such as direct, simple, compound, differential, angular indexing. * Explain each indexing method with its limitation. * Calculate gear ratio to obtain indexing by differential indexing method. * etc.
7.13	Machining particular of spur Gear (One hour)	Understand machining particulars of spur gear. * List the parameters required for machining particulars such as module, no. of teeth, outside diameter, pitch diameter, circular pitch indexing. * Define the above parameters and their inter relation. * Calculate outside diameter, pitch diameter, indexing etc. where module and no of teeth given. * etc.

8.	Grinding Machines	
8.1	Abrasives in grinding wheels (One hour) 8.1 x 8.2	Know grinding wheel a as multi point cutter used to remove metal. • List name of abrasives (artificial and natural ones) used in grind wheel to remove metal. • Explain sand used to polish the metals and diamond is hardest element which can machine metals and remove stock rapidly.
8.2	Use of Bond	Know that bonds are used to bind the abrasives in the form of wheels. • List different type of bonds used in grinding of wheels such as vitrified, rubber, shellac, oxydorice silicate. • Explain quantity and type of bond used in grinding wheel change the hardness and work utility of grinding wheel.
8.3	Classification of grinding wheel (One hour)	Understand that grinding wheels are marked with a number denoting abrasive and bond material. • List the classification denoted by the name of abrasive size of particle, hardness grade structure, percentage of bond and type of bond used in grinding. • Explain details of grain size hardness number denoted by grade, percentage of bond used as structure and type of bond with its use.

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8.4	Standard wheel marking (One hour) 8.5 x 8.6	Know about manufacturing code of wheel marking. * State standard wheel marking and its use in industry for selection of grinding wheel for required purpose.
8.5	Standard wheel shape and size	Know the different wheel shapes used on grinding machine for different types of work. * List the different grinding wheel shapes such as straight, cylinder, flaring cup, dish, straight cup, mounted points. * Sketch the shapes of grinding wheel. * Explain use of different shapes for cylindrical grinding, saw tooth grinding, milling machine cutter grinding, dies grinding etc. * etc.
8.6	Selection of grinding wheel (One hour)	Know selection of grinding wheel for deferent applications. * List the factors to be considered while selecting a grinding wheel under (i) Constant factor (ii) Variable factor. * State constant factors as (i) Material to be ground. (ii) Amount of stock removed. (iii) Area of contact. (iv) Type of grinding machine. * Explain each constant factor for selection of grinding wheel. * State variable function for selection of grinding wheels as wheel speed, work speed, condition of machine, personal factor (skill of operator). * Explain each variable factor for selection of grinding wheel.

8.7	Balancing of grinding wheel (One hour) 8.8 x 8.9	Understand the reason for balancing of grinding wheel. • Explain the necessity and method to be used for balancing of grinding wheel. • etc
8.8	Wear in grinding wheel	Understand grinding wheel wear phenomenon and terms used to classify. • List the terms such as glazing, loading, deforming. • Explain dressing and truing methods to remove wear of wheels.
8.9	Grinding machine (One hour)	Understand basic principle of working of grinding machines. • Sketch diagram of a plain contra type of grinder machine. • List the main parts such as base, table, head stock, tail stock, upper table, wheel Head, grinding wheel. • Explain function of each part in cylindrical grinding.
8.10	Types of grinding machines (One hour) 8.11 x 8.12	Know the different types of grinding machine and their application. • List the different type of grinding machine such as cylindrical grinding, surface grinding, internal grinding and centreless grinding. • Explain different operations performed on the above machine.

8.11	Surface grinding	Know surface grinding used to grind plan and flat surfaces. * State horizontal spindle and vertical spindle grinders to machine surfaces on reciprocating and rotary tables. * Explain area of contact and stock removal rate is high in vertical spindle grinders.
8.12	Form profile grinding (One hour)	Understand grinding of different forms, tapers, faces, shoulders, crank shafts, etc * State work rotation in a fixed position and wheel feed forward to grind faces, shoulder forms etc. * Explain plunge grinding in grinding bearing base of crank shaft. * Explain grinding of with eccentric rotation of work.
8.13	Centerless grinding (One hour)	Understand principle of centerless grinding and its importance in mass production of precision parts by grinding. * State the principle or centreless grinding where work is neither supported nor clamped in devices. * Sketch external centreless grinding and list the main parts such as regulating wheel grinding wheel and work. * Explain that the process is continuous, saves labour time, and provide controlled precision size of grind finished work. * Sketch internal centreless grinder and list parts such as pressure role work, regulating wheel, support wheel grinding wheel.

		• Explain internal grinding producing uniform wall thickness and concentricity without clamping work. • etc.
8.14	Tool and cutter grinder (One hour)	Know method to sharpen multiple tool cutter. • List the multi point tools like reamers, milling cutter, drill, taps, hobs, jigs and fixture, gauges are grinded on tool and cutter grinder. • Sketch universal tool & cutter grinder and list main parts such as base column, table, saddle, wheel head, wheel head stock, tail stock. • State function of these parts • Explain all these covement of work longitudinal on table, cross on saddle • etc.
9.	Basic production process Classification	Know the basic production processes. • List the basic production processes such as cutting shaping processes to include turning, drilling, milling etc. and non-cutting shaping processes to include forging, rolling, pressing etc.
9.1.1	Various non cutting (Plastic deformation) processes	Know the parameters considered in plastic deformation such as pressure and temperature. • List the different parameters considered for plastic deformation such as pressure and temp. etc. • Explain the role of these parameters. • Explain the phenomenon of plastic deformation.

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9.2	Hot working processes principle, advantage and disadvantages, different hot working processes such as rolling, forging, spinning, extrusion, piercing and drawing (Wire)	Understand the concepts of hot and cold working processes. • Define recrystallisation temp., hot and cold working. • List the advantages and disadvantages of hot working processes. • List the hot working processes.
9.3	Hot rolling	• List the raw materials used for hot rolling such as ingots, blocks, billets, slab. • Name at least five products produced by hot rolling such as flat, angle, tee., channel round bar, I-section etc. • Enumerate the advantage of producing such section by rolling • etc.
9.3.1	Principle of rolling	Understand the rolling process. • Explain the principle of rolling. • List the various types of rolling mill such as two high mill, three high mill, four high mill, cluster mill, • Explain the construction & working of at least one type of hot rolling mill
9.4	Forging tools and equipments (Power hammer, (press) drop-hammer). Forging processes (necking down, drawing, bending upsetting, welding)	Understand the forging process • List the tools and equipments used in forging Recall the hand tools • State the function of various forging tools and equipments (presses or power hammers) used in black smithy. • Explain the various forging processes such as drawing, upsetting. • etc.

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9.4.1	Forging defects	State the varous forging defects.
9.5	Hot spinning	Understand the spinning process. • Define the spinning process. • Explain the hot spinning process.
9.6	Hot extrusion	Understand the hot extrusion process. • List the types of extrusion process such as direct extrusion or forward process, indirect extrusion or backward process. • Explain theconstruction & working principle of an extructer ror this process
9.7	Welded pipe and tube manufacturing	Understand the manufacturing of welded pipe an tubes. • Explain the process of manufacturing of welded pipe and tubes. • State its advantages over seamless pipes & tubes
9.8	Roll piercing	Understand the process of roll piercing. • Define the roll piercing. • Explain the process of roll piercing.
9.9	Hot drawing	Understand the hot drawing process. • Define the term drawing. • Explain the hot drawing process and illustrate the process with suitable examples such as cup making.
9.10	Cold working processes definition, advantages, disadvantages limitations	Understand the cold working processes. • List advantage and disadvantages limitations of cold working process. • Name at least four colo working processes

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9.11	Cold drawing (wire), cold spinning, cold hobbing, cold extrusion, embossing, coining	• List various cold working process. • Explain the various cold working process. Give the area of application of the various cold working processes with suitable examples.
10.	Revision	• Revise a compare the processes studied

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LIST OF PRACTICALS

a)	Measuring of angles of a single point cutting tool with reference to main plane with the aid of sheet templates.	5 hrs
b)	Demonstration of different shapes of cutting tool used for different operations.	
c)	Demonstration of functions of lathe parts.	
4.	Practice of plane turning and step turning on a pieces of bar.	3 hrs
5.	Practice of chamfering grooving, knurling and taper by form tool on a piece of bar.	3 hrs
6.	Practice taper turning.	3 hrs
7.	Practice whitworth threads cutting even pitch pitch on lathe	3 hrs
8.	Practice of whitworth threads in inch system of of odd number pitch.	3 hrs
9.	Practice cutting internal thread on a nut to match with 5.	3 hrs
		26 hrs

a) Demonstration of grinding of cutting edge, rake angle of drill.

b) Demonstration of twist drill, parallel and taper shank inch system and metric drills. — 3 hrs

Practice of drilling a hole on work produced on lathe.

Boring of drilled hole on lathe to increase the diameter by boring tools — 3 hrs

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6 hrs

Demonstration of holding a work on shaper machine table.

Demonstration of adjustment of length of stroke and place of stroke with reference to work. — 3 hrs

Practice of formation of two perpendular sides and angle of V block. — 6 hrs

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9 hrs

Demonstration of holding a work on plane machine.

Demonstration of adjustment of stroke length and quick return mechanism of planer. — 3 hrs

Practice of surface planning of work on planer. — 6 hrs

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9 hrs

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1.	Demonstration of single point tool used and fixed in vertical position for machining.	
	Demonstration of quick return mechanism of slotter.	3 hrs
2.	Practice of key way machining on a pulley.	3 hrs
	Practice of side surfacing on a work.	6 hrs
1.	Practice mounting of cutter on milling machine arbor and demonstration of hand and automatic motion to work (longitudinal, vertical and cross).	3 hrs
2.	Practice of Up milling and down milling operation with slab mill cutter.	3 hrs
3.	Practice cutting of the spur gear on milling machine.	6 hrs
4.	Demonstration of grinding of milling cutter on tool and cutter grinder.	3 hrs
		15 hrs
1.	Demonstration of balancing and dressing of grinding wheel.	3 hrs
2.	Practice of cylindrical grinding on grinding machine.	6 hrs
		9 hrs
1.	Demonstration of bending angle of 90° and shearing of sheet including development of sheet. (may be done through visit to an industry)	4 hrs
		4 hrs

PROGRAMME: DIPLOMA IN PRODUCTION ENGG.
SCHEME: REVISED, IMPLEMENTED FROM 1995-96
SEMESTER: FOURTH
COURSE: Production Drawing (P.C. 2063)

RATIONALE

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Topic	Theory (Hrs.)	Practical (Hrs.)	Plates (Hrs.)
Development of surfaces	02	12	1
Intersection of surfaces	02	12	1
Multiview projections	3	18	2
Sectional views of machine parts	3	18	2
Threaded fasteners and screwed joints	01	06	1
Welded joints	1	6	1
Couplings	1	6	1
Bearings	1	6	1
Assembly of machine elements	6	36	6
Surface texture	1	6	1
Introduction of fits, tolerance on production drawing	1	6	1
Shop floor drawings	2	12	1
Pipenglayout drawing	1	6	1
Reproduction of drawings	1	6	one leaving
Computer aided drawings	2	12	1
	28 (1)	168 (6)	21 plates

S.no	Topic & Sub - topics	I.L.O.S	Remark
1.	Development of surface (2 hrs. Theory + 12 Hrs. Practice) - Introduction - Principal methods of development Parallel line development Radial line development Triangulation development - Development of polyhedra Rectangular prism Squre pyramid Tetrahedron Hexagonal prism - Developments of solids of Right circular cylinder Right circular cone - Development of truncated solids Right regular trancated hexagonal prism Right regular trancated pentagonal pyramid Trancated cylinder Right regular trancuted	Applies the concept or development of of the surfaces in prepaing drawing Explain following principal methods of development 1) Parallel line development 2) Radial line development 3) Triangulation development Draws the development of the surface or the folling polyhedra 1) Rectangular prism 2) Squre pyramid 3) Tetrahedron 4) Hexagonal prism Draws the development of surface of the folling solids 1) Right regular truncated 2) Right circular cone Draws the development of following truncuted solids 1) Right regular trancuted hexagonal prism 2) Right regular trancated pentagonal pyramid 3) Trancated cylinder 4) Right a regular trancuted cone	One plate to be
2.	Intersection of surfaces (2 Hrs.Th. + 12 Hrs.Pr.) - Introduction - Classirication of intersection surfaces :- Intersection of the plane surface	Aplication the term "Intersection of surfaces" Explains the classification of Intersecting surfaces	One plate to be prepared

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	Intersection of two plane surfaces Intersection of one plane and one curved surfaces - Methods used to draw the line of intersection Line method or piercing point method Cutting plane method	States the methods used to draw the line or intersection	
	- Line of intersection of prism	Draws the line of intersection of prism in prism	
	- Line of intersection of cylinder	Draws the line of intersection of cylinder in cylinder	
	- Line of intersection of cylinder in cone	Draws the line of interseftion of cylinder in cone	
3.	Multivew projections (Frist angle method) (3 Hrs.Th. = 18 Hrs.Pr.) - Introduction to multiview	Applies the concepts about multiview projection in preparting drawings	Two plates to be prepared
	- Principle of multuiview projec- (Orthographic projection) Different between first and third angle projection Indication of method of projection	- Defines the terms projection and plane of projection - Lists the methods used fpr shape representation - Explains the principle of multiview projection ro represent the true shope and size of a three dimention object on two diamention plane - Explains the two methods of projection - Differentiates between the projections drawn by two methods	
	- Orientation of objects		
	- Selection of views One view drawing Two view drawing Three view drawing - Procedure for preparing orthographic view	- Sketches the symbols used in the rirst and third angle projection	

	Projection of an object having normal surfaces Projection of an object having inclined surfaces Projection of an object having curved surfaces Projection of an object having oblicue surfaces Projection of an object having fillets and rounds - Auxiliary views	- Explains the process of selecting position of an object for the purpose of preparing orthographic views of it - Selects the numbere of views for describing the scope of an object completely through its orthographic views i.e. - One view drawing - Two view drawing - Three view drawing - Explains the step by step procedure to make orthorgraphic views of an object - Illustrates as to row the orthographic views are drawn from pictorial views of object having a) Normal surfaces b) Inclined surfaces c) Curved surfaces d) Oblique surfaces - Defines auxiliary pane and auxiliary view - Explain the method of project the view or the inclired surface or an object on an auxiliary plane - Given a situation applies the concepts to drans the desined views of the given object	
4.	Sectional views of machine parts (3 Hrs.Th. + 18 Hrs.Pr.) - Introduction - Full section views	Applies the concepts about sectional views of machine parts in preparing drawings - Explains sectional view or sectional projection used in machine drawing	Two plates to be prepared

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- Half sectional views - Sectioning conventions - Conventional representation of materials	- States the reason of drawing the sectional views in orthographic projection - Explains the method of drawing full sectional views and volt sectional views in orthographic projection - State the different conventions used representation of materials - Given a machine part draws sectional views (full/half) using conventional representation of materials

Threaded Fasteners and Screwed joints (1 Hr. Th + 6 Hrs. Pr.)

(A) Threaded Fasteners

- Introduction
- Nomenclasature of screw
- Right hand & left hand thread
- Forms of screw threads
- Designation of threads
- Conventional Representation of thread
- Representation of External threads
- Representation of Internal threads
- Types of threaded fasterners
- Nuts, Bolts and Washers & their proportions
- Drawing of hexagonal and squaring bolts & Nuts
- Stud or Stud bolt
- Bolts with special forms of heads screws
- Classification of screws

Applies the concept about threaded fasteners and screwed joints in prepairs

- States the use of fasteners
- Defines fastering
- States the classirication of fasteners
- Defines the terms used in specifying any
- Sketches the symbols used for representing thread
- Explains the following
  a) Single Start and Multi-Start threads
  b) Right and Left hand threads
- States the important forms of screw threads i.e. ISO metric thread, square thread, Achne thread
- States the method of oesignation of threads as per Indian standard
- Sketches External & Internal threads
- States the important types of threaded fasterners i.e. different types of Nuts, Bolt, Studs, Screws
- States the approximate proportions used for drawing a bolt and a nut with a washer
- Draws three views of hexagonal and square

One plate to be

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	A) Cap B) Grub C) Set D) Machine - Dimension of ends of screws - Locking arrangement of Nuts - Different types of screwed	nuts and bolts - Lists the shapes of the ends of the screws as given below and the way their dimensions are shown in drawing a) Radiused or oral end b) Chamfered or flat end c) Coniut pointed end d) Clip end - Lists the different locking arrangements or nuts and the types or screwed joints - Draw the a) Assembly of a bolt, nut & washer b) Assembly or a bolt in a through hole c) Assembly of a bolt in a blind hole d) Assembly or a stud in a through hole e) Assembly of a stud in a blind hole	
6.	Welded Joints (1 Hr. Th. + 6 Hrs. Pr.) - Introduction - Classification of Welds 1. Types of welds 2. Types of joints 3. Length of Weld 4. Position of weld - Size of weld - Edge preparation - Representation of weld by symbols on production drawing - Positioning of welding symbols on a production drawing	Applies the concepts about welded joints in perpairs drawings - Recalls the concepts about the welding such as classification, process, Procedure to include type or welded joints etc. in brief - Defines size of weld - Sketches different types of welds joint length of welds and position of the welds as production drawing - Prepares a drawing showing welding details as per I.S. code	Welding is taught in the course of Manufacturing Technology - I of second year One plate to be prepared
7.	Coupling (1 Hr. Th. + 6 Hrs. Pr.) - Introduction - Classification of coupling - Flanged coupling protected - Universal coupling	Applies the knowledge about couplings in preparing drawing - States the use of coupling - Classification the coupling - Draws the front and side type and universal coupling	One plate to be prepared

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8.	Bearings (1 Hr. Th. + 6 Hrs. Pr.) - Representation of Rolling contact bearing on production drawing	Applies the knowledge about bearing preparing drawing - States the purpose of bearing - Given the following dimensions Sketches the deep grove ball bearing shaft diameter, outer daimeter, Inner dia and width of the bearing - Draws the assembly or the cylindrical roller bearing and a single thrust ball bearing - Sketches the convention for the representation of the ball and rollwe bearing in a machine desing	One plate to be prepared
	2) Sliding contact bearings - Types of journal bearing - Bearing brasses and their support - Presentation of rotation of brasses - Solid bearing - Bush bearing - Plummer block - Foot-step bearing	- Draws the dimensional view of the assembly of a plummer block and foot-step bearing - Draws the working drawing of bush bearing - Describes different types of thrust bearing and journal bearing - Describes the constructional details & material used for the making of brasses - Describes the different methods of preventing the rotation of the brasses along with the shaft with sketches	
9.	Assembly of Machine Elements (6 Hrs. Th. + 3 Hrs. Pr.) - Introduction - Making an assembly drawing - Making a workirg drawing - Machine tool parts 1. Plummer block 2. Foot step bearing 3. Lathe tail stock 4. Lathe tool post 5. Tool head of spring machine	Applies the knowledge about assemoly of machine elements in preparing drawing of - Explains the step by step of making details and assembly drawing - Draws the assembly drawing of the following machine tool parts: 1. Plummer block 2. Foot step bearing 3. Lathe tail stock 4. Lathe tail post 5. Tool head of shifting machine	Plates are to be prepared

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- Miscellaneous Machine Element - C-clamp - Machine vie - Screw jack - Jigs & fixture - Slip bush - Drill jag (post type) - Drill jig (latch type) - Milling fixture (Indexing	- Draws the assembly drawing of the following miscellaneous machine element a. C-clamp b. Machine vice c. Screw jack - Draws the assembly drawing of the following jigs and fixtures :- a. Slip bush b. Drill jig (post type) c. Drill Jig (lactch type) d. Milling fixture (Indexing type)
Surface Texture (1 Hr. Th. + 6 Hrs. Pr.) - Types of surfaces - Nomenclature of surfaces - Surface roughness value - Symbol used for Indication of surface texture - Indication of surface roughness - Indication of special surface texture characteristics - Surface texture symbol with all surface texture characteristics - Indication surface texture symbol with all surfaces texture - Indicating a complicated surfaces texture symbol repeatedly on a drawing - Selection of roughness values	Applies the concepts about surface textures appropriately as per I.S. on the production drawing the types of surfaces - States the types of surfaces - State the important terms (nomenclature) as used for surface - Explains the following two methods to calculate the surface roughness values a) Centre line arerage (CLA) metnod b) Root mean square (RMS) method - Draws the symbol used for surface texture to indicate by 1. Numerical values 2. Grade Numbers and - Explains special surface texture characterisitics such as a) Types of production method b) Types of treatment or coating c) Sampling length d) Direction of lay e) Machining allowances and f) Roughness values as used on production drawings

		- Shows on the drawing the surface texture symbol with all the surface texture characteristics - Sketches a complicated surface texture symbol in a simplied way on a drawing - Given a situation, selects the proper roughness values from the tabular data	One plate to be prepared
11.	Indication of Fits, Tolerance on production drawing (1 Hr. Th. + 6 Hrs. Pr.) - Indication of linear tolerances - Indication of fats on production drawing - Tolerance specified as note on - Geometrical Tolerances - Recommended symbols for geometrical characteristics - Tolerance frame and datum letter - Connecting tolerance frame to a tolerance feature	Applies the concepts about fits and Tolerances on production drawing - Draws different methods of indicating linear tolerances by letters and numerical symbols ar production drawing - Draws different methods of indicating fits on drawings - Describes two typical method representing the tolerances specified as a note within the tittle block or at the bottom of the drawing - Defines geametial tolerances - Knows the use of symbols (recommended by I.S.) to represent different - Types of geometrical characteristics as drawing - Describes a tolerancemframe hamg tnree campartments 2 two compartments - Draws three different methods of connecting tolerance frame to the art line of a feature ar drawing	One plate to be prepared
12.	Shop - Floor drawing (2 Hrs. Th. + 12 Hrs. Pr.) - Introduction - Types of shop floor drawings - Informations to be furnished on shop floor drawing	Applies the knowledge about shop floor drawing in preparing such drawings - Prepares part drawings or an assembly to be producedm complete informations necessary for manufacturing that part a particular shop	One plate to be prepared

	- Reading a shop floor drawing - Preparation a part drawing of an assembly for production - Overhung Crank	- Defines the term shop floor drawing - Name five important types of shop floor drawings - Outlines the important information to be furnished an shop floor drawing - Identify the basic requairments to develops th skill of readings on shop floor drawing	
13	Piping Layout Drawing (1 Hr. Th. + 6 Hrs. Pr.) - Introduction - Pipe fittings and values - Representation of pipe fittings and values - Single line Orthographic - Views - Single line Orthographic layout - Dimensioning of piping layout drawings	Applies the knowledge about piping layout drawings for preparing such drawings - Explains the use of pipes, pipe fittings and values - Represents different types of pipe fittings in a piping system on a drawing - Uses the method of dimensioning on drawings of piping layout art - Prepares single line Orthographic layout and single line developed layout of a given piping system	One plate to be prepared
14.	Reproduction of Drawing (1 Hr. Th. + 6 Hrs. Pr.) - Introduction - Drawing office - Tracing of drawings - Reprographic methods - Blue printing - Mirco filming - Ammonia printing	Understands the about reproduction of - States the functions of drawing office and the duties of draughts man - Describes a step by step procedure suggested for preparing better traings - Explains the following three reprographic methods used for rdproducing production drawing 1. Blue printing 2. Micro printing 3. Ammonia printing	Visit be arranged to Well equipment modern drawing office
15	Computer Aided Drafting (CAD) (2 Hrs. Th. + 12 Hrs. Pr.)	Understands the basic concepts about CAD - Defines the terms CAD, CAM etc. (as	Practice be given on computer as to enable

- CAD - Fundamentals of CAD - Hardware requirements for CAD - Various Software for CAD - Layer concept - Dimensioning - Units of measurement - Different type of lines - Hatch - Mouse - Digitzer - Definitons of :- CAD CAT CIM CAM CAPP FMC CIM CAOC CAE FEA CADG CAI FMS CADD - Application Areas of CAD concepts of Drafting a) Co-ordinate System b) Drawing Units - Drawing Resolution - Basic Operation Copy Move Select Delete Undo Edit - Important DOS commands	listed in topics) - OUtlines the foundamentals of CAD Identifies the hardware requirements for CAD - Names the various software for CAD - Names various plotting device - Explains layer concepts - Explains the concept of dimensioning, units of measurement - Describe different types of lines and hatch - Explains the use of Mouse and digitizer - States the area of application of CAD - Explains the concepts of Co-ordinating system and drawing units - Explains the term Drawing resolution Applies the knowledge about basic operation in practice - Names the basic operation - Lists important DOS commands - Performs basic operations such as Copy, Move etc.	students to make use of CAD, Software, Basic Utilities, Drawing set up, Creating simple entities, Creating complex entities Editing entities Dimensioning, linear, circular and angular

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Reference Books

a) Machine Drawing :-
Jovast Publishers
Vijjar, Trichur 680010 Ph. 26288

1. Engineering Graphics part I & II
By P.I. Varghese
K.G. John

2. Machine Drawing
(First angle projection)

3. Machine Drawing
N.D. Bhatt

4. Machine Drawing
Gupta

b) Computer Aided Drawing (CAD)
1.
2.
3.
4.
5.

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PROGRAMME: DIPLOMA IN PRODUCTION ENGG.
SCHEME: REVISED, IMPLEMENTED FROM 1995-96
SEMESTER: FOURTH
COURSE: Engg. Maths (Basic +Higher Maths) **(P.C. 2064)**

RATIONALE

Mathematics being a back bone of all types of technologies, Occupies an important place is the curriculum of polytechnics. It develops reasoning and thinking power of students. Being an elective subject for second year Diploma students the syllabus is so designed so as to work as bridge learning for those students who want to opt for higher studies such as BE,AMIE etc. and the course will definately fulfill the mathematical need of all technical subjects taught an the Diploma in production Engineering
Secondly, teachers are suggested that in general more stress should be given on theorem based problem so that the fendamentails of the subject/topic will automatically be clear to the students

HIGHER MATHS - I

S.NO	TOPIC	IN HRS.
	ALGEBRA	
1.1	Sets and binary operations	07
1.2	Sequence and series	04
1.3	Permutations	04
1.4	Combinations	04
1.5	Binomial	06
1.6	Exponential series	03
1.7	Logarithmic series	04
1.8	Determinants	04
1.9	Matrix TRIGONOMERIY	05
1.10	Inverse Trigonometric function	06
	LINEAR PROGRAMMING	
1.11	Linear Programming	08
	Total IN. HRS.	56

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HIGHER MATH II

S.NO.	TOPIC	TH. HRS
	COORDINATE GEOMETRY	
2.1	Family of lines	06
2.2	Circle	08
2.3	Conic section	06
2.4	Three dimensional Geometry	06
	STATISTICS	
2.5	Correlation and regression	06
2.6	Probability	06
2.7	Binomial distributation	04
	DIFFERENTIAL CALCULUS	
2.8	Application of derivatue	08
	DIFFERENTIAL EQUATIONS	
2.9	Introduction to differential equations	06
	Total TH. HRS	56

ALGEBRA

HIGHER MATHS - I

S.NO	TOPIC/SUB TOPIC	OBJECTIVE/ALOE	REMARK	PERIODS
1.1	Step and binary operation (7 Hrs.)	Applies basic concepts about set theory - Defines sets, sets operations - Solves problems to algebra of sets - Describes cartesian product of sets Applies the concept of binary operations - Defines binary operation in a set as a functions from (AxA) to A - Explains laws of associativity and commutativity of binary operation - Explains inverse of an element of A - Solves problems		
1.2	Sequence and series (4 Hrs.)	Applies the concept sequence and series - Distinguishes between sequence and series - Explains the general terms used in formulating a series - Solves problems	stress should be given an aggregate sequence and series obeying mathematical laws	
1.3	Permutation (4 Hrs.)	Applies the concepts of permulation - Defines for where n is a positive integer - Defines the permutations of n dissimilar things taken `r' at a tise - Gives the expression for finding the permutations of `n' which `p' and `q' forms separate groups of similar things - Gives the expression for finding the permutation of `n' dissimilar things taken `r' at a time such that i) `p' things always occur		

		ii) 'q' things never occur iii) 'p' things always occur and 'q' things never occur - Solved problems	
1.4	Combination (4 Hrs.)	Applies the concept of combination - Defines the combination of 'n' dissilar things taken 'r' at a time - Explains the formulae $ncr = \frac{n}{n-r \quad r}$, $ncr + ncr-1 = n+1cr$ $npr = n \quad ncr$	Solve simple problem on combination
1.5	Binomial Theorem (6 Hrs.)	- Solved problems Applies basic concepts of Binomial theory - States the binomial expansion of (x+a)n, Where n is any index - Writes the general term of the binomial expansion of (x+a)n - Find out the following the expansion of (x+a)n i) Middle terms ii) Coefficient of xn iii) Term independent of x - Solved problems	
1.6	Exponential Series (3 Hrs.)	Applies the concepts of exponential functions - Defines exponential functions - Explains the expression 2<e<3	Problems on sumination of series

		- Defines the hyperbole functions Sin hx, cos hx, tan hx.... etc. - Computes the sum of the series pertaining to the form of exponentia series	
1.7	Logarithmic Series	Applies the concept of Logarithmic Series - Write the expansion of loge (1+x), loge (1-x) - Solves in problems based on logarithmic series	
1.8	Determinants	Applies the concept of determinants - Defines determinants and its elements, row, column and order - Defines minor and the Co-factor of determinants - Computes the minor and the Co-factor - Solves higher order determinants into determinants of lower order - States the properties of determinants - Solves the determinants by using the properties - Solves simultaneous linear equations in three vaible by using determinants and applying Cramer's Rule	
1.9	Matrix (6 Hrs.)	Applies concepts of Matrix - Defines Matrix and its elements, row, column, order of matrix notation representing matrix - Defines equality, transpire, conjugate of matrix - Defines special matrix as as Square, Diagonal, Row, Column, Scalar, Unit,	Simple program based on these operation and laws

		Zero or Null, Upper and Lower triangular, Symmetric, Skew Symmetric matrix - Gives expression of addition of matrix, closer, identity, inverse and commutative law - Solve simple problems - Gives expressions for product of matricer, Reversal law ror the transpire of a product - Gives expression ror adjoint or a square matrix, Inverse of a matrix, Non singular and Singular matrices, Reversal law for the inverse of a product - Solves simple problem rared on Abjoint, Inverse and simple examples on non-singular and singular matrix
1.10	Inverse Trigonometric Functions (6 Hrs.)	Applies the concept of Inverse Trigonometic Functions - Defines Inverse Trgigonometrical Functions - Computes Principal values of a Trgigonometrical Functions - States properties of Inverse Trgigonometrical Functions - Relates Inverse Trgigonometrical Functions - Solves problems
1.11	Linear Programming (8 Hrs.)	Applies the concept of Linear Programming - Explains Linear Inequations in two variables - Solves Inequations by graphical method - Explains system of Inequations

- Solves simple problems on system of Inequations
- Defines Linear Programming
- Explains terms in Linear Programming
- Computes the problems of two variable Linear Programs by graphical method

2.1 Family of Lines (6 Hrs.)

Applies concepts of Family of Lines
- States the second degree homogenous equation of lines
- States angle between pair of lines
- States combined equation of the bisector of the angle between pair of lines
- States conditions for general second degree equation to represent a pair of lines
- Computes the point of intersection and angle between the two lines
- Solves simple problems based on above

2.2 Circle (8 Hrs.)

Applies concepts about Circle
- States standard and general form of the equation of a circle, its radius and centre
- States equation of circle in the parameter forms, and when the end points of the diameter are given
- Find out intersection points of lines and circle with the centre at the origin
- Explains condition for a line to be a tangent to the circle
- Computes length of the tangent and equation of the tangent at any point with respect to a circle
- Solves problems based on above

2.3	Conic Section	Applies concepts of Conic Section - Defines Conic Section - States standard equation and parametric equation of parabola - Defines eccentricity, focus, direcxtive, axis, Latus rectum for parabola - Explains tangent and tangent in terms of gradient to the parabola and point of contact of them - States standard equation and parametric equation of Ellipse - Defines Eccentricity, Latus Pectum, Major axis, Minor axis, foci and Directrix for Ellipse - Explains tangent and tangent in terms of gradient to the alias and point of contact - States standard equation and parametric equation of Hyperbola - Defines Latus Rectum, Transverse axis, Conjugate axis, Directrix for hyperbola - Explains Rectangular hyperbola, Condition for tangency
2.4	Decomposition of a Vector into Non-Coplanar Direction i,j,k as Base Vector in Three Dimensions (6 Hrs.)	Applies concepts of decomposition of Vector into three dimension - Defines direction Ratio and direction Cosine for any vector, angle between two Vector whose direction cosines - States distance between two points section formula, equation of lines through two given points, angle between two lines - States condition for the intersection of two lines, Shortest distance between two lines

		- States equations of a plane containing a given point and normal to a given direction - Explains angle between two planes, angle between a line and a plane - States distance of a point from the plane - Explains equations of any plane passing through the intersections of two planes - States Vector equation of the sphere - Explains Vector equation sphere with the position Vector of ends of Diameter
2.5	Correlation and Repression (6 Hrs.)	Applies the concepts of Frequency - Explains the term "Frequency Distribution" - Describes the types of frequency distribution - Describes relationship between variables - Defines Co-Variance - Computes simple problems on covariance - Defines correlation and its types - States Karl Persona's Co-efficient of Correlation - Computes simple problems on above - Defines Refraction and its types - Explains Regression lines and Repression equation - Computes Repression Co-efficient
2.6	Probability (6 Hrs.)	Applies concepts of probability - Defines Probability - Defines the term event - Describes types of an Events - States the formulas used for finding Probability of occurrence of an event

		- Explains odds in favour or against of an event - Explains addition theorems for mutually exclusive and mutually non-exclusive events - Explains probability for dependent and independent events - Solves problems on above
2.7	Binomial Distributions (4 Hrs.)	Applies the concepts of Binomial Distributions - Defines Binomial Distribution - States the formula for finding Binomial Distribution - Solves Binomial Distribution
2.8	Application of Derivative (8 Hrs.)	Applies concept of Derivation - Defines velocity acceleration. - Express the velocity and acceleration in derivative form - Finds velocity and acceleration in different problem - Express the formulae for motion under gravity - Solves the problem on motion under gravity - Solves the problems involving rate of change of quantities - Defines increasing and decreasing functions - Defines the terms Maxima and Minima - Solves simple problems on Maxima and Minima theorem - Solves problem on above theorem - Explains the terms approximation and Error - Solves problems of approximation and Error

2.9	Introduction to Differential Equations (6 Hrs.)	Applies concept of Differential Equation - Defines differential equation and its order and degree - Explains the different methods of solving of different equations of first order and first degree such as i) Variable separable ii) Homogeneous equation iii) Exact differential equation iv) Linear differential equation - Solves the simple problems on first order and first degree differential equations - Explains second order linear Differential method of solution equation with constant Co-efficient i) $f(D)y = o$ ii) $f(D)y = f(x)$ - Solves problem

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List Of Reference Books

1.	Mathematics for Polytechnic part I & II	Prepared by I.T.I Bhopal
2.	Probability	Scheme Series
3.	Differentials calcus	By Grouch
4.	Applied Mathematics	By Khare & Singhal
5.	Applied Mathematics	PBS Publication
6.	Engineering Mathematics	Deepak Prakashan Gwalior By Dr S.K.Chouksey and Manoj singh

PROGRAMME: DIPLOMA IN PRODUCTION ENGG.
SCHEME: REVISED, IMPLEMENTED FROM 1995-96
SEMESTER: FOURTH
COURSE: Steel Fabrication Tech. **(P.C. 2065)**

Rationale

Faced with the ned of competent technifian in the area of production engineering, a student technitian requires an integral approach with steel fabircation which will help him in dealing with various process involved in production technology such as steel compositioon, standards, different processes involved such in facbication work.

along with this same emerging processes are also involved such as hader beam welding. Plasure Arc welding and cutting and electron beam welding which will up grade the knopwledge and skill will help the students to interact with the today's need of industries.

So this course approach will definitely make the student skill full and job oriented.

Sl No.	List of topics	Hours Allocated Theory	Practical
1.	Types of steels, composition properties, standards etc. (National & International)	2	2
2.	Development of profiles, Nesting of components (manual and Computer aided)	2	4
3.	Weld prepration- Shearing, Gullptine, Planning, Rolling flame cutting, Plasma are cutting	4	6
4.	Welding symbols as per I.S.	2	-
5.	Methods of distortion control preheating, weld sequencing fixturing	1	3
6.	Fabrication assembly tools and method - lolerances, Levelling, Layout, Tag assembly	2	6
7.	Welding processing:- Oxy - Acctylene, Gas welding, Co2, Shielded metal arc welding, Submerged arc welding, Resi-estance welding, Electro slag welding	8	10
8.	Special welding processes:- TIG&MIG plasma arc welding flux cored arc welding, Electron beam and laser beam welding	8	6
9.	Selection ofwelding parameter	-	-
10.	Welding consumable	2	-
11.	Weld testing & inspection (As per ISO standards) Dyc penetration test, magenetic particle test, ultasonic test, and radio graphy	4	6
12.	Welding defects and remedies	1	2
13.	Quality control/quality assirance aspect in welding as periso standards Welding qualirication and welding procedure qualification Documentation as per clause 4.9 or ISO 9001 (Special processes)	5	4
14.	Mechanizationin welding (Rotatics)	4	4 visit to

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STEEL FABRICATION

.No	Topic	Time Period (Hrs.) TH.	PR.
	Types of steels, composition properties, Standards etc. (National & Internation)	3	2
	Development of profiles, Nesting of computer aided)	3	4
	Weld preparation shearing,bullotine; Planning, Rolling Flame cutting, Plasma arc cutting	4	6
	Welding symbols as per I.S.	2	-
	Methods of distortion control preheating, weld sequencing fixturing	5	3
	Fabrication asembly tools and methods- Iolerances, Levelling, Lauout,Jag assembly	3	6
	Welding processes :- Oxy - Acetylene Gas welding, Co2, Shielded metal arc welding, Submerged arc welding, Resistance welding, Electro-slag welding TIG & MIG	12	16
	Advances in welding processes laser Beam & Electron Beam		
	post welding treatment, Stress relieving, Metallurgicl chages in HAZ	2	2
	Welding equipments - Torch, Generators etc. Constructional & operational details	4	4
	Selection Uof welding parameters	2	-
	Welding consummables	2	-
	Weld testing & Inspection (As per I.S.U.. standards) Dye penetration test magenetic particle test, Ultrasonic test, Radiography	-	6
	Welding defects & remedies	5	2
	Quality contro/Quality Assurance aspects in welding as per I.S.U standards Welder Qualification and welding procedure Qualification Documentation as per clause 4.9 of I.S.U 9001 (Special Processes mecha-nization	5	4 (Demonstrat
	Automation in welding (Robitics)	4	4 (visit to industry)

1.	Steel material for Fabrication	Understands different types of steels used in steel fabrication - Lists different ytpes of steel used in fabrication such as 1) Low Carbon Steel 2) Mild Carbon Steel 3) Medium Carbon Steel 4) High Carbon Steel 5) Alloy Steel - Explain composition of above steels with their properties. - Lists various standard metals (National and international) used in steel fabrication on the basis of strength, heat treated condition and service application
.	Wild Preparation	Knows the metal cutting methods to prepare for Welding - List different methods of metal cutting such as flame cutting, shearing, rawing, punch press balnk in g, Eullotion, lething off (ror bar and triles). Plasma arc cutting - Explain importance of the above methods and their selection for most economical metal cutting the methods of forming as preparation fog welding such as press brake, bending rolls, contom bending, flanging and disting press die forming and drawing
.	Weld symbol	Understands parameters or welding symobols used for welding - Lists all parameters of wedding symbols such as finish, contour, root opening,effection theoat, depth, process reference type of weld, reference line, tail and arrow length of weld - Explain above symbols used and their importance - Explain elements of ISO standards such as referece time, arrow, basic weld symbol dimnentions and other data, supplementry symbols, finish symbols, tail, specification process

5. Distortion control

Understands a hard faced component is subject to distortion
- Explains the cause of distortion
- Lists the methods to control distortion such as, Straightened when hot slightly made convex before weld, minimum amount of weld depost, special welding sequence
- Explain special welding seuence to control distortion such as alternate in opposite sice, Divice in two equal point Short weld on one side and longerweids on opposite sice

Understands how the preheating used to reduce the hardness of of weld metel
- Explain the methods of preheating in frenace, circumferential heating of pipes with burness. induction heating, Electrical resistance heating

6. Assembly for Fabrication

Understands design and different of Assembly Tools used for Fabrication
- List assembly tools and devices used to position and to clamp the work during welding such as positioners, rotation, booms seamers, jigs, clamping systems and fixtures to assemble parts
- Explain importance to assemble parts quickly and accuratily for welding, use of toggle clamps, cam clamps, use of V block and angle plate for round and square work
- Explains use of Hydrostatic and premaratic clamp for positioning and clamping

7. Welding processes
1. Gas Welding

Understand Gas Welding process used to weld ferrous and Non ferrous metals
- Explains selection of filler rod for different thickness of metals
- Gives selection of filler rod thickness, Oxygen and acetylene pressure for different type of work and flame adjustment
- Explain functioning of Welding torch to change pressure and quantity according to welding requirement

- Sketch water cooled touch and explain its operation
- Give ratings of standard TIG control units
- Give classification and requirement Tungsten electrodes (As. 12,80) and current ranges
- Explains how Tungsten electrodes tip size is selected at different current ranges
- Explains TIG welding procedure for semi-automatic and automatic welding
- Give standard dimension for TIG welding rods as I.S.O. for GAS

MIG Welding

Understands Metal Inert Gas/Co2 Arc welding for welding

Knows MIG Welding technique as Metal Inert gas and welding and MAG welding as metal action gas in which Co2 or argon Gas mixture is used as shielding gas

- Explains the working of equipments such as D.C. Power source, a wire feeder, a shielding gas supply wire drive control, controls for current, gas flow cooling water
- Explains the working of welding gas with the arrangement for electrol wire, gas passage, nozzle cooling water control switches for current flow, wire feed and gas etc. of labelled sketch
- Give details of Automatic wleding head

Understands the process procedure of MIG welding

- List parameters considered for MIG welding procedure such as Electric size, welding current Arc voltage, Arc travel speed, Electrode extension, position of electrode, welding position
- Explains selection of Electrode size, current and voltage for welding procedure
- Gives edge preparation and joint fit up procedure required before welding
- Explains use of MIG welding to weld Mild Steel, Alloy steels, Stainless steel Aluminium Alloys copper and copper alloys

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- Give examples of selection of current rating voltage wire feed rate and arc travel speed for different size of plate thickness and different position of welding.

Plasma Arc Welding

Understands Plasma Arc Welding process and its application
- Define Plasma Arc Welding
- List advantage of Plasma Arc Welding and compare it with TIG welding
- Explains the operation of Plasma Arc Welding process with list of equipment such as electrode, Electrode setback, orifice gas plenem chamber, shielding gas, constricting nozzle orifice dioneter and torch stand off
- Define Microplasma Arc Welding
- Explains low current P.A.W is used to weld extremely thin sheets with slight rin in voltage
- Gives importance of gas shielding and good fixturing to weld thin sheets with better flixibility, high quality and better economy
- List Engineering and Industrial application of P.A.W in ship bilding, nuclear, electronic, aeroplace and Engineering Industry

Flux Cored Arc Welding

Understands flux Cored Arc Welding and its advantage over MIG/Co2 welding
- Explains flux core arc welding process with a continuous flux cored electrode wire (a tubular wire) filled inside with flux
- List advantage of flux cored arc welding such as, low arc time, low diposition rate, stub loss, welding skill and failigue Automatic wire feed and arc control reduction in spatter, improved weld surface low gas consumption than MIG
- Explains similarity in equipment as used in MIG/Co2 welding except the gas which may be used as an automatic process with welding head

Flux Cored Arc Welding	- List core elements used in flux cored electrodes and the various designs of cross-section to store elements - Explains application of F.C.A.W. Industries
Electron beam and Laser beam Welding	Understands Electrode beam Welding process and its application - Explains electron beam emitted from a heated Tungsten filament at 2000 C to weld work piece placed in a vacuum - List advantages of electron beam welding - Explains the working of equipment and function of each part with labelled sketch - List critical application of Electron beam welding in Bimetal saws, aircaraft engine, components, impellers for diesel engines
Electron beam and Laser beam Welding	Understand laser welding process to weld extremely small size of dissilar metals - Define LASER - Explains LASER technique to obtain fusion and welding of dissimilar metals which are very difficult to weld such as Tungsten stainless steel, titanium and columbium - Explains Industrial use of LASER beam welding in Aerospace and electronic industry
Welding Parameters	Understands Welding Parameter to devise Welding Procedure - List various parameters such as electrode size, current characteristics and value, welding speed, arc length, angle of electrode, welding position and wleding technique - Explains each parameter and its effect to select proper electrode and current rating for welding procedure
Welding Consumables	Understands filler material used as electrode coated with flux for welding - Explains functions of flux wating on electrode - Lists common flux ingredients and their function - Lists different type of elctrode wating and their limitation in use different proformance - Gives composition of Electrode core wire I.S.: 2879-1975 and expain its performance to influence weld metak properties

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Understand classification and wading of elect
1) List different groups of electrodes such a
electrode,
2) Low alloy steel electrodes
3) Stainless steel electrod
4) Surfacing electrode
5) Electrode for Cast iron
6) Copper and copper alloy electrodes
7) Ni-Nickel alloy electrode
8) Al & Al alloy electrode
- Gives I.S.O. 2560-1973(E) listing electrode symbols, current rating & voltage and type mild steel electrode
- Give electrode classification I.S. 1395 for electrodes, classification composition, cov weld properties
- Gives specification for stainless steel welding of corrosion resisting and heat res per I.S.O. 5206-1969 and details of coverin current condition
- Lists surfacing filler metals prepared by
- Give specification for covoereod electrode cast iron I.S. - 5511-1969
- Give specification for copper and copper al class, composition and use I.S. 8666-1977
- Knows handling and storage of electrodes
- Explains importance of storing electrode to grese shop floow dust moisture
- Explains influence of atmospheric humidity redrying schedules for electrode at differe

Testing and inspection of welds	Understands non distructive list of welding & Inspection - Lists variouus methods such as visual inspection, magnetic particle inspection, liquid penetrant inspection Radiographic inspection Uetrasonic inspection, Eddy current testing and Leak testing - Explains each testing methods in details with its limitation in testing, to obtain quantitative information - Give examples of I.S.O standards for Radiography, Ultrasonic testing	
Welding defects and remidies	Knows the different welding defects and their remidies - Lists the different welding defects such as incomplete penetration, lack of fusion, undercut, overlap, slag inclusion polosity, crack (Hot and Cold) crater crack, faulty weld size and profile spatter, melting off, arc blow, distortion, peening - Explains each welding defect and its remidies	
Quality control in Welding	Understand the Quality assurance aspects in Welding - Give I.S.O. 9000 standard for welding process control - Explains salient features of process control such as welding qualification and training records, control of environment and equipment, process revision, production and process control in terms of I.S.O. standards - Give I.S.O. 9000 standard for Inspection and testing - Explains Material inspection, Inprocess inspection and testing find inspection and testing. Test verification, final acceptance in terms of I.S.O. standards	
Welding process	Knows the about equipments and proceoss of gas welding properties of weldable for metal the importance of these properties in welding - Define certain meta' properties such as :- 1) Elasticity 2) Tensile strength 3) Yield strength	Recall the Knowledge about equipments process and general appcation of gas welding process Recall from the knowledge of materials technology

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4) Ductility
5) Brittleness
6) Hardness

- Lists ferous and non-ferous allys used in a welding process
- Differentiate between the requirements of f and non-ferous metals from the welding poin view

Knows about edge preparation of parts to be w

- List the steps of edge prepapration such as as per joint design cleaning and alignment
- States that level cutting for edge preparat by Oxt-acetylene gas cutting

Understands the control of parameters and the flame

- States the parameters to be controlled such and vol of gases to be mixed
- Explains the importance of control pressure acetylene gas and the mixture proportion fo adjustment
- States the about the gas welding procedure cast steel parts, sheet galvarised iron, me
- Describe welding procedures for iron & cast metal parts, cast iron
- State the reasons for adopting different pr
- Knows about filling of holws by gas welding
- States the procedure of filling of holes
- States procedure for gas welding for galva States procedure for welding cast iron

Knows about preparation of edge to be welded

- Describe welding rods, flux flame adjustmen of acetylene and oxygen
- Knows the various composition if alloy ste
- State preparation of edges for welding

- Describe methods used in alloy steel welding

Knows various composition of alluminium and alloy alluminium
- State welding properties of alluminium
- Describe welding methods for alluminium and alluminium alloy

Knows various compositions of copper and copper alloys
- State welding properties of copper and copper alloys
- Describe welding method for copper and copper alloys

Knows the composition of bronze
- State welding rods used for bronze welding
- State techniques used in bronze welding
- Describe a method of welding bronze sheet

Arc Welding

Understands properties of weldable metal in arc welding process
- Know about safety precaution in arc welding
- States starting procedurwes
  - Position of welder
  - Position of eletrode
  - Striking arc viz. Holding, Gripping etc.
  - Care in advancing arc
  - General instructions
- Illustrate first bead and guiding lives
- Illustrate typical wearing patterns
- Describe wearing procedures

Recall know ledge about equipments and general application of arc welding process

Knows about elerode stroge facilities
- Lists accessories used in cleaning welds
- Sketch efficient and inefficient welds along with cross section to show faults

Understands basic features of the arc welding power source
- Gives list of basic features

Defines static characterustic curve

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	- Sketch S.C.C Understands about current rating and duty cycles - Defines duty cycle, power factor of a power-source Knows about transformers - Classify parts and level on the schematic diagrams	
Welding processes Gas welding	Understands mechanisation as employed in gas welding process - Define mechanisation - Explain mechanisation - Select the parameters	Recall knowledge about equipments and general application of Oxy - Acetylence welding process
	Knows about fixtures and electrodes in gas welding process - Defines fixture and electrods - Explains geometrical features of fixtures and their selction - Sketch a situation where fixtures are used and level them - Knows safety prcaution - Explains different methods used for testing a fabricated structure - Sketch a diagram showing the testing of a mechanical equipment compon[illegible]	
Arc welding	Understands about mechanisation as employed in various Arc welding process - Defines mechanisation - Explains mechainsation for various Arc weldings - Select parameters Differentiate ferous and non - ferous alloy meterial - Lists ferous and non - ferous alloy meterials used for arc welding purpose	Recall knowledge about equipments and general application of Arc welding process

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PROGRAMME: DIPLOMA IN PRODUCTION ENGG.
SCHEME: REVISED, IMPLEMENTED FROM 1995-96
SEMESTER: FOURTH
COURSE: Plastic Technology **(P.C. 2066)**

1.No.	Topic	Number of Hours Theory	Practicals
1.	Polymers	2	
2.	Plastic Materials	14	
3.	General principles of selection of various additives	4	
4.	elements of different types of mould	6	12
5.	Plastic processing	22	30
6.	Raw Material and product	6	14
7.	Future trends in Plastics	2	
	Processing		
	Total	56	56

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S.NO	LIST A PRACTICAL	HR.
1.	Selection of electrides different thickness and type of metals	3
2.	Weld prepration	1
3.	Gas cutting of a steel plaste of 5mm (MS plaste)	3
4.	TIG Welding of steel sheet	3
5.	MIG welding of alluminum sheet	
6.	Testing of welding defects with the help ultrasonic m/c	
7.	Use of inspection instrument like vernier callipers, micrometer etc.	

REFERENCES

1.	Production technology	HMT
2.	Basic welding principles	Stieri
3.	Modern arc welding Technology	S.V.Nadkarni
4.	Materials and processes in manufacturing	E.PaulDegarmao
5.	Work shop technology Vol.II	Raghuwansi
5.	Work shop technology Vol.II	Hazra choudheri

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Plastic Technology

Rationale

It would be diffcult to imagine our modern world without plastics. Today they are an integral part of everyones life styles with applications varying from common place domestic articles to sophisticated scientific and medical instruments. The new applications of plastics are being explored every day.

The field of Production/Manufacturing Engg. is not left untouched by plastics, and in the real sense, it is now the new darling material for designs. Plastics has replaced many applications of other materials in Engineering products. To cater need for providing Technicians with workable knowledge in this field it is thought to introduce plastics engg. as an optional course at the level of second year.

The objective of the course is to make production engg. students familiar with plastics, its processing, commonly employed machines, its engineering application, testing etc.

The basic knowledge this gained here will be sufficient to make student conversant with plastics and its processing

Presently institutions do not have equipment for plastics processing and testing. Thus, it is proposed to organise industrial visits to organise for demonstration of these, till the institution are able to procure relevant equipment

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- Understands safely measures during working an arc welding
- Knows about electrode storage facilities
- Gives types of electrodes and materials used in
- Lists safety accessories
- Sketch efficient and inefficient weld along with cross sections to show faults
- Show different weaving patterns of welds

Understands basic features of the arc welding power source

- Gives list of basic features
- Define static characteristic curve
- Sketch S.C.C
- Define open circuit Vvoltage
- Sketch open circuit voltage curves
- Understands current rating and duty cycles
- Defines duty cycles
- Defines power factor of a power source

Understands transfermer

- Classify them
- Lists different parts
- Sketch types of transfermers and level ther

S.No.	Topic/Sub-Topic	Intended Learning Outcome	Remark
1.	Polymers (2 Hrs.) - Basic concepts - Types of Polymers - Process of Polymerization - Classification of Polymers according to use of Plastics, fixtures and - Properties of Polymers	Recall that the basic concept of Polymers & process of Polymerization - Define Polymers - List the types of Polymers - Classify Polymers - Describe the process of Polymerization - States the properties of polymers	Recall this topic as it has been taught in first year applied science (Chemistry)
2.	Plastic Materials - Introduction Composition - Use - Importance/Advantages - Types - Pigmentation	Know the Plastics materials - Define Plastics - State its composition - List the uses of Plastics in different engineering applications - Describe the importance of Plastics - Lists the types of plastics - Describe the process of Pigmentation	
	Introduction Composition, Processing properties, Application and use, Detailing properties, aging and climate effects of the finishing materials	Understands the different types of Plastics their composition, properties and application - Distinguish between different types of plastics on the basis of their composition - List the processing properties of each type - Explain the aging & climatic effects on Plastics - Explain the need and use of relishing of plastics - etc	

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A) Thermo Plastics
- PVC
- Polyethylene
  1) High Density
  2) Low Density
  3) Linear Low Density
  4) High Molecular High Density

Polypropylene, Polystyrene, High impact Polystyrene, Nylon, ABS, Acre clies, Cellulose

B) Thermo Setting plastics
- Expose/Polyester, Melamine, Urea Formaldehyde, Bakelite

C) Special Plastics
- Silicones, PPO, EVA, PVDC, PVDF PEEK, EVAL, EAA

3. General Principles of selection of various additives

Plastic Processing
- Principle of Processing
- Common Plastic Processing Processes
- Introduction types, constructional details, operation, process control parameters and their effects on final product, Auxiliary equipments, starting and shut-down procedure trouble shooting and specifications of the equipments used for the following processes
- Injection moulding
- Extrusion process
- Compression moulding

- Gives of examples of application of each type of plastics
- Explain aging and climatic effects on different types of Plastics, their proneness to such conditions
- Explains the reselling behaviour of different Plastics

Understands the principles of selection of various additives
- Explain the use of various additives

Understands the principles of Plastics Processing
- List the common Plastics Processing Processes
- Explain the working of different types of moulding machines
- State the use of different auxiliary equipments
- Give the starting and shut-down procedure for different moulding machines.
- Locate the fault in the working of of moulding machine
- Give the major Specifications of moulding machine

Till the lab of Plastics Processing is established in the institution, the practicals may be arranged through visits to industries or and other

General introduction, area of application of the following processes - Thermo forming - Vacuum forming - Rotational moulding - Stretch blow moulding - Transfer moulding	Knows the working principle of these processes - Name the area of application of each process - State its advantages & limitations	
Secondary Processes introduction application - Printing - Calandering - Lamination - Decorating	Knows the utility of secondary or Post-production processes - Describe the working principle of these processes	
Raw material and product Testing (6 Hrs.) - Specification and standards - Sample Preparation	Knows the various test performed on raw material and product testing - List the specifications and Standards - Describe the process of sample preparation	Testing procedure may be demonstrated
- Test - Tensile, - Impact, - Flexural, - Tear, - Creep, - Hardness, - Abrasion, - Stress Relaxation, - Light transmission, - Melt flow index, - Environment tests, - Weather Resistance Quality Control - Visual inspection	Understands the principle of each test - Explains the procedure of each test - Gives the significance of each test Applies these test to sample specimen and analysa the results Understands the concepts of quality control - Explains the importance of total Quality Control (TQC)	

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- Testing of Finished product
- Basic Concept
- Total Quality Control

7.	Future Trends in Plastics Processing (2 Hrs. - New development in plastics - Micro processor controlled machines - New application of plastics	Knows the future trends in plastics Processing - List the new development in plastics - List the new application of plastics in engineering - Explain the use of micro processor in plastic processing

REFERENCES

1. Plastic Engineering, R.J. Crawford 1981, Pegamon Press
2. Plastics, L.S.Brough, 1978, Hutchinson education
3. Plastics Testing - Bishu Shah
4. Injection Moulding - Athalye
5. Plastic Materials - Brydson J A
6. Plastic materials - Birley & Scoft
7. Plastic Technology - Mills
   - Mc Graw Hill

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Curriculum

for

Fifth Semester

Diploma in Production Engg.

(Under Indo-German Project)

Implemented from 1995-96
(Based on Semester System)

M.P. Board of Technical Education,
Office Complex, Block A/IV, Gautam Nagar, Bhopal - 462-023

M. P. BOARD OF TECHNICAL EDUCATION, BHOPAL

FIFTH SEMESTER DIPLOMA IN PRODUCTION ENGG. **(REVISED, IMPLEMENTED FROM 1995-96 AT BHOPAL & INDORE)**

S. No.	Name of Subjects	Scheme of study			Scheme of Examination										
					SESSIONALS		PROGRESSIVE ASSESSMENT		BOARD EXAMINATION						REMARK
		THEORY	LAB	TOTAL	TERM WORK	Lab. WORK	I	II	THEORY PAPER	DUR-ATION	MARKS	PRACT.	DUR-ATION	MARKS	
1.	Manufacturing Technology-III (P.C. 2067)	5(80)	4(64)	9(144)	20	30	10	10	I	3HRS	100	I	3HRS	50	220
2.	Production Management (P.C. 2068)	8(128)	4(64)	12 (192)	20	30	10	10	I	3HRS	100	I	3HRS	50	220
3.	Process Planning, Tooling and Costing-I (P.C. 2069)	3(48)	6(96)	9 (144)	20	30	10	10	I	3HRS	100	I	3HRS	50	220
4.	Elective (Any one from the following) a. Higher Maths (P.C. 2070) b. Entrepreneurship (P.C. 2071)	6(96)	-	6(96)	20	-	10	10	I	3HRS	100	-	-	-	140
	TOTAL	22 (352)	14 (224)	36 (576)	80	90	40	40	4	-	400	3	-	150	800

NOTE:

1. No. of theory paper:04
2. Total theory marks: 400
3. No. of Practical: 03
4. Total Practical Marks: 150
5. In-plant Training Marks: Nil
6. Total marks of Sessionals, Prog. Assessment, Pract. & Inplant training: (80+90+40+40+150=400)
7. Ratio of theory marks and total of: 400:400 sessional, Prog. Assess., Pract. and i.e.1:1 In-plant training
8. Total marks: 800
9. Passing marks for
   a. Theory: 33%
   b. Practical : 40%
   c. Sessional: 60%
   d. Inplant training: 50%

NOTE: All students have to undergo Industrial Training (phase-IV) of six weeks immediately after FIFTH semester examination. Assessment will be done with SIX semester practical examinations.

Amendment for Phase-IV training as approved in the Board of Studies meeting held on 6/6/2000:

All students have to undergo **Training of FOUR WEEKS (two weeks TCPC and two weeks Industrial Training)** immediately **after FIFTH semester examination.**

PROGRAMME: DIPLOMA IN PRODUCTION ENGG.
SCHEME: REVISED, IMPLEMENTED FROM 1995-96
SEMESTER: FIFTH
COURSE: Manufacturing Technology-III (P.C. 2067)

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MANUFACTURING TECHNOLOGY - III

Working Group

MANUFACTURING TECHNOLOGY - III

1. Prof. Dr. C.M. Agarwal, M.A.C.T., Bhopal.

2. Prof. P.N. Mishra, Work-shop Superintendent, M.A.C.T., Bhopal.

3. Mr. Shamim Uddin,H.O.D. (Maint.), S.V.Govt. Polytechnic,Bhopal.

4. Mr. B.K. Saxena, Sr. Lecturer, S.V.Govt. Polytechnic, Bhopal.

5. Mr. N.H.Kela, Sr. Lecturer, Govt. Polytechnic, Durg.

6. Mr. V.M. Saxena, Work-shop Superintendent, S.A.T.I., Vidisha.

7. Mr. K.C. Verma, Co-ordinator, PDU, Bhopal.

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RATIONALE

In the increasingly competitive environment manufacturing Technology is key to industrial prosperity. The rapid advances in the field of metal working , particularly in the past half century , are responsible not only new machining techniques, but also for refining many of the earlier known basic processes and equipments.

Keeping in view of the importance and vastness of the subject, content of Manufacturing Technology, has been splitted at second and third year levels. This subject of Manufacturing Technology III encompasses the topics pertaining to Unconventional machining processes, Finishing processes, Automates, Broaching, Boring , Planomilling, Thread and gear cutting machines etc.

Care has already been taken for imparting the Knowledge about general purpose machine tool such as lathe, milling etc. at second year level.

The following is the etiology for including various topics in this subjects.

With the development of technology, many new materials such as Ceramics, Carbide etc. have been developed. They are difficult to machine by conventional machining processes. To overcome this difficulty non-conventional machining processes have come in vogue. This topic has been included to acquaint the students with various types of non-conventional processes and related equipments.

Modern developments of high speed machines and properties of Wear, friction , fatigue and corrosion resistance form the basis of giving higher emphasis to surface finish and therefore the topic of finishing processes has been included.

Keeping in view of the requirement of heavy engineering manufacturing and mass production units, where most of the jobs are done by Boring machines, Plano-millers, Semi-automatic/ Automatic machines and special machining processes for Thread and gear cutting are used, due care has been taken by including these in the Curriculum.

MANUFACTURING TECHNOLOGY III Yr. DIPLOMA IN PRODUCTION ENGINEERING.

S.No.	Topic	Hours
1.	FINISHING - * HONING * LAPPING * SUPERFINISHING * BUFFING * BURNISHING	16 hrs.
2.	UNCONVENTIONAL MACHINING PROCESSES * AJM ¦ * USM ¦ Detailed study * EDM ¦ * ECM ¦ * EBM) Introductory study * LBM)	20 hrs.
3.	AUTOMATES - * SEMI-AUTOMATIC/AUTOMATIC M/C TOOLS - CAPSTAN - TURRET - INTRODUCTION TO AUTOMATIC SCREW M/C - INTRODUCTION TO COPYING LATHE	16 hrs.
4.	THREAD AND GEAR CUTTING MACHINE * THREAD CUTTING PROCESSES & M/C'S - THREAD CHASING - THREAD ROLLING - THREAD TAPPING * GEAR CUTTING PROCESSES & M/C'S - GEAR SHAPING - GEAR HOBBING - GEAR SHAVING - GEAR RACK PLANING	20 hrs.
5.	BROACHING, BORING AND PLANO-MILLERS * BROACHING * BORING MACHINES * PLANO-MILLER.	8 hrs.
	TOTAL HOUR'S- 80 .	

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NAME OF SUBJECT : MANUFACTURING TECHNOLOGY III YEAR DIPLOMA IN PRODUCTION ENGINEERING

SNo.	Topic/ Sub Topic	Intended learning Outcome (ILO) (Objective)	Remarks
1	2	3	4
1.	FINISHING	[16 hrs.]	* Ref.[2],[4] [5],[1]
1.1.	Introduction -Necessity -Types * Honning * Lapping * Super Finishing * Buffing * Burnishing	Knows the purpose of fine finishing processes is to produce a very high surface finish. * State the necessity of high finishing proceses. * List the different high finishing process.	
1.2.	Honing - Honing Process & tool - Abrasive for - Honing process	Understand the honing process. * Explain the Honing process with sketch. * Describe a honing tool with the help of a labelled diagram. * State the type & Specification of Abrasive used for Honing various metals.	
	- Methods of honing,i.e. - Manual and power stroking - Factors considered for- Method selection, such as lot size, tolerance, requirement, availability of equipment, operator skills etc.	Understand methods of Honing. * List the Methods of Honing. * Explain the criteria for selection of method of Honing. * Describe manual and Power stroking.	

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Cutting conditions.
Factors for Honing such as :
- Spindle speed.
- Reciprocating speed
- Cross hatch angle.

Utility of honing Process.

* List the cutting conditions for Honing.
* Explain the terms involved in cutting conditions.
* Explain the factor which influence the selection of above condition.

* Know application of Honing process in Industry.

* List the applications of Honing process in industry.

1.3.1. Lapping

- Material used for Lapping process.
- Accuracy in lapping and affecting factors such as:
  (a) Type of Lab Material.
  (b) Type of Lapping medium.
  (c) Speed of Lapping motion and pressure.
  (d) Type of work material.

Understand the Lapping process.

* Explain the Lapping process with sketch and use of Abrasive Powder and Vehicles.
* List the factors affecting the Dimensional accuracy.

1.3.2. Methods of Lapping

Such as :
(a) Hand Lapping flat surface.
(b) Ring Lapping of external cylinders.
(c) Lapping of internal cylindrical surface.

Understand Different methods of Lapping.

* List the different methods.
* Explain Lapping methods with neat sketch.
* Give Examples of application of above methods.

1.3.3. Lapping Machines.

- Classification

(a) Vertical lapping machines with two circular plate.
(b) Machine with single circular plate lab?

* Know the different type of lapping machines.

* Classify the different type of Lapping machines.

* Describe the working of above machines with the help of a sketch.

(c) Centreless roll lapping Machining.
(d) Centreless Lapping machine.
(e) Lapping machine for internal cylindrical surfaces.
(f) Lapping spherical surfaces.
- Working of Machines.

1.3.4. Lapping of slip gauges.

-Process Description.

Understand the Lapping of slip gauges.

* Explain the lapping process of Slip gauges with accuracy.

1.3.5.

1) Lapping Materials.

2) Vehicles.

Know commonly used lapping material, lapping mediums, Vehicles.

* List commonly used materials & their specific applications.

* List the functions of a Vehicle.

* List the properties required in good vehicle.

1.4. Superfinishing.

1.4.1.Superfinishing process

Ref.[1]

Understand the Superfinishing process.

* Explain the Superfinishing process with sketch.

1.4.2. Superfinishing stone.

Know the Specifications and materials used for Superfinishing stone.

* State the specification for superfinishing stone.

* List the different type of material used.

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1.4.3. Superfinishing Fluids.

Know the coolant used.

* Give functions of coolant in superfinishing.

* List the different coolant used in superfinishing process.

1.5. Burnishing

Ref. [1]

1.5.1. Burnishing Process
- Definition.
Classification
such as :

1) Roller Burnishing
2) Impact Burnishing;
Process Details,
Applications.

Understand the Burnishing process.
* Define the burnishing process.

* List the type of burnishing process.

* Describe the burnishing process with the help of line diagram.

* List the application of burnishing process.

1.6. Buffing

Understand Buffing.

* Explain Buffing process.

* Give examples of General application of buffing process.

1.7. Finishes and Coatings.

* Metal cleaning.
- Types of cleaners .
- Process of cleaning.
- Using Alkine cleaners.
- Electrocleaning
- Spray cleaning
- Dip-Tank cleaning
- Steam cleaning
- Solvent cleaning.

Understand the importance of cleaning of a job. * Ref. [4],[3]
* State the different types of cleaning processes and cleaners used.
* Explain the process of cleaning by using different type of cleaners.

- Ultrasonic cleaning.
- Mechanical cleaning.
  - Abrasive blasting
  - Power brushing

1.7.1. Metal Protective Coatings.
- Purpose
- Types of Metal Coating such as

Understand the purpose of metal protective coatings.
* State the purpose of protective coatings on metal surfaces.
* List the types of coatings.
* Describe the following important characteristics of different type of metal protective coatings.

* List the area of application.

-Interim Coatings.
-Conversion Coating.
  - Phosphate coating.
  - Chromate coating.
  - Oxide coating.
  - Anodized coatings.
-Double Coatings.

Give the advantages & disadvantages of each type of coatings.

a) Organic coatings.
Oil Paint,Alkyd paint,
Expoxy paint,Silicon paint,
Varnishes and Enamels, Polyesters,
Lacquers, Acryclics,Cellulose,
Vinyls, Polyurethene, Nylon,
Polyproplyne,Fluorocarbons,
Phenolics.

b) Inorganic Coatings.
- Porcelien enamels
- Ceramic coatings
- Primers

- Metallic coatings
  - Electroplating
  - Dipping
  - Immersion
  - Diffusion Coating
  - Vapor depdsited coatings
  - Metallizing

1.7.2. Pre-coated Metals.

Explain the procedure for Pre-coating of Metals.

2. UNCONVENTIONAL MACHINING PROCESSES. [20 Hrs.]

2.1. Introduction

* Classify Un-conventional Machining processes.
* Mechanical- Abrasive Jet Machining, Ultrasonic.
* Thermal - E.D.M.Laser beam Machining,Plasma arc cutting, Electron beam machining.
* Chemical - Chemical cutting. Electrical- E.C.M.

Understand different non conventional machining processes. Ref.[4],[2], [1]

* Define the terms non-conventional macining process.
* Explain the difference between Conventional and Non-conventional machining processes.
* State the limitations of Conventional and Non-conventional machining processes.
* List the different Conventional and Non-conventional machining processes.

2.2. Abrasive Jet Machining.

- Process Description.
- Advantage & Disadvantage.
- Product application.
- Process selection factors.

Understand Abrasive Jet Machining process (A.J.M.).

* Explain the Abrasive Jet Machining Process with the help of a sketch.
* Explain the equipment parts and their functions.
* List Advantages & Disadvantages of A.J.M.
* List the factors to be considered in selection of A.J.M. as a machining process.

Application of A.J.M. such as; machining brittle,heat sensitive material like glass Quartz, Semi-conductor material, Mica and Ceramics.

State the major field of application of the A.J.M.

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2.3. Ultrasonic Machining (U.S.M.)

- Introduction
- Principle of working
- Principle components to include :
  * Generator to produce Ultrasonic frequency
  * Transducer
  * Velocity transformer
  * Tool and tool holder
  * Tool feed machanism
  * Work holding arrangement
  * Absasive & abrasive media
  * Pump for circulation of abrasive slurry.
- Accuracy and surface finish
- Application area .

* Ref.[2], [4],[1]

Understand the U.S.M. process.

* Explain the Principle of Working of U.S.M. system with the help of a labelled sketch.
* Explain the function of principle components with details in brief.
* State the limits to which the accuracy and finish are obtained in U.S.M.
* State the application area of U.S.M.
* etc.

2.31. Ultrasonic Machining.(U.S.M.).

Introduction.

Ref.[2],[4],[1]

Understand the U.S.M. process.

* Explain the process of cutting tool oscillation at high frequency and impact of abrasive slurry.

2.32. U.S.M. Process technique.

- Process Description.
- Techniques.
- U.S.M. parameters
- Resonance
- U.S.M. machines.
- U.S.M. cutting tools.
- Work holding methods.
- Product applications.
- Process selection factors.

Understand the process technique of U.S.M.

* Explain the technique of U.S.M.
* Explain the parameters of the process,such as Amplitude of tool, Oscillation frequency, Tool material, type of abrasive and size of abrasive.
* Explain effect of the above parameter stock removal, surface finish and accuracy.
* List the general applications of U.S.M.
* List the factors to be considered for selection of U.S.M. as a machining process.
* Knows about the U.S.M. machines.
* Describe Working of U.S.M. Machines.
* Know the construction of commonly used U.S.M. stake tools. state the procedure of holding work in U.S.M.

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2.4 Electric Discharge Machining.(E.D.M.)

Introduction.	Understand E.D.M. Process of metal removal.
- Principle of operation.	* Explain principle of operation with the help of a labelled diagram.
Electric discharge machine.	Understand E.D.M.Machine & equipment.
Fundamentals - Physical set-up. - Power Supplies. - Dielectric fluid. - Electrode materials. - Kind of Electrodes - Electrode wear and wear ratio.	* Sketch the diagram of E.D.M. Set-up. * Explain the functions of Power supply, Dielectric fluid, Electrode cutting tool,movement of electrode. * List different types of electrodes and their functions. * Describe electrode wear with a neat sketch.
Tool Material such as ; copper, brass, aluminium, silver,tungsten, Copper tungsten, cast iron for rough machining.	Know about the different tool material used in E.D.M. * State different tool materials used in E.D.M. and their important characteristics.
Application Area.	Know about the application of E.D.M. * State the applications of E.D.M. such as; manufacturing and reconditioning of press tools and forging Dies,production of intricate and irregular shapes.
Advantages & Disadvantages.	* Explain advantages and Disadvantages of E.D.M.process. * etc.
2.5. Electrochemical machining. (E.C.M.) Introduction.	Understand E.C.M.process.
- Principle of operation.	* State the Faraday's Law of Electrolysis. * Explain Principle of operation of E.C.M. process with the help of labelled diagram.

E.C.M. Equipment.	Understand E.C.M. equipment and process of machining.
- Principle components. - Electrolyte.	* Sketch diagram of E.C.M. equipment. * Explain function of principal components of equipment. * Explain function of electrolyte. * List different type of Electrolyte solution and their use in machining different materials.
Advantages & Limitations, Accuracy and surface finish.	Understand the advantages, limitations, accuracy and surface finish as obtained in E.C.M. * Explain advantages and limitations of E.C.M. * State the accuracy and surface finish as obtained in E.C.M.
Applications. - Aerospace industry - Shaping of Jet Enquire blades, - Shaping of hard materials. - etc.	Understand E.C.M. as an excellent method of producing complex cavities in materials difficult to machine. * Explain use of E.C.M. in Aerospace Industry. * etc.
2.6. Electron Beam Machining. (E.B.M.) - Introduction.	Understand E.B.M. process to remove metal.
- E.B.M. Process and the principle of its operation.	* Explain E.B.M. Process to remove material from work piece by the Thermal Energy which heat, melt and vaporize by high velocity stream of electrons. * Explain the principle of operation of E.B.M. process.
- Energy source for E.B.M. consisting of (A) A hot tungsten cathodes filament. (B) A grid cup negatively biased. (C) A anodes at ground potential.	* Explain source of energy for electron beam.
Advantages, Limitations, Accuracy and surface finish. application.	Understand Advantages, Limitation, Accuracy and surface finish related with E.B.M. process. * List advantages and limitations of E.B.M. process. * State the accuracy and surface finish obtained in E.B.M process.

	* Know about applications of E.B.M. * List the various applications of E.B.M. * etc.
2.7.Chemical Machining (CHM)	Understand the process of Chemical Machining.
Introduction.	* Explain Chemical machining as a process of metal removed by controlled chemical reaction.
Process & Operation. - Process operation steps to include : a. Precleaning. b. Masking & exposing. c. Etching. d. Stripping & cleaning. e. Finishing. - Maskants and etchants.	Understand process operation of chemical machining. * State the operation steps in chemical machining process. * Identify the important parameters as Maskants and etchants in Chemical machining. * Give the types, essential requirements and selection criteria of Maskant and etchant.
Application.	List different application of Chemical machining.
2.8. Chemical Milling.	
- Process operation - Advantages & Disadvantages. - Application area such as ; to machine performed aerospace parts, engrave intricate details on any metal.	Know about Chemical milling process, its advantages & disadvantages. * State the steps of process. * List advantages and disadvantages of process. * State application areas. * etc.
2.8.1.Chemical Blanking.	
- Introduction. - Process steps. - Application areas such as; burr-free stampings, intricate parts, printed circuits.	Understand Chemical Blanking process. * Define the process. * List the process steps. * List the application areas.

2.8.2.Chemical Engraving. - Introduction. - Process steps. - Application areas.	Understand Chemical Engraving process. * State the purpose of process. * List the process steps.
2.9. Laser Beam Machining. - Laser characteristics. Principal of operation.	Understand the Laser beam machining operation. * List Laser characteristics. * Explain principle of L.B.M. operation with the help of a labelled diagram.
Accuracy and surface,finish.	* Know about Accuracy and surface finish obtained, advantages and limitations and application area of laser beam machining process. * State about the Accuracy and surface finish obtained .
Advantages & Limitations. - Applications	* List the advantages and limitations and application in Industry of L.B.M.
2.10. Iron Beam Machining (IBM) - Introduction. - Principle of Working. - Equipment. - Accuracy and surface finish. - Advantages & Disadvantages. - Application.	Understand Iron Beam Machining (IBM). - State the purpose of IBM. - Explain the principle of working with the help of a labelled diagram. - Give an outline of the equipment used for IBM. - State the accuracy and surface finish obtainable by this process. - List advantages and disadvantages of the process. - Give the applications of the IBM process. - etc.
2.11. Plasma Arc Machining(PAM) - Introduction. - Principal of operation. - Equipment-Plasma Torch. - Accuracy and surface finish.	Understand P.A.M. process. - State the purpose. - Explain principal of operation with the help of labelled diagram. - Describe a Plasma Torch. - State the accuracy and surface finish. obtained.
- Advantages and Limitations. - Applications.	- List the advantages and limitations of the process. - List the applications of the process.

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2.12. Comparative Study of Un-conventional machining Processes.(NCM)	* Apply the knowledge to select the NCM process.	
- Information required to select the process to include; * Nature of machining problem. * Physical parameters. * Capability of different processes. * Operating characteristics of machines. * Economics of possible manufacturing processes.	- Explain the different Pre-requisite information for selection amongst conventional and Non-conventional machining process.	
- Comparison of Conventional and Un-conventional machining processes in respect of Maximum material removal rate, Power consumed in Kilowatt per cubic centimeter of material removal per minute, and accuracy in millimeter at maximum material removal rate.	* Given necessary data select the right type of machining process.	* Refer[2] Tabular data can be displayed.
- Comparison of Un-conventional Machining processes on the basis of: * Operations of Drilling and Microdrilling. * Voltage current and Power requirements. * Surface finish and accuracy.	* Given necessary data select the right type of Unconventional machining process.	* Refer[2]-----do------
- Conclude that : * When economic manufacture is possible by conventional process, Un-conventional machining process should not be used.	- Conclude the inferences of various aspects for different UN-conventional machining processes.	* Refer[2]-----do------

* Ceramic and glass are machined by AJM and USM.
* Fine holes can be produced by LBM and EBM.
* EBM is expensive compared to LBM.
* ECM is successfully employed for super alloys.
* CHM is generally used for aluminium and alloys.
* PAM is usually applied for cutting operations.
* Initial expenditure in ECM is very high where as it is low in PAM and AJM.

2.13. Machining Unit

Understand the working of machining equipment used in U.S.M.
* Sketch the diagram of Electronic oscillator, amplifier, transducer tool, Tool holder, work piece Pump, Abrasive slurry.
* Explain the function of Oscillation and transducer to produce high frequency and amplitude.

1-108-1

3. AUTOMATES

Ref.[1],[5],[7]

3.1 Introduction.

Need.
Uses.

Know about the requirements of special purpose machines in mass production.

3.1.1 Automation.
- -Individual machine automation.
- -Multiple machine automation.
- -Integrated or linked lines.
- -Unitised lines.
- -Unit machine construction.

-Identify the need of special purpose machines.
-Give examples of uses of S.P.M.
Understand automation in machine tools.
-Explain automation with reference to individual and multiple machine automation.

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3.1.2 Transfer Machines. -Inlive transfer machines. -Rotary index table Transfer. machine. -Drum type transfer. machine.	Understand special utility of transfer machine. * Classify transfer machine. * Explain the Working of different type of transfer machine with a live sketch. * Give examples of uses of transfer machine.
3.1.3 Capstan Lathe. -Description of Capstan lathe.	Understand the Capstan lathe. - Demonstrate the use of capstan lathe. * Give sketch of capstan lathe. * Label the parts of lathe. * Explain function of parts. * Prepare machine for running/production. * Show its working procedure (starting /stopping) with function different control. (practical)
3.1.4 Turret Lathe. Description of turret lathe.	Understand the turret lathe. - Demonstrate the use of turret lathe. * Give sketch of turret lathe. * Label the parts of turret lathe. * Explain function of parts. * Prepare machine for running /production. * Show its working (starting/stopping) with function of different control.
3.1.5 Turret Head Mounting. Rem type Lathe. Saddle type Lathe.	Understand the difference in turret head mounting. in Capstan lathe and Turret lathe. * Explain the difference between Center lathe, Capstan and Turret lathe.
3.1.6 Bar feeding Mechanism.	Know the function of Bar feeding Mechanism for automatic bar feeding. * Sketch the diagram and label the parts. * Explain working of Bar feeding equipment.
3.1.7 Turret Indexing Mechanism.	Know the Turret head Indexing Mechanism to rotate turret head automatically.

	* Sketch the diagram and label the parts. * Explain working of parts and Mechanism.
3.1.8 Tool Holding Devices. a) Bar stock b) Roller support turning devices. c) Box tool holder. d) Knee tool holder. e) Multiple tool holder. f) Self opening Die heads. g) Collapsing tab.	Know tool holding devices. * Sketch the diagram and label the parts. * Explain use of each devices.
3.1.9 Turret Tooling Layout.	Prepare tooling layout for a production work. * Draw sketch of a hexagonal bolt. * List sequence of operation. * Draw tooling layout related to sequence of operation. * Prepare tooling schedule chart giving operation, tool position and tool. Prepare tooling layout for different type of broaches and to similar type of jobs.
3.2 Automatic Lathe. Classification. a) Single spindle automatic. b) Multy spindle automatic. c) Bar stock machine. d) Checking machine. e) Horizontal spindle machine. f) Vertical spindle machine.	Understand classification of Automatic Lathe. * List different type of Automatic lathe. * Explain working of different type of Automatic lathe.
3.2.1 Advantages & Application of Automatic lathe.	Know the Advantages of Automatic lathe. * Explain use of automatic machine in mass production.
3.2.2 Copying Lathe.	Understand principal of Hydraulic Copying lathe. * List different parts of Copying lathe. * Explain use of Copying slide and hydraulic circuit to control tool movement. * Give examples of uses of Copying lathe.

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3.2.3 Essential Elements.	Know the function of parts. * Explain use of Master former, Hydraulic controlled, slides and movements of tools. * List advantages of Copying lathe in mass production.

4. THREAD AND GEAR CUTTING MACHINES.

Ref.[1],[5]

4.1 Thread cutting process.	Know about the different type of thread production process.
a) Thread chasing (Die threading) b) Thread rolling c) Thread tapping	- State the different methods used for thread cutting in mass production.
4.1.1 Thread chasing process.	Understand the Die threading process. - Explain the Die thread process with sketch.
4.1.2 Types of Die head. a) Round solid die head. b) Self opening die head.	Know about the types of Die head. - List the types of Die heads. - Describe with a neat sketch
Advantage of Self opening die head.	- Give advantages of Self opening die head over round solid die head.
4.1.3 Classification of Self opening die head.	Know about the different type of Self opening die head.
1) Radial 2) Tangential 3) Circular self opening die head.	- Describe the different types of self opening die head with sketch.
4.2 Thread rolling process and Machines.	
4.2.1 Thread rolling process.	Understand thread rolling process. - Explain the thread rolling process with sketch. - Give the advantages of thread rolling process.
4.2.2 Thread Rolling Machines.	Know about the different types of thread rolling machines used in practice.

1) Flat die machines — List the types of thread rolling machines.
2) Cylindrical die machines. — Describe the principle of working of such thread rolling machines with sketch.
   a) For internal thread cutting.
   b) For external thread cutting.
3) Planetary thread rolling machines. — State the applications of such type of machines.

4.3 Tapping.

4.3.1 Tapping process

Understand the Tapping process. Ref.[1],[5]

Application of tap on machines.
1) Drilling machine
2) Tapping machine
3) Capstan lathes
4) Turret lathe
5) Centre lathe
6) Automatic lathe
7) Manual Tapping

* Explain tapping process with sketch.
* List the machine tools on which tapping operation is performed .

4.3.2 Different type of Taps.

Know about the different type of taps.

1) Solid taps.
2) Shell taps.
3) Inserted chaser taps.
4) Collapsible taps.

* List the different type of Taps.

Classification of Solid taps.

1) Hand tap.
2) Spiral tap.
3) Spiral flute taps.
4) Bent shank taps .
5) Combination roughing and finishing taps.

* List the different type of solid taps.
* Describe the different type of Solid taps with sketch.
* Give uses of each type of taps.

1) Shell taps.
2) Inserted chaser taps.
3) Collapsible taps.

* Describe each type of tap with sketch.
* Give uses of each type of tap.

4.3.3 Tapping attachment.	Understand the tapping attachment. * Explain the working of tapping attachment with sketch. * Give necessity tapping attachment.
4.4 Gear cutting process & machines.	Ref.[5],[1]
4.4.1 Generating process.	Understand the Gear generating process. * Recall the terminology used in gears. * Explain the gear generating process.
4.4.2 Classification of Generating Process. 1) Gear hobbing. 2) Gear shaping. 3) Rack planing.	Understand the principle of different type of gear generating process. * List the different type of Gear generating processes. * Explain the Gear hobbing operation with sketch. * Explain the Gear shaping operation with sketch. * Explain the rack planing operation with sketch.
4.4.3 Gear Cutters. 1) Hob - Gear Hobbing machines. 2) Shaper cutter- Gear shaping machine. 3) Rack cutter- Rack planing machine.	Know about the different types of Gear cutters used. * List the types of Gear cutter used. * Describe each type of cutter with sketch.
4.4.4 Gear hobbing machine.	- Know about the Gear hobbing machine. - Describe the Gear hobbing machine with sketch. - Label the main parts of machine. - Describe the Gear hobbing (Gear cutting)Cycle.

4.4.5 Gear Shaping Machine.	Know about the Gear shaping machine. * Describe the Gear shaping machine with sketch. * Label the main parts of machine. * Describe the Gear shaping (Gear cutting) Cycle.
4.4.6 Gear Planing Cycle.	Know about the Gear planing cycle. * Describe the Gear planing (Gear cutting) Cycle with sketch.
4.5 Gear Finishing Methods. 1) Gear shaving. 2) Gear grinding. 3) Gear burnishing. 4) Gear lapping. 5) Gear honing. 6) Gear tooth rounding.	Understand the Gear finishing methods. * State the need of gear finishing. * List the Gear finishing methods. * Explain each of the gear finishing methods.

5. BROACHING, BORING AND PLANOMILLERS.

Ref.[1] Production Technology, HMT

[4] : Manufacturing of Process-Herbert W Yankee.

5.1 Broaching.	
5.1.1 Description of the process. Advantages and Limitations and application area.	- Understand broaching process and its area of application, advantages and limitation. - Describe the broaching process. - State the area of applications. - Give advantages and limitations.
5.1.2 Broaching Tools.	- Know about the broaching tool, its types techniques employed.
5.1.3 Broaching Tool, material and construction. types of broaches, Techniques,broaching speeds, sharpening of broaches. A) Internal Broaching.	- Sketch a labelled diagram of broach tool. - State the techniques employed for internal and external broaching. - State the materials used for broaches. - Speeds specify the broaching. - State the purpose of sharpening of broaches.

- Rotary cut broaching.
- Double cut broaching.
- Polygon broaching.
- Key-way broaching.

5.1.4 B) External Broaching.

- Progressive Broaching.
- Double cut Broaching.
- Straddle Broaching.
- Broaching of gear teeth.
- Broaching Fir-tree slots.

Broaching Machines.
- Vertical machines.
- Horizontal machines.
- Continuous surface. broaching machines.

- Know about the broaching machines.
- Describe the different types of broaching machines.
- etc.

5.1.5 Process Selection Factors.

- List the factors to be considered while Selecting broaching as a machining process.

5.2 Boring Machine.

- Understand the working of the boring machines and boring operation.
- Define the boring operation.
- Differentiate between drilling and boring operations.

5.2.1 Classification to include:

- Horizontal boring machine.
- Vertical boring machine.
- Jig boring machine.

Constructional/ and Operational details.

- List the types of boring machines.
- Explain the working of each type of boring machine with sketch.
- List the different operations performed on each type of machines.
- Explain the boring tool mountings for horizontal boring with sketch.
- List the different operations performed on vertical boring machine.
- etc.

Ref.

5.3 Plano-Milling.	Understand Plano-milling operation.	[4]:Manufacturing Process.-herbert W. Yankee. [1]:Prod. Tech.,HMT.
5.3.1 Type of planers. - Double housing planer. - Open side planer. - Edge or plate planer. - Pit type planer.	- Give the types of planers. - Explain working of different types of planers.	
5.3.2 Applications of plano-miller.	- Know the applications of plano-milling in general industries.	
5.3.3 Accessories/Attachments.	- Know the accessories/attachments used with plano-millers. - List the accessories/attachment used in plano-milling. - Give use of each type accessories/attachments.	
5.3.4 Work Holding Methods and devices. - Planing tools. - Cutting forces.	- Know about work holding methods and devices used in planing. - Describe the commonly used work holding methods and devices. - Know about the planing tools. - List planing tools and their specific applications. - Understand cutting forces. - Explain cutting forces in planing operation.	

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8. De Germo E. Paul, Black J.T., Kohser R., Materials and Processes in Manufacturing, Maxwell Mac millan International Edition, Seventh Edition 1990.

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LIST OF MACHINES AND EQUIPMENTS REQUIRED

S.No.	Names of Machines / Equipments
1.	Buffing Machine.
2.	Electroplating Unit (Small size for training.
3.	Attachment for Superfinishing on Lathe.
4.	Anodizing Unit (Small size for training).
5.	Spray Painting Set.
6.	Capstan - two no.

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PRACTICALS

* GALVANIZING
* ELECTROPLATING
* POLISHING
* COATING
* PLANNING OF TOOL LAYOUT AND JOB MACHINING ON CAPSTAN AND TURRET LATHE
  (Minimum 3 Jobs each)
* EXTERNAL & INTERNAL THREAD CUTTING BY DIE & TAP.

LIST OF PRACTICALS

S.No.	List of Practicals	Hours
1.	Cleaning, Electroplating & Buffing- Minimum two Jobs.	10 hrs.
2.	Superfinishing one job.-made by Student himself.	5 hrs.
3.	One Job on anodizing technique of Coatings.	5 hrs.
4.	One Job by Spray painting.	5 hrs.
5.	Planing of Tool layout and Job machining on Capstan or Turret Lathe.-Minimum two Jobs.	15 hrs.
6.	External Thread Cutting by Die & its measurement. -one Job.	3 hrs.
7.	Internal Thread Cutting by tap and its measurement. -one Job.	3 hrs.
8.	One Job by boring operation on Lathe machine/ Boring machine.	4 hrs.
9.	One Job with Thread by Capstan Lathe.	6 hrs.
10.	One Job of Spur gear cutting on milling machine.	8 hrs.
	Total -	64 Hrs.

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PROGRAMME: DIPLOMA IN PRODUCTION ENGG.
SCHEME: REVISED, IMPLEMENTED FROM 1995-96
SEMESTER: FIFTH
COURSE: Production Management (P.C. 2068)

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PRODUCTION MANAGEMENT

Working Group

PRODUCTION MANAGEMENT

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2. Prof. Dr. V.K.Khare, MACT, Bhopal.
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RATIONALE

The optimum operation of any industrial organization demands its staff to share the administrative and technical responsibilities efficiently and effectively. The great technological and sociological advances that have occurred in all segments of our society have forced the developments of new management concepts, techniques and tools to cope up with complexity of growth and change. To meet the challenges of complexity, the systematic and organized approach in every discipline is indispensable in a society which is producing more technically qualified persons, newer materials and complex products and more information than ever before.

The production function should be seen as a system in which no element can be significantly altered without affecting the other parts. Attempt has been made to familiarize the students with each key factor and explain how production managers can improve efficiency within a frame work related to knowledge, skills, attitude and objective of their organizations.

Keeping in view of the competencies identified during discussions with a group of industrialists and academicians the following new topics have been added.

- Productivity, Total Quality Management (Various approaches- philip Croby, Deming, Juron, Taguchi, Kaizan Etc.), Just-in-time concepts, Ishikawa diagram, SWOT analysis, Logic structures and Communication Skills etc.

This subject will go a long way towards helping him to remove some of the obstacles to improved productivity.

PRODUCTION MANAGEMENT

SNo.	TOPICS	HRS. THEORY	LAB./TUTORIALS
1.	Management an overview	10	4
2.	Organization & Organizational Climate	10	4
3.	Human Factors in Production	15	4
4.	Materials Management	18	8
5.	Production Planning & Control	12	8
6.	Project Planning by Network Analysis	15	8
7.	Work Study	16	20
8.	Plant Layout & Materials Handling	08	-
9.	Operation Research	08	8
10.	Application of Computers in Management.	08	-
11.	New trends in Management	08	-
		128	64

NAME OF SUBJECT :- PRODUCTION MANAGEMENT

Code:

S.No.	Topic/Sub Topic	Intended Learning Outcome (ILO) (Objective)	Remark
1.	MANAGEMENT AN OVERVIEW:		
1.1	What is Management ?	- Knows about Management. - Defines Management.	
1.2	Brief history of Management	- Knows the history of Management.	
1.3	Function of Management - Planning - Organizing - Staffing - Directing - Co-ordinating - Controlling - Reporting - Innovating - Budgeting - Evaluation	* Understands the concepts of Management. - Explains the functions of Management.	
1.3.1	Management Phases - Preplanning,Planning, Implementation and control.	- Explains the different phases of management. - Explains that the planning is a continuous process.	
1.4	Applications of management in different areas such as Finance, Personnel,Marketing,Purchasing, Storing,Production etc.	* Understand the universality of the concept of application of management in defferent areas. - Outline the area of application of Management concepts in practice.	

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(B.K. Sharma)

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1.5	System Approach - Definition - Parameters	* Applies the concepts of system approach. - Defines the term system. - Lists the parameters of a system
	- Classification of system a) Open,closed and isolated systems b) Production,Non-productive and service systems.	
	- System design procedure	- Explains the different types of systems with examples.
	- Evaluation of system by considering productivity and effectiveness.	- Explains the system design procedure. - Given a situation,applies the concepts to design a system. - Defines the terms productivity and effectiveness of a system. - Justifies the importance of measuring effectiveness of a system.
2.	ORGANIZATION AND ORGANIZATIONAL CLIMATE.	
2.1	Introduction - Definition - Illustration	* Knows about the oragnisation.
2.2	Principles of Organization	* Understands the principles of organisation. - Explain the principles of organisation.
2.3	Organisational structure and organisational chart.	* Understand the basic elements of organisational structure.

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		- Prepare an organisational chart for an organisation you are familiar with.
2.4	Types of Organisation	* Understand different type of Organisations. - Distinguish between different types of organisation.
	Formal Organisation - Line - Functional - Line & staff - Committees - Project - Matrix Informal organisation	- Show examples of different type of Organization from real life.
2.5	Classification of organisation	* Know the classification of organisations. - Classify organisation on the basis of Function,Product,Customer and location. - Show examples of the organisation based on above parameters.
2.6	Authority and Delegation of authority.	* Know the basic principles of Authority & Delegation. - Define authority. - Explain process of delegation of authority.
	Centralisation and Decentralisation.	- State the purpose of centralisation and Decentralisation.
	Authority and Responsibility.	- Define relationship between authority and responsibility.
2.7	Group Dynamics	

	- Concept - Characteristics of groups.	- Know the concept of group dynamics - Define basic characteritics of groups.	
	- Reason for formation of groups.	- Explain reson for formation of groups	
	- Types of groups	- List different type of groups such as formal,informal groups.	
	- Advantages and disadvantage of groups.	- List advantages and disadvantages of groups.	
2.8	Organisational change	* Applies the concepts of managing change in a given situation.	
	- Introduction - Causes of organisational change.	- Define organisational change. - Identifies the causes of organisational change.	
	- Response to change		
	- Process of change - Resistance to change	- Explain the process of change. - State the causes of resistance to change.	
	- Overcoming resistance to change.	- Given a situation,suggests the method of overcoming resistance to change.	- Through case study.
2.9	Organisational Conflict	* Understand the concept of organisation conflict and its management.	
	- Concept - Types of conflict	- Define conflict. - Recognise different type of conflicts.	
	- Conflict between individuals - Conflict between an invidual and group. - Conflict between groups within an organisation. - Conflict between organisation.		
	- Process/Stages of conflict	* Describe the process of conflict.	

- Source of conflict - Impact of conflict	- Identify the sources of conflict.
- Resolution of conflict or modes of conflict management.	- Give the strategies for resolution of conflict.

3. HUMAN FACTORS IN PRODUCTION.

3.1 Managing Men:

3.1.1. Motivation:	* Understands the importance of motivation.
- Introduction	- Defines motivation.
- Factors affecting motivation	- List the important factors that influence human behaviour.
- External Job/Company environment.	
- Internal- Human needs.	
3.1.2. Motivation process.	- Explains the motivation process.
3.1.3. Secondary motivation drives	- Explains the secondary motivating devices.
- Aggressiveness	
- Acquisitiveness	
- Self assersition	
- Constructiveness	
- Gregouriousness	
3.1.4. Outlet for drives	- List outlet for drives
- Expression	- Explain outlet for drives
- Repression	
- Control and re-direction.	
3.1.5. Behavioural Theories	- Disscuss importance of Behavioural Theories.
- Maslow's need Hierarchy	- Explain behavioural theories.
- Heizberz Theory	
- Douglas Mc Gregar Theory (Theory X and Y)	
- Personal skill required such	- List the ingrediients of leadership

as persuassion, influence and Rapport.	
- Leadership qualities	- Identify qualities in a leadership
- Relationship between motivatio- motivation and leadership.	- Establish relationship between motivation and leadership.
3.1.6. Morale.	
- Definition	* Understands the concepts related with Morale.
- Importance	
3.1.7. Morale and Productivity .	- Defines morale.
	- Explains the importance of Morale.
	- Corvelate morale with productivity etc.
3.1.8. Job - satisfaction.	* Understands the concepts related with job satisfaction.
- Importance	- Explains the importance of job satisfaction.
- Factors	- List the factors, to be considered in designing a job, for giving job satisfaction.
3.1.9. Training.	
- Concept of Training	* Understands the concepts of training
- Need of Training	- Explains the need of training
- Benefits of training	- Explains the benefits of training.
3.2 Leadership.	* Understand leadership.
- Definition.	- Define leadeship.
3.2.1. Personal skill required such as persuassion, influence and Rapport.	- List the ingredients of leadership.
3.2.2. Leadership qualities.	- Identify qualities in a leadership.
3.2.3. Relationship between motivation and leadership.	- Establish ralationship between motivation and leadership.
3.2.4. Kinds of leadership Traditional	- List types of leadership styles.

- Autocratic - Democratic - Free Rein	- Describe different types of leadership styles.	
3.3. MANAGEMENT BY OBJECTIVES	- Knows the concept of MBO	
3.3.1. Introduction to MBO		
3.3.2. Application of MBO - Advantages and disadvantages of MBO.	- Describes the MBO - State the various applications of MBO. - List the advantages and disadvantages of MBO.	
3.3.3. Recent- Result centered (Management by objectives MBO - Cantigency or situational		
3.4. Management Grid	- Explain chart of management grid	
3.5. Supervision:	* Understand the importance of supervision.	
3.5.1. Definition of Supervisor 3.5.2. Personal attitudes of supervisor. 3.5.3. Duties and responsibilities of a Supervisor.	- Define the role of Supervisor - Identify personal attitudes required in a Supervisor. - List the duties and responsibilities of a Supervisor.	
3.6. Time Management:	* Appreciate the importance of time management.	- Importance.
3.6.1. Importance	- Justify that time is a valuable resource.	- Main features: a)Learn management and organization principles, communication Techniques and Work study. b) Use logical approach.
3.6.2. Techniques employed. - Steps to be taken. - Avoiding time wastas. - Communication as peets.	- Explain the Steps which could be taken for Managing the time resource effectively. - Explain the techniques employed for	- (A) Steps.

- Using diaries.	time management. - List the various electronic gadgets used for better time management.	Initial check - 1) Records roles & activities. 2) Establish priorities. 3) List omitted tasks. 4) Analyse and rearrange items from the above three points. B) Applying Principles and techniques of management. C) Other aspects- 1) Using diaries. 2) Delegating. 3) Avoiding time wasters a) Avoid needless switching from one activity to another. b) Take action emmediatly. c) Attempt to restrict interuption d) Determine quiet and busy period and plan tasks accordingly. e) Choose appropreate time to contact others, as to ensure sufficient time availability. f) Do not rely on memory,write everything down immediatly, recording in your notes in the appropreate places
3.7. Communication: - Definition	* Understand Communication - Define communication.	
- Communication Process - Communication types - Communication Channels - communicatioin Barriers	- Explain the process of communication. - Describe channels of communication. - List the barriers in communication.	
3.7.1. Effective communication - Person to Person - With Groups - In meetings/Committies	- Explain the method of communication with - a person - in groups - in meetings/committies.	

later if it is difficult to do so at the time.

4) Communication aspects-
-Ensure clear communications.
-Conduct all meetings effectively, avoid unnecessary debate, justify the presence of those who do attend.
-Always listen attentively and write down important points.
-Choose times interrupt carefullyand avoid loss of concentration.
-Liaise with other sections to check that work is not duplicated.
-Seek out all sources of information and advice.

5) Management-Supervisor relations :-
-Attempt to manage with superior, aiming to avoide spending unnecessary amounts of time with him or hir.

6) Check results:-
-Aiming to improve

constantly by checking results and adjusting plans accordingly. only the individuals can solve time management problems by being self disciplines and persevering.

* Writing a letter.
  - Categories of letter.
  a) Important.
  b) Routine.
  - Organization of the letter (Four section).
  i) Information
     - Starting with the most important point.
  ii) Supporting details, evidence and view.
  iii)Summary starting the conclusions actions needed to follow.
  iv)Closure- Thanks giving etc.

* Knows the concepts related with written Communication.
- States the Categories of letter.

* Describes the organization of letter with suitable example.

* Memoranda :-
  - Definition.
  - Difference between a letter and memorandum.

* Defines Memoranda.
* Illustrate difference between a letter and a memorandum.

-Memos used for interdepartmental communication with in an organization.
-Bussiness letter is an external communication.
-No salutation at the start and end.
-Both memos and letters are structured.

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* Reports :-

- Definition.
- Task involved in writing reports to include the following aspects-
  - Collection of material.
  - Selection of material.
- Ordering sections.
  - Classification of materials.
  - Placing sections in a logical order.
  - Deciding Headings and Sub-headings.
- Writing the report.
- Choosing a style appropreate to the audience.
- Choise of illustrations,table, grafhs, diagramms.
- Presentation of the report.
  - A possible layout may include.
  - title page.
  - Summary.
  - Table of contents.
  - Introduction.
  - Text of main body of the report.
  - Conclusions.
  - Recommendations.
  - Appendices containing tables, technical conclusios, references etc.

* Knoes about report writing.

- Defines a report.
- List the tasks involved in writing a report.
- Describes the step-by-step procedure of report writing.

- Summarizes the presentation of a report.

* Presentation skills.
- Introduction

* Understands the importance of presentation skill in group

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	- Scope	interaction and the methodology to be adopted.	
		* illustrate the occasion where as a Supervisor one needs to address a group of people.	e.g.- Team briefing. - Imparting instructions to workers. - training activities - Formal presentation
*	Verbal Communicating media (Body Language)	* Explain the important role played by body language in verbal communication.	* Body language to include- - Posture - Gesture - Voice - Dress
*	Phases for group interaction. - Preparation phase - Subject metter - Visual aids - Psychological(Overcome nervousness) - Presentation phase - Pace - Timing - Voice modulation - Eye contact - Star/ Introductory pleasantries - Strss on the main theme. - Keeping on track. - Closure (Summarize).	* Explain the phases and elements to be taken cure in group interaction. * Given a situation display the presentation skills.	
5.8.	Grievances: - Definition. - Causes of grievences . - Recognising grievences.	* Comprehend the phenomenon of grievances. - Define grievances. - Identify causes of grievances.	
5.8.1.	Solving greivances of a) Indivisual - knowing the individual - Watching for changes	* Explain method of solving greivances for an individual and group.	* Through case studies.

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- Analyse change and information.
- Consult with employee
- Treatment
- Follow-up

b) of Group
- Group Disscussion:

* Expalin the method of leading a group disscussion in a given situation.

* Conduct a group disscussion on greivence handling.

- Introduction
- Stating the case
- Controlling the disscission
- The conclusion

3.9. PROBLEM SOLVING & DECISION MAKING.

3.9.1. Steps in Problem solving.
- Define the Problem.
- Collect relevant information
- List Possible causes.
- Select the most likely cause.
- Suggest alternative solution.
- Evaluate alternatives
- Choose ane solution
- Plan for implementation
- Receive feed back.
- Replan and implement.

* Uderstand the process of problem solving and dicision making.
- Explain systametically the steps involved in problem solving.

3.9.2. Methods of Problem solving.
- Institution
- Analytical thinking
- Creative Thinking
- Group discussion and Brain storming.
- Lateral Thinking.
- Logic Thinking

- Describe the method of problem solving with their tros & cons.

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(Cause-Effect diagram)
- Synectics.

* Swot Analysis:-
- Definition (Factors involved)
  - (S - Strengths)
  - (W - Weakness)
  - (O - Opportunities)
  - (T - Threats)
- Procedure.
- Application areas.

* Understands the concepts related with SWOT analysis.
- Define the terms.
- Explain the procedure by illustrating Examples.

3.9.3. Importance of Problem Solving

- Outline the importance of problem solving.
- Define decision making.

3.9.4. DECISION MAKING:
- Introduction and
- Definition

3.9.5. Types of Decisions.
- Programmed and Non-programmed decision.
- Major and Minor decisions
- Routine and strategic decisions.
- Organizational and personal decisions.
- Policy and operation decision
- Long term, Departmental and Non-economic decisions.

- Classify the decision in different types.

3.9.6. Decision Making Process.

- Explain the right process of decision making.

3.9.7. Barriers in decision making.

- List & Describe the Barriers in Dicision making.

3.9.8. Quantitative methods in decision making.
- Introduction.
- Deterministic models
  - Break Even Analysis.
  - Linear Programming

- Explain the use and omportance of Quantitative methods in dicision making.

- Capital Budgeting
- Inventory Management

3.9.9. Probabilistic Models.
- Expected value model
- Decision Tree
- Simulation

- Define Probabilistic models.
- Explain different types of models.

3.9.10. Other Techniques.
- Waiting line theory
- Game Theory
- Information Theory
- Utility Theory
- Heuristic problen solving.

- List other commonly used techniques in dicision making.
- Explain each of these, with their specific area of application.

4. MATERIAL MANAGEMENT.

- Functions of Materials Management system encompassing
(A) The purchasing
(B) Storing and
(C) Inventory - control functions
(D) Waste management.

* Understand the concepts about materials management system in an industry.
- State the areas included in the materials management system.
- Justify the importance of the role of Materials Management system in an industry etc.

(A) Purchasing
- Objectives of Purchasing
- Decissions to be made before purchasing (Apply systems Approach)

- List the objectives of purchasing.
- Given a situation, identify the decisions to be made before the actual purchases are made.

System approach as applied for such decision making.
(1) Input: Purchase requisition, specifications.
(2) Constraints: Legal considerations, Management policies (centralised/ Decentralised), Resource limitations, Marketing conditions, Demand factors

		(3) Purchasing decision - Supplier selection, - Timing of purchase, Pricedetermination (F.O.B. - Free on board C.I.F. - cost of materials insurance and Frieght) - Quality and quantity.
4.2.	Material Requisition Planning. - Definition. - Importance. - Factors to be considered.	- Understands the term M.R.P. * Explain the Importance of material requisition planning. * Describes in brief the factors to be considered for material requisition planning etc.
4.3.	Buying Techniques such as Batch,Speculative,scheduled and purchasing by sole supplier agreement	- Explain the different types of buying techniques with examples.
4.4.	Purchasing Procedure	* Understand the purchasing procedure - Explain the purchasing procedure etc.
4.5.	Purchase Documentation	- know about the different types of formats/related with purchasing - state the different types of proformas/formats used in purchasing etc.
4.6.	Computerised Purchasing system	* Know about the application of computer in purchasing function. - Illustrate the application of computer in purchasing etc.

4.7. Purchasing Organization;
Based on the principle of
- Function
- Product
- Location
- Stage of manufacturing

* Know about the purchasing organization.
- Classify purchasing organization.

4.8. (B) Stores Management
- Stores functions.
- stores organization centralized and Decentralized.

* Understand the working of stores
- state the stores functions
- state the types and characteristics of stores organization.

4.8.1. Stores systems and procedures.
(1) Identification system
- Arbitrary approach
- Symbolic approach

- State the importance of identification systems related with storage of items in an industry.

4.8.2. Use of Engineering drawing number.

- State the characteristics of each of the different systems involved in storage give examples.

(2) Receipt System
(3) Storage system:
(a) Physical system- closed, open and Random access stores.
(b) Stores Records system: Bin cards, Storage Ledger.

- Display the different types of formats used in record keeping and working of stores.

(4) Issue System
(5) Stores according includes
- FIFO (First-In-First-Out)
- LIFO (Last-In-First-Out)
- Average cost system
- Market value systems

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- Standard cost system
- System of costing the closing stock.

(6) Stores verification system includes
- Annual or Periodic verification
- Perpectual Inventory and continuous stock taking system.
- Low point inventory system

(7) Stores Address system

Stores Location and layout

* Know about stores location and layout related concepts.
- state the factors to be considered for locating the stores in any industry.
- State the different type of layouts used in the stores etc.
- State the different types of equipments used for storing and material handling etc.

4.8.3. Standardization,Codification and variety Reduction.

* Understand the importance of standardization,Codification and variety Reduction.
- Explain the terms standardization, Codification and variety Reduction and emphasise their importance.

4.9. (C) Inventory control

- Definition
- Function of inventory

* Understand the concept of inventory control.
- Define the term inventory
- State the functions of inventory

- Economic Order Quantity

- Derive an expression for the Economic Order Quantity.

- Stock Turnover

- Understands the term stock Turnover.

- Definition. - Importance.	* Defines the term stock turnover ratio. * Explain the importance of stock turnover. * States its applications on inventory control etc.
4.9.1. Inventory Models: Order Quantity, buffer stock, Reorder point, Lead time, Stock out.	- Define the terms model, inventory model and different terms used in relation to Inventory models. - State the functions of inventory models.
4.9.2. Fixed Order Quantity Model Wilson model) without and with bufferstock.	- Derive an expression for Economic Order Quantity (EOQ). - Given data,compute EOQ.
4.9.3. Fixed Time Period (Replenishment) model. 4.9.4. Two-bin Model.	- Explain the inventory models (Wilson, Replenishment and Two-bin) with graphical representations.
4.9.5. ABC,VED (Vital,Essential and Desirable),FSN (Fast,Slow and Non-moving) analysis. SDE (Scarce, Difficult and Easy) analysis.	- Explain the ABC, VED ,FSN and SDE analysis and their importance. - Given the necessory data. Plot the Pare to Curve for ABC analysis.
4.10. VALUE ENGG. AND VALUE ANALYSIS.	* Understands the concepts of value Engineering and value analysis.
- Introduction to value Engg.and value analysis. - Difference between value Engg. and value analysis. * Scope and objectives * Reasons for unnecessary costs	- Defines the term value,value engg. and value analysis. - Gives the types of value. - State the objectives of Value Engg. - State the reasons for unnecessary costs.

	* DARSIRI method for value analysis.	- Explains the DARSIRI method for value analysis etc.	* Concepts can be reinforced by taking a case-study.
4.11.	(D) Waste Management. - Introduction. - Complimentarity of Waste management and Resource management. - Taxonorry of waste. a) On the basis of resource wasted. b) On the basis of source of origin. c) On the basis of property. d) On the basis of recoverability.	* Understand the concept of waste management. - Define waste management. - Establish the complimentarity of waste management and resource management. - Classify waste on the basis of different criterion.	
	- Westivity. - Gross and Net Westivity.	- Define Westivity. - Explain gross and Net Westivity.	* Westivity = Waste / Input * Gross Westivity = Net Waste generate / Total Input. * Net waste = Total waste generated - Waste recycled within the system . * Wet Westivity = Net Waste generated / Total Input.
	- Functional classification of waste management. - Generation of Waste. - A systematic approach to waste reduction. - Waste collection system. - Recycling of Waste. - Waste disposal system. a) Guide lines for disposal of solvable waste. b) Processing and Disposable technique for non solvable waste.	- Identify the fundamental elements of Waste management. - List the causes of generation of waste. - Explain the systematic approach of waste reduction. - State the importance of waste collection. - Define the meaning of recycling of waste. - Classify waste disposable system on the basis of soluable and Non soluable waste. - List the techniques of Waste	

		disposal systems.	
5.0.	Production Planning and control. - Introduction - Productivity. - Definition. - Importance. - Factors to be considered.	* Understand the functions of PPC. - Explain the functions of PPC. - Understands the concepts related Productivity. - Defines the term Productivity. - Explain the importance of productivity. - Describe in brief the factors to be considered for improving productivity. etc.	* Suitable examples can be quoted.
5.1.	Functions of Production Planning and control (PPC) to include the following:	- Correlate the functions of PPC with the three phases of work completion, i.e. planning,implementation and control.	
5.2.	Planning for Men,Machines, Materials,Estimating,Routing, Scheduling,Despatching,Follow-up,Inspection and Evaluation. - Sequencing	- Define the terms sequencing and loading.	
5.3.	Loading and Scheduling * Critical Ratio. - Definition. - Importance.	- Establish that scheduling is preceded by sequencing and loading etc. - Know about critical ratio. * Defines the term Critical Ratio. - States the importance of Critical Ratio in the scheduling of activities. etc.	
5.4.	Types of Production system; Job,Batch,Mass/Flow,Group Technology,FMS project.	* Know about Production Systems - Classify the production systems - State the characteristics of different types of production systems etc.	
5.5.	Determination of optimum/ Economic batch size for production.	* Understand the method of finding Economic Batch size for production given the necessary data,compute the	

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		optimum batch size for production.	
5.6.	Documents used in production - Production order - Work Ticket - Job card - Job Ticket	* Know about the different types of formats used for PPC in an industry. - State the different types of formats used in the PPC and their functions in an industry.	* Display the different type of formats for work execution.
5.7.	Machine and labour utilization chart.	* Prepare machine and Labour utilization chart for a given data.	
6.0.	PROJECT PLANNING BY NETWORK ANALYSIS:		
	Introduction & Definition	* Understand the concepts of Project Management.	
6.1.	Steps/Phases of project management; - Preplanning - Planning to include scheduling - Implementation - Controlling - Reviewing and updating.	- Define the term project. - Explain the steps/phases of project management.	
6.2.	Tools/Techniques applied for project management	- Apply the techniques used for Project Management. - Explain the procedure of drawing a Gantt chart. - Interpret the Gantt chart. - Given necessary data draw the Gantt chart - Explain the procedure for developing a Network,Updating and Resource levelling. - Differentiate between C.P.M. and P.E.R.T. - Given necessary data,develope the	
	- Bar charts & Milestone shants (Gantt chart)		
	- Network methods,i.e.C.P.M. & P.E.R.T. Development of Network. - Fulkerson's Rule for numbering events. - Updating,Crashing		

	- Resource profile - Resource smoothening/Resource levelling.	network giving numbers to events according to Fulkerson's Rule, Update the network,draw Resource profile, and smoothen the Resource profile etc.
7.0.	WORK STUDY	
	* Introduction * Objectives * Components - Method study and work measurement.	* Knows about work study. - States objectives of work study - List the types of studies performed in work study.
7.1.	Method study * Introduction * Objectives * Steps for method study	* Understands Method Study. - States objectives of method study performing. - Describes procedure of performing method study. * Applies the concepts of method study in practice.
	* Work Measurement * Procedure	- Given the situation,performs method study.
7.2.	Work Measurement - Procedure - Techniques to include the Time study,Work sampling Predetermined motion time system.	* Understand Work Measurement. - Describes procedure of work measurement. - States techniques of work measurement
7.3.	Principles of motion economy.	- States principles of motion economy.
8.0	FACILITIES LAYOUT AND MAINTENANCE OF FACILITIES.	* Understand the concepts related with Facilities Layout in an industry.
	- Introduction: Importance and function	- Explain the importance,functions and the objectives of proper

		- Objectives	facilities layout in an industry etc.
8.1.	Basic types of plant layouts such as: - Product or line layout - Process or Functional layout - Cellular or Group layout - Job shop layout - Project or Fixed Position layout.	* Understand about the different types of plant layout and related facts. - Describe the types of layouts and their characteristics by taking live examples of different types of industry.	
8.2.	Plant layout factors.	- State the factors to be considered in selection of plant layout.	
8.3.	(B) Maintenance of the facilities:	*Understand the concepts about Maintenance of facilities.	
8.3.1.	Objectives	- State the objectives of maintenance of facilities.	
8.3.2.	Types of maintenance Such as: Scheduled (Planned) Maintenance Preventive Maintenance Condition based/Protective Maintenance. Running Maintenance Corrective Maintenance Design out.	- Correlate the importance of proper maintenance of facilities installed in an industry with the growing competitive market (cost,quality of product and morale of the workers points of views) - State the different types of maintenance practices and their characteristics etc.	
8.3.3.	Maintenance Documentation such as: History card,Lubrication card, Preventive maintenance schedule etc.	* Know about the differeent types of maintenance records kept in an industry. - State the different types of records kept about Maintenance of facilities and their importance.	- Display formats of different types of records kept in Maintenance Department of an industry.
8.4.0.	Materials Handling.	* Knows about the concepts of material handling.	

	- Introduction
	- Importance
	- Materials Hanling equipments
	  - types
	  - areas of application
		- States the importance of materials Handling in the industry.
		- States the functions of various material handling equipments and their areas of application.

9.0.	OPERATION RESEARCH.	
	Introduction to operation research.	- knows basic concepts
9.1.	Application areas of operation such as: Inventory Control Project Management (Network analysis) Decision Theory Queveing Theory Simulation Game Theory Optimisation etc.	- List specific areas of Application - Illustrates the various application areas with examples.
9.2.	Linear Programming Problems	* Understands the method of linear programming.
	Characteristics and limitations	- States the characteristics and limitations.
	Identification and formulation for solving the problems by graphical method.	- Given necessary data, solve the problem etc.
10.0.	APPLICATION OF COMPUTERS IN MANAGEMENT.	* Understand the managerial applications of Computers.
10.1.	Role of Computers in effective performance of various management functions.	- Describe the role of Computers in management functions.

10.2.	Application of Computer in: - Finance. - Production - Inventories - Maintenance. - Marketing. - Personnel. - Process-Planning.	- List the application of Computers different functions of management. - Explain, how Computers can be used to enhance effectiveness of management of these functions. - List the commonly used and latest soft ware packages for application of computers. - List the important features of these packages.	
11.0.	NEW TRENDS IN MANAGEMENT.		
11.1.	TOTAL QUALITY MANAGEMENT * Introduction.	* Understands the importance and related concepts about Total Quality Management.	* Ref: Management Quality. Edited by - B.G.Dale & J.J. Plunkett.
11.2.	Stages of development. -Inspection -Quality control -Quality assurance -Product assurance -Total Quality Control (TQM) -Total Quality Management.	- Explain the different stages of development of T.Q.M.	
11.3.	Philip Crosby's five absolutes of Quality Management.	- List the five Philip Crosby's essentials in regard to quality management.	
11.4.	W.E. Deming's fourteen point approach about improving quality and Deming's PDCA cycle (plan,Do, check,Action)	- States the Deming's approach about improving quality. - Explains Deming's PDCA cycle.	
11.5.	The Juran trilogy (Quality-Planning, Control and improvement) and two major kinds of quality management (break through-encouraging the occurance of good	- Explains the Juran Trilogy. - Explains the two majors kinds of quality Management.	

	things, to attack cronic problems; and control- Preventing the occurance of bad things, to attack sporadic problem.)	
11.6.	Feigenbaum's Concepts about total quality cost comprising of -Appraisal cost, Prevention cost and Failure Cost.	- Explains Feigenbaum's approach about total quality.
11.7.	Taguchi Quality System cycle- off-line and on-line; and Quadratic (Taguchi) quality/ loss function.	- Explains Taguchi Quality System Cycle. - Explains Taguchi's loss function.
11.8.	Japanese Quality Management Culture :- -Kaizen strategy (continuous improvement) -Quality Circle -Ishikawa's Cause and Effect Diagram (Fishbone Diagram)	- Appreciates Japanese concepts about TQM. - Explains Kaizen strategy. - Explains the concept of Quality Circle. - Explains the Ishikawa's Cause and effect diagram with suitable illustrations.
11.9.	JUST-IN-TIME (JIT) Concepts and application area in Materials Management and and Production control.	* Understand the concepts about JIT. - Explains the important role played by JIT approach in material Management and Production Control.
11.10.	Logic Structures - Definition - Purpose - Procedure - Application area	* Understands the concepts related with Logic Structures. - Define the term. - Explain the purpose and procedure of developing of Logic Structure by giving illustration..
11.11	TRENDS IN MODERN MANAGEMENT TECHNIQUE TQM (Total Quality Management) SWOT analysis	* Understands different concepts of modern management techniques..

10.7.97
(Shailesh Vaidya)

10.7.97
(B. K. Saxena)

10.7.97
R M Khan.

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FINAL YEAR PRODUCTION ENGINEERING

PRODUCTION MANAGEMENT.

1. Belts,P.W., Supervisory Management, 6th edition, (ELBS with Pitman Publishing,1994)

2. Khanna,O.P., Industrial Engineering and Management (Dhanpat Rai and Sons 1995)

3. Koontz, O'Donnell, Weihrich, Essentials of Management, 4th Edition, (Mc Graw-Hill Book company 1986)

4. Indira Gandhi National Open University, module published for Diploma in Management Course.

5. Buffa, Modern Production operations Management, 7th edition (Wiley Eastern Ltd.,1983)

6. Goel,B.S.,Production Operations Management (Pragati Prakashan,1986)

PROGRAMME: DIPLOMA IN PRODUCTION ENGG.
SCHEME: REVISED, IMPLEMENTED FROM 1995-96
SEMESTER: FIFTH
COURSE: Process Planning, Tooling and Costing-I (P.C. 2069)

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PROCESS PLANNING, TOOLING & COSTING

I

PROCESS PLANNING , TOOLING & COSTING -I & II

WORKING GROUPS

1. Dr. S.M. Bhatia, Govt.Engg.College, Bhopal.
2. Mr. M.K.Sachdeva, Sachdeva Engg. Works, Bhopal.
3. Mr. A.K. Tuli, Lect., S.V.Govt. Polytechnic, Bhopal.
4. Mr. R.L. Shrimali, Course Co-ordinator, PDU, Bhopal.

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PROCESS PLANNING, TOOLING & COSTING - I & II

RATIONALE

The need for planning in any field of life and in manufacturing in particular, need not be emphasized. The subject brings home this message through integration of knowledge in various subjects & if feasible for the students to apply in real practical situation.

Knowledge of machine tools,equipments & Cutting tools, their limitations & tooling possibilities are essential for economic production. This essentially needs estimation, prior to manufacture & classified costing system to monitor & control the costs within the limits estimated,as far as possible.

Thus, the curriculum development group, feels it essential to put these subjects together instead of putting them separately, as conventional. It is envisaged that this shall provide a more integrated approach for manufacture planning to the students including its monitoring through costing. The process planning on one hand, tries to emphasize the factors to be considered in planning the process to manufacture a given product drawing & quantity to be produced. Tooling (tool design) on the other hand concentrates on not only Production through machine tools but also the other manufacturing processes of importance such as press work, sheet metal working, forging, plastics etc.The tooling part stress upon understanding of basic approach to create rigidity, fool-proofing, accuracy & repeatability in manufacture at minimum cost. The elements used for the purpose are discussed through their principle of working and integration to form bodies like Jigs, Fixtures, moulds, dies etc.

Estimation, though relates to several factors but due to the constraints of the available experience & data to/ with the students, only time estimates are expected to be dealt with, in details, through this Curriculum. Costing broadly concentrates on the cost elements of a product & their relation with production shop floor.

The subject obviously needs to be dealt through as many real shop floor practical examples as possible, discussion among students & with faculty as well as guided industrial visits. It is not intended to enter in to rigorous mathematical calculations but to the idea generation & application in practice .

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PROCESS PLANNING TOOLING & COSTING -I

	THEORY 64	PR./TUTORIAL 96
(A) PROCESS PLANNING	THEORY	PR./TUTORIAL
1) Introduction to process planning	2	-
2) Types of Engineering Production	3	4
3) Considerations in process planning	3	10
4) Basic steps in process planning	3	6
5) Selection of Manufacturing process	3	4
6) Design of Machining Sequence Operation	8	30
7) Introduction to Pre-planning, Active planning and Monitoring.	6	10
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(B) COSTING		
1) Introduction to Costing & Estimation	2	-
2) Elements of cost	4	-
3) Overhead Expenses & their Allocation	8	6
4) Job Costing	2	10
5) Contract Costing	2	4
6) Budget & Budgetary Control	2	-
	20	20

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(C) GENERAL CONSIDERATIONS IN TOOL DESIGN

1) Introduction to tool design & its scope	- 2	-
2) Safety factors in tool design	- 2	2
3) Tool & Die material	- 4	-
4) Tool Economics	- 2	10
	10	12
(D) Revision	6	-

PROCESS PLANNING TOOLING & COSTING -I

THEORY 64 PR./TUTORIAL 96

	TH.	PR./TU.	ASSESSMENT Kn.	Comp.	Higher Level	Total
(A) PROCESS PLANNING						
1) Introduction to process planning -	2	-	-	-	-	-
2) Types of Engineering Production -	3	4	3	4	-	7
3) Considerations in process planning -	3	10	2	4	4	10
4) Basic steps in process planning -	3	6	1	3	3	7
5) Selection of Manufacturing process -	3	4	-	2	5	7
6) Design of Machining Sequence Operation-	8	30	2	5	10	17
7) Introduction to Pre-planning, Active planning and Monitoring. -	6	10	2	4	5	11
	34	64				
(B) COSTING						
1) Introduction to Costing & Estimation -	2	-	-	-	-	-
2) Elements of cost -	4	-	2	2	-	4
3) Overhead Expenses & their Allocation -	8	6	2	4	5	11
4) Job Costing -	2	10	-	6	5	11
5) Contract Costing -	2	4	1	2	-	3
6) Budget & Budgetary Control -	2	-	1	-	-	1
	20	20				

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(C) GENERAL CONSIDERATIONS IN TOOL DESIGN

1) Introduction to tool design & its scope	-2	-	-	-	-	-
2) Safety factors in tool design	-2	2	2	2	-	4
3) Tool & Die material	-4	-	2	-	-	-
4) Tool Economics	-2	10	-	2	3	5
	10	12	20	40	40	100

(D) Revision 6 -

NAME OF SUBJECT - PROCESS PLANNING , TOOLING AND COSTING -I

SNo.	Topic/ Sub Topic	Intended learning Outcome (ILO) (Objective)	Remarks
1	2	3	4
(A)	PROCESS PLANNING.		
3.1	INTRODUCTION TO PROCESS PLANNING (2 hrs.)		
	* Aims, scope and functions of process planning.	- State the meaning of Process planning. - Describe the Scope & function of Process planning. - Conclude that Process Planning a must for economic production in medium & large industry.	
3.2	TYPES OF ENGINEERING PRODUCTION. - (Th. 3 hrs.+Tuto.4 hrs.)		
	* Organizational aspects of process planning and mass, batch and piece production. * Technical and economic characteristics and typical features of each type of production.	* Know the meaning of different types of Production. * Classify the type of industry according to the type of production (piece,batch or mass) * Explain the technical and economic considerations of each type. * Co-relate the organizational aspects of process planning with each type of production. * Given relevant data, name the type of production. * Describes organizational aspects related to each type of production.	- Consider different types & Volume of industrial production & Let the students identify & describe the type & organisational aspects.

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3.3 CONSIDERATION IN PROCESS PLANNING.
(Th.3 hrs.+tuto.10 hrs.)

* Choice of manufacturing methods.

* State,example and give examples of technical and economic considerations, choice of manufacturing process.
* Describe the physical facilities required.
* List the factors to be considered in selection of physical facilities.

* Choice of basic manufacturing process.
* Physical facilities required for different types of production.
* Factors affecting.

a) Blank Production methods and their characteristics.
b) Machining process & their characteristics.
c) Methods of component production without stock removal.

* State various types of blank production methods like casting,Forming, rolling, powder metallurgy , combinations & Plastics etc.
* Summarizes the considerations in choice of blank production methods such as technical,economical, Fabrication & their influence on product properties.
* State various types of machining process like metal cutting, electro physical & Electro-Chemical machining.
* Summarizes the considerations in choice of machining processes such as machine tools,Operations, Volume of production etc.
* List the factors affecting choice of component production without stock removal.

-Solve exercises by quoting suitable field examples with supporting explaination or comments.

* Given suitable data, Student shall select suitable blank production method & machining method. (Solve at least five examples)

3.4 BASIC STEPS IN P.P.
(Th. 3 hrs.+Tuto.6 hrs.)

* List the steps in process planning.
* Understand the importance of each of the steps mentioned above.
* Conclude that the steps in planning must be adopted in sequence for effective & comprehensive planning.

* Undertake suitable exercises to illustrate the importance of each step in given sequence.

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.5 SELECTION OF MANUFACTURING PROCESS.
Th. 3 hrs. + Tuto. 4 hrs.

* Basic information required for selection of manufacturing process & Facilities required/available.

* Co-relate the Volume of production/ Job order, Frequency of repetition of order, properties required, Job specifications etc. with the preferred type of manufacturing process.
* Co-relate the physical facilities & resources available with the preferred type of production to make a final choice of process.
* Conclude that the equipment capacity data is of vital importance in planning for a given quality of manufacture.
* Conclude that equipment capacity is affected by type of tooling & its condition.

- * Take appropriate Practical examples to illustrate.

.6 DESIGN OF MACHINING OPERATION SEQUENCE
(Th. 8 hrs. +Tuto. 30 hrs.)

* Basic data required in designing machining process and sequence of operations.
* Prepare route & schedule sheet.

* Read a component/ product drawing & specifications.
* Select machining process.
* Principle & auxiliary operation on the basis of above.
* Identify appropriate equipment, machinery & tooling required.
* State what is meant by route sheet.
- List the contents of a route sheet.
- Comprehend that time estimate on route sheet states actual operation time.
- Conclude that route sheet considers only work station for various operations & No handling time, setting time etc.
* Develop process route sheet.

- * Given data and product drawing select production & machining process, principle and auxiliary operations, equipments, machinery, tooling & appropriate sequence.

3.7 INTRODUCTION TO PRE-PLANNING, ACTIVE PLANNING AND MONITORING.

Th. 6 hrs.+ Tuto.10 hrs.

* Different areas of Production Planning & Control.	* Summarizes that P.P.C. is broadly classified as Pre-planning, Planning and Control. * Prepares the list of Planning activities in each of the three areas. * List the Ten functions of P.P.C. * Explain the concepts of each of the Ten functions of P.P.C.	
* Pre-planning.	* States that Pre-planning includes- (a) Product development & design. (b) Sales forecasting & Estimating. (c) Plant layout and (d) Evaluation of materials and methods. * Explain the use and importance of each of the Pre-planning details.	
* Planning.	* State that the Planning includes. (a) The production order. (b) Quantities in batch production. (c) Batch-size determination under boundary conditions. (d) Machine capacity. (e) Scheduling. * Explain the use and importance of each of the five fields of Planning. * Prepare route and schedule sheet for some simple jobs.	* Relevant data from industry may help to schedule, Gantt chart scheduling.
* Active Planning.	* State that active Planning includes Dispatching and Expediting. * Explain need aspects and responsibility of Dispatching activities. * Explain that Expediting is a Monitoring activity. * State the three functions of Expediting.	

(D) COSTING		
	* Define & state the objectives of Costing & Estimation.	
3.8 INTRODUCTION TO COSTING & ESTIMATION. - 2 hrs.	* Describe characteristics of a good Costing system & its advantages. * Define each type of Cost.	
3.9 ELEMENTS OF COST. - 4 hrs.	* Classify & distinguish these Costs. * Give examples of each Cost.	
3.10 OVERHEAD EXPENSES & THEIR ALLOCATION. (Th. 8 hrs.+ Tuto. 6 hrs.)	* Understands Concept of Overhead Allocation. * List the various methods of overhead cost allocation. * Understands the method of distributing overheads. * Advantages & Disadvantages of different methods of Overhead allocation.	-* Given data, allocate overheads, using each of the Four methods.
3.11 JOB COSTING. (Th. 2 hrs.+ Tuto. 10 hrs.)	* Explain the meaning of Job Costing. * Summarizes the importance of job costing as a cost tracking/ monitoring system. * Analyse input costs of actual project/ job and compare with estimated costs. * Update estimation data for future reference.	-* Relevant examp. from ancillary or small scale industry may be more useful. * Adequate number of examples in tutorial would help the students to comprehend better.
3.12 CONTRACT COSTING. (Th 2 hrs. + Tuto. 4 hrs.)	* Explain the meaning of Contract Costing. * State technical & Commercial aspects of the Contract. * Explain the procedure for preparation & Submission of tenders. * Verify and write acceptance of purchase order/contract. * Use a system of estimating costs prior to submission of tender.	* Relevant example from ancillary and small scale industry may be more useful. * Adequate number of examps. in tutorial would help the students

3.13 BUDGET & BUDGETARY CONTROL. (2 hrs.)	-* Define Budgets various elements of Budget. * Types of Budgets. * Define Budgetary Control. * Understands the purpose of Budgetary control.	

(C) GENERAL CONSIDERATIONS IN TOOL DESIGN.

3.14 Introduction to tool design and its scope. (Th. 2 hrs.)	* Explain the meaning,need & scope of tool design. * Understand tooling layout for simple jobs on semi-automatic machine tools.	
3.15 Safety factors in tool design. (Th.2 hrs.+Tuto.2 hrs.)	* Describe Commonly observed safety factors in tool design.	* Relevant example from ancillary and small scale industry may be more useful.
3.16 Tool and Die material. (Th.4 hrs.)	* Name the commonly used Tool & Die materials. * Describe their characteristic properties composition & application.	
3.17.Tool Economics. (Th 2 hrs.+ Tuto. 10 Hrs.)	* Know the criteria for selection of material for different tools and dies. * Explain tool-economics, analysis of tooling cost. * Cost analyse the tool economics based on give relevant data industry tool re-sharpening time & costs.	*Relevant example from ancillary and small scale industry may be more useful.

(D) Revision - (6 hrs.)

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PROCESS PLANNING TOOLING & COSTING – I

LIST OF BOOKS RECOMMENDED FOR REFERENCE

SNo.	Title	Name of Author	Publishers
1.	Process Engineering for Manufacturing	- Donald F. Eary and Gerald E. Johnson	- Prentice Hall
2.	Engineering manufacturing Process	- D. Maslov, V. Danilevsky V. Sasor	- Mir Publishers Moscow
3.	Fundamentals of Process Engineering	- V. Kovan	- Foreign languages Publishing house moscow
4.	Manufacturing Engineering	- Wage	- Mc Graw Hill
5.	Manufacturing Engineering	- V.Danilevsky	- Mir Publication

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PROGRAMME: DIPLOMA IN PRODUCTION ENGG.
SCHEME: REVISED, IMPLEMENTED FROM 1995-96
SEMESTER: FIFTH
COURSE: Higher Maths

(P.C. 20709)

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HIGHER MATHEMATICS - III & IV

HIGHER MATHEMATICS - III & IV

WORKING GROUPS

1. Dr. D.K. Wagh, Prof., S.G.S.I.T.S., Indore.
2. Mr. Anil Bakhru, Sr.lect., S.V. Govt. Polytechnic, Bhopal.
3. Mrs. S.D. Wagh, Lect. , S.V. Polytechnic , Indore.
4. Mr. Manoj Singh, Lect. S.V. Govt. Polytechnic, Bhopal.
5. Mr. R.L. Shrimali, Course Co-ordinator, PDU, Bhopal.

HIGHER MATHEMATICS - III & IV

RATIONALE

Mathematics, being the back-bone of all technologies, Occupies an important place in the Curriculum of Polytechnics. It developes reasoning and logical thinking among students. Being an elective subject for final year diploma in Production Engineering students, the syllabus is designed to bridge the gap existing due to admission qualification of Polytechnics(10 +) and for engineering Colleges (12+). Thus to prepare those Students who Opt for higher mathematics at second year level, by complementary inputs in mathematics at third year level to enable them to take-up mathematics for higher studies such as B.E. AMIE, etc. without difficulty. This Curriculum will definitely fulfill the need of mathematics' background of all Technical subjects included in the diploma in Production Engineering course.

The tutorials can be taken up by concerned teacher as per the requirement of the class. Hence, separate tutorial periods are NOT to be specified in time table. It is further emphasized that rhetoric & theoretical, pure mathematics examples be kept to a minimum, if NOT eliminated. More & more examples from engineering field will help the students.

It is suggested that even in examination, curriculum relevant, simple (involving no derivation and rigorous mathematics) exercises be given.

HIGHER MATHEMATICS -III

SCHEME OF STUDIES (TIME ALLOCATION)

S.No.	TOPICS	THEORY HOURS	TUTORIAL HOURS	TOTAL HOURS
1.	Differential Calculus	10	2	12
2.	Integral Calculus	10	2	12
3.	Complex Number	07	1	08
	Total Hours -	27	5	32

HIGHER MATHEMATICS -III

TABLE OF SPECIFICATION FOR ASSESSMENT

S.No.	TOPICS	KNOWLEDGE	COMPREHENSION	APPLICATION	TOTAL
1.	Differential Calculus	03	09	18	30
2.	Integral Calculus	03	08	18	29
3.	Complex number	02	04	10	16
	Total Hours -	08	21	46	75

HIGHER MATHEMATICS -IV

TABLE OF SPECIFICATION FOR ASSESSMENT

S.No.	TOPICS	KNOWLEDGE	COMPREHENSION	APPLICATION	TOTAL
1.	Matrices	04	10	15	29
2.	Numerical Methods:				
	- Computer Arithmatic	02	05	-	07
	- Iterative Methods	02	-	10	12
	- Simultaneous Linear Equations	02	-	05	07
	- Approximation of Functions	-	05	-	05
	- Numerical Integration	-	05	10	15
	Total Hours -	10	25	40	75

HIGHER MATHEMATICS – III

S.No.	Topic/Sub Topic	Intended Learning Outcome (ILO) (Objective)	Remarks
1	2	3	4
1.	DIFFERENTIAL CALCULUS		
1.1.	Successive Differentiation (Th.4 hrs.+ Tuto.1 hrs.)		
	n^{th} derivatives of e^{ax}, $(ax+b)^n$, $\frac{x}{(ax+b)}$, $\log(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $e^{ax}\sin(ax+b)$, $e^{ax}\cos(ax+b)$	* Recapitulation of the principles of differential calculus. - Find out the n^{th} order derivatives of some functions. - Solve problems to find out n^{th} derivatives of function.	
1.2.	Leibnitz's Theorem (Th. 2 hrs.)	- State the Leibnitz's Theorem. - Apply the Theorem to solve the problems. - State a few Engineering applications.	
1.3	Partial Differentiation. (Th.4 hrs.+Tuto.1 hr.)		
	- Functions of many variables. - Partial derivatives of first, second & higher order. - Applications.	- Know the functions of many variables. - Define the Partial differential coefficients of first and higher order. - Find out Partial derivative of first & second order.	

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- Homogeneous function.
- Euler's Theorem.

- Identify Homogeneous functions.
- State Euler's Theorem.
- Solve simple problems on Euler's Theorem.

2. INTEGRAL CALCULUS

* Recapitulation of principles of integration.

2.1. Integration of rational & Irrational functions.
(Th. 2 hrs.+Tuto.1 hr.)

$$\frac{1}{a^2 \pm x^2} \qquad \frac{1}{x^2 \pm a^2}$$

$$\frac{1}{ax^2+bx+c}, \qquad \frac{Ax+B}{ax^2+bx+c}$$

$$\frac{1}{\sqrt{(a^2 \pm x^2)}} \qquad \frac{1}{\sqrt{(x^2-a^2)}}$$

$$\frac{1}{\sqrt{(ax^2+bx+c)}}, \qquad \frac{Ax+B}{\sqrt{(ax^2+bx+c)}}$$

- Find the integrates of rational and irrational functions following the mathematical procedure.
- Solve problems on above.

2.2. Reduction formula
(Th.2 hrs.)

$\int \sin^n x.dx, \quad \int \cos^n x.dx$

$\int \tan^n x.dx \quad \int \sin^m x \cos^n x.dx$

- Derive reduction formula.
- Apply reduction formula to solve problems.

2.3. Definite Integral
(Th.4 hrs.)

- Review the basic concepts of definite integral.
- Derive the properties of definite integrals.
- Apply properties of definite integral to evaluate definite integral.

2.4. Gamma functions.
(Th.2 hrs.+Tuto. 1 hrs.)

- Define Gamma functions.
- State gamma function & its reduction formula.

- State the formula for $\int_0^{\pi/2} \sin^m x \cos^n x.dx$ in terms of gamma function.
- Compute $\int_0^{\pi/2} \sin^m x \cos^n x.dx$
- Clarify gamma function.

3. COMPLEX NUMBER

3.1. Algebra of Complex Number. (Th.1 hrs.)
- Define complex number.
- Solve simple arithmetical operation of complex numbers.

3.2. De Moiver's Theorem. (Th.2 hrs.)
- State and solve for the repetition of complex number in Argand diagram.

3.3. Application of De Moiver's theorem. (Th.2 hrs.+ Tuto.1 hrs.)
- State De Moiver's theorem.
- Applies De Moiver's theorem to solve problems.
- Apply De Moiver's theorem to find out roots of a complex number.
- Expand sin $n\theta$ & cos $n\theta$, on power of sinθ & cosθ .
- Solve problem on above.
- Expand $\sin^n\theta$ & $\cos^n\theta$ in series of sine & Cosine of multiple angle.
- Solve problems on above.

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HIGHER MATHEMATICS -IV

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SCHEME OF STUDIES

S.No.	TOPICS	THEORY HOURS	TUTORIAL HOURS	TOTAL HOURS
1.	Matrices	08	02	10
2.	Numerical Methods:			
	- Computer Arithmatic	04	01	05
	- Iterative Methods	04	01	05
	- Simultaneous Linear Equations	04	01	05
	- Approximation of Functions	02	-	02
	- Numerical Integration	04	01	05
	Total Hours -	26	06	32

NAME OF SUBJECT : HIGHER MATHEMATICS - IV 8/179

S.No.	Topic/Sub Topic	Intended Learning Outcome (ILO) (Objective)	Remarks
1	2	3	4
1.	MATRIX		
1.1.	Recapitulation. (2 hrs.)	- Recapitulate of the principles of matrix.	
1.2.	Rank of a Matrix. (2 hrs.)	- Define rank of matrix. - Solve example on rank of a matrix.	
1.3.	Elementary transformation of a matrix. (Th.2 hrs.+Tuto.1 hr.)	- Define elementary transformation of matrix. - Apply elementary transformation to find out rank of a matrix.	
1.4.	System of Linear Simultaneous Equations. (Th.2 hrs.+tuto.1 hr.)	- Apply elementary transformation to find solution of simple linear simultaneous Equation.	
2.	NUMERICAL METHODS.		
	* Introduction. (Th. 1 hr.)	- State the Scope & purpose of studying 'Numerical Methods'.	
2.1.	Computer Arithmatic. (Th.2 hrs.)		
	- Floating point representation of number.	- State the fixed & floating point representation of numbers.	
	- Arithmatic operations with normalized floating point representation.	- Explain Arithmatic operation with normalized floating point representation. - Solve problems on above.	
	Numerical instability and Trucation Errors.(Th 1 hr.+ Tuto.1hrs.)	- Express the numerical instability and Truncation Error.	

2.2. Iterative Methods. - Successive Bisection Method. 2.hrs. - False position or Regula falsi method. 2 hrs. - Newton Rephsone's method. 2. hrs.	* Find out approximate solution by the iterative Method. * Derive formula for Successive Bisection method. * Solve problem on successive Bisection method. * Derive formula for false position or regula falsi method. * Solve problem on above. * Derive Newton- Rephsone's Method. * Solve problem on above.
2.3. - Simultaneous Linear Equation. - Gauss Elimination method. - Gauss Seidal iterative method. (Th.2hrs.+Tuto.1hr.)	* State the meaning of system of Equation. * Explain Gauss elimination method. * Solve problems on above. * Explain Gauss Seidal interative method. * Solve problems on above.
2.4. Approximation of function. 2 hrs.	* Find the approximate value of functions e^x, sin x, and cos x by power series.
2.5. Numerical Integration. - Trapezoidal rule. 2 hrs. - Simpson's rule. (Th.2hrs.+Tuto.1 hr.)	* Knows the method of numerical integration. * Explain trapezoidal rule & Simpson's rule. * Solve problems on above.

SUGGESTED LIST OF REFERENCE BOOKS

HIGHER MATHEMATICS -III

S.No.	Title	Authors	Publishers
1.	Mathematics for Polytechnic part I & II.	T.T.T.I. Bhopal	-
2.	Applied Mathematics	Choubey	Deepak prakashan.
3.	Higher Engg. Mathematics	Dr. B.S.Grewal	Khanna publishers Delhi.
4.	Engg. Mathematics	Dr. S.K. Chouksey & Manoj Singh	M.P. Hindi Granth Academy.

SUGGESTED LIST OF REFERENCE BOOKS

HIGHER MATHEMATICS -IV (Semester -VI)

S.No.	Title	Authors	Publishers
1.	Computer Oriented Numerical Methods.	V. Rajaraman	Prentice Hall of India Pvt. ltd. New Delhi.
2.	Introductory Methods of Numerical Analysis	S.S. Sastry	"
3.	Higher Engg. Maths.	Dr. B.S. Grewal	Khanna Publishers Delhi.

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PROGRAMME: DIPLOMA IN PRODUCTION ENGG.
SCHEME: REVISED, IMPLEMENTED FROM 1995-96
SEMESTER: FIFTH
COURSE: Entrepreneurship (P.C. 2071)

ENTREPRENEURSHIP

WORKING GROUPS

ENTREPRENEURSHIP

1. Dr. P.N. Mishra, ED, Bhopal.
2. Dr. G.S. Jariyal, EDI, Bhopal.
3. Mr. U.K.Jain, HDPE, S.V. Govt. Polytechnic, Bhopal.
4. Mr. Shamim Uddin, HDMaint.C, S.V. Govt. Polytechnic, Bhopal.
5. Mr. S.R. Madan, HDME, S.V. Govt. Polytechnic, Bhopal.
6. Mr. B.K.Saxena, Sr.Lect., S.V. Govt. Polytechnic, Bhopal.
7. Mr. Arvind Jain, Lect., S.V. Govt. Polytechnic, Bhopal.
8. Mr. A.K. Jain, Lect. S.V. Polytechnic, Indore.
9. Mr. K.C. Verma, Course Co-ordinator, PDU, Bhopal.

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ENTREPRENEURSHIP

RATIONALE

The subject Entrepreneurship has been developed keeping in view of the employment scenario of the country. The country is passing through socio-economic changes imposed by internal pressures on one hand and impact of globalization on the other hand. Up till now the government (both central and state) were the major source of the job potential,but with the adoption of the open market policy and growing stress on privatization of various sectors pertaining to the heavy industries, public undertakings and service system such as Railways, Tele-communication etc., the job potential in the govt. sectors further receding at a faster rate.

To keep pace with these changes and the National Policy, this subject of Entrepreneurship has been developed as to prepare Diploma passouts in the field of Production Engineering to go for self employment rather than seeking the jobs.

The curriculum is designed & developed from concept formation of Entrepreneurship to complete knowledge of planning of an Industrial Unit,implementingthe plans, generating the resources and successfullymanagingthe enterprise. Information about the commercial and tex laws have also been included to further enhance the competence for managing the enterprise efficiently and effectively.

NAME OF SUBJECT :- ENTREPRENEURSHIP

SNo.	Name of Topics	Hours Allotted
1.	INTRODUCTION TO ENTREPRENEURSHIP	- 10 Hrs.

* Definition of Entrepreneur/ Intrapreneur/ Entrepreneurship/ Intrapreneurship.
* Difference between Entrepreneurship/Intrapreneurship.
* Need for Entrepreneurship .
* Qualities of a successful Entrepreneur.
* MYTHS about Entrepreneurship .
* Classification of Entrepreneurs on the basis of different criteria.
* Reasons for failure of Entrepreneurs.

2. INDUSTRIES AND BUSINESS ORGANIZATIONS. - 10 Hrs.

* Concept of Industry or Enterprise.
* Classification of Industries
  (A) On the basis of Capital Investment.
    - Tiny (Micro) Industry.
    - Small scale
    - medium scale
    - Large scale.
  (B) Others.
    - Rural Industry
    - Cottage Industry.
  (C) Forms of Business Organization.
    - Proprietorship
    - Board & Co-operative.
    - Partnership
    - Public Ltd.
    - Pvt. Ltd.
    - Jt. Sector
    - Govt. Co-operative/ Undertakings.

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* Tiny/ Small Scale Industry.
  - Definition
  - Its significance in National Development
  - Govt. Policies for SSI Promotion
  - Sector/ Products reserved for SSI.

INSTITUTIONAL ASSISTANCE. - 10 Hrs.

* Types of Institutional Assistance.
  - Infrastructural Assistance
  - Technical Assistance
  - Financial Assistance
  - Marketing Assistance.

* Institutions and their Roles.
  - Statutory and Promotional.

* Institutions and Assistance Available From Them.
* Information/ Guidance & Training.
  - SISI. - ASK.
  - MPCON. - CSIR.
  - CED-MA. - NRDC.
* Infrastructure.
  - DIC. AVN/AKVN
* Finance.
  - SIDBI.MPFC. - KVIB
  - NABARD. BANKS - MPWDC.
  - NSIC - M.P.A.V.V.N.
* Marketing.
  - MP-AGRO - NSIC
  - MP.LUN - EXPORT CORPORATION
  - KVIB. - MPHSVN, MPLDC.

* Quality Control.
  - BIS. - FPO.
  - MPLUN. - F.D.A.
  - AG.MKT.BOARD.

INCENTIVES/ CONCESSION/ FACILITIES, AVAILABLE TO SSI ENTREPRENEUR (M.P.STATE). - 6 Hrs.

* Seed Money.

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* Incentives/ Subsidies.
* Others (Phones, Lands etc.)

PLANNING OF AN INDUSTRIAL UNIT (SSI). - 16 Hrs.

* Pre-planning stage.
  - Scanning the Environment.
  - Market Survey.
  - Seeking information.
  - Product/ Project Selections.

** Implementation stage.
  - PPR. Preparation.
  - DIC. registration
  - Arrangement of Land.
  - Arrangement of power.
  - Obtaining NOC/ Licances from various deptt.
  - DPR Preparation.
  - Seeking Financial Assistance.
  - Commercial Production.

*** Post Implementation stage.
  - Permanent requestration from DIC.
  - Availing Subsidies.
  - Diversification/ Modification.
  - Setting up of Marketing Chanel/ Distribution.

ACHIEVEMENT MOTIVATION. - 15 Hrs.

* Historical Perspective.
* Concept of achievement motivation.
* Significance of achievement motivation.
* Components of achievement motivation.
* Development of achievement motivation.

FINANCIAL MANAGEMENT OF AN INDUSTRIAL UNIT (SSI). - 8 Hrs.

* Tools of financial analysis.
* Ratio analysis.
* Fund flow/ Cash flow analysis.
* Working capital and concepts.

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* Financing of working capital of management requirement.
* Financial Accounting.
  - Book of account.
  - Principle of Accounting.
  - Profit and loss account.
  - Balance sheet.

MARKETING MANAGEMENT. - 8 Hrs.

* Concept / 4 PS of marketing.
* Marketing strategy.
* Packaging and Distribution.
* After sales service.
* Marketing of a service.

PERSONNEL MANAGEMENT AND INDUSTRIAL RELATIONS. - 5 Hrs.

INTRODUCTION TO COMMERCIAL AND TAX LAWS APPLICABLE TO SSI UNITS. - 8 Hrs.

Total - 96 Hrs.

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NAME OF SUBJECT :- ENTREPRENEURSHIP

No.	Topic/ Sub-topic	Intended learning Outcome (ILO) (Objectives)	Remarks
1	2	3	4
.	INTRODUCTION TO ENTREPRENEURSHIP.		
	* Definition of Entrepreneurs/ Intrapreneur/Entrepreneurship/ Intrapreneurship. * Difference between Entrepreneurship and Intrapreneurship.	Understand the concepts related with Entrepreneurship. * Define the terms Entrepreneur, Intrapreneur, Entrepreneurship, Intrapreneurship. * Differentiate between entrepreneurship and Intrapreneurship. * Give illustrations of entrepreneurs and intrapreneurs. * etc.	
	* Need for entrepreneurship. - Personal (need for achievement, power and affiliation monetary benefits etc.) - Societal, Regional/ National Socio-economic development etc. and Governmental (Overcoming employment problem etc.)	Understand the need for developing entrepreneurship in changing economic scenario of the country. - Explain the need for development of entrepreneurship concept. - etc.	* Give illustrations.
	* Characteristics of a successful entrepreneur such as - - Innovation - Organizing abilities - Motivation - Pride - Risk taking - Dynamism - Aptitude for change	Understand the importance of desirable qualities/ characteristics an entrepreneur should posses. * List the desirable qualities/characte-ristics. * Explain each of the characteristics and illustrate these with suitable examples.	

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- Adaptability
- Flexibility
- Determination
- Will power
- Creativity
- Tactfulness
- Self confidence
- Intelligence
- Knowledge
- Commitment
- Goal setting
- Decision making
- Good at maintaining human relations.
- Leadership
- Perseverance
- Achiever
- etc.

* Myths about entrepreneurship
  - Popular prejudices based on Family background (Social, Financial etc.) Caste, community, Region, Race, Religion, Sex etc.

Recognizes that the prejudices popular in society related with successful entrepreneurship are unscientific.
* List some related prejudices in society.
* Infer with suitable examples that such myths are baseless.

* Case histories can be quoted defying this misconcpt.

* Classification of entrepreneurs to include the following :-
  - According to the type of business.
    - Business entrepreneur
    - Trading entrepreneur
    - Industrial entrepreneur (-large,-medium,-small, and -tiny)
    - Corporate entrepreneur
    - Agricultural entrepreneur
      - Plantation
      - Horticulture

Know about classification of entrepreneurs on the basis of different criteria.
- List the different criteria for classification.
- Describe the different types of entrepreneurs considered under each criteria.

* Ref:Entrepreneurial development Vol. 1 by Vasant Desai

* Quote suitable examples for each different type of entrepreneur.

- Dairy
- Forestry
- Retail entrepreneur
- Service entrepreneur

- According to use of Technology
  - Technical entrepreneur
  - Non-technical entrepreneur
  - Professional entrepreneur
  - High-tech entrepreneur
  - Low-tech entrepreneur

- According to the Motivation.
  - Pure entrepreneur
  - Induced entrepreneur
  - Motivated entrepreneur
  - Spontaneous entrepreneur

- According to the growth.
  - Growth entrepreneur
  - Super-growth entrepreneur

- According to the stages of development-
  - First generation entrepreneur
  - Modern entrepreneur
  - Rural entrepreneur

- According to gender and age-
  - Men entrepreneur
  - Women entrepreneur
  - Young entrepreneur
  - Middle aged entrepreneur
  - Old entrepreneur

- Others or Unclassified-
  - Professional entrepreneur
  - Non-Professional entrepreneur
  - Modern entrepreneur
  - Traditional entrepreneur
  - Skilled entrepreneur
  - Non-skilled entrepreneur
  - Imitating entrepreneur
  - Forced entrepreneur
  - National entrepreneur
  - International entrepreneur

- Bureaucratic entrepreneur
- Intrapreneur entrepreneur
- Immigrant entrepreneur

* Reasons foe failure.
  - Lack of Planning
  - Incorrect market survey
  - Rise in competition
  - Obsolescence of technology
  - Conservative attitude
  - Labour upheaval
  - Socio-Economics- political governmental policies
  - Goots Bureaucratic approach-
  - Chaotic conditions
  (Natural- flood, earthquality etc.
  (Man.made- Accidents.
  - Lack of leadership
  - Poor decision making
  - Lack of professionalism
  - Trade unions
  - Financial losses
  - Diruption in material supply line
  - Poor quality product
  - Poor marketing- 4F.'s approach not properly employed.
  - Improper institutional assistance
    - Technical, Infra-structural, finance etc.
  - Legal implications.

- Recognizes the reasons for failure of entrepreneurs.
- Identifies the reasons of failure.
- Explain these reasons with suitable examples.

INDUSTRIES AND DUSINESS ORGANIZATION

1. Concept of industry/Enterprise.

   - Definition.
   - Aims and objectives.

* Understand the concepts related with Industries/ Enterprise.
* Explain the aims and objectives of an industry/ Enterprise.
* State the role played by industries in human life.

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2.2. Classification of Industries.	* Classification of industries based on different criteria.
(A) On the basis of Capital investment. (i) Tiny industries (ii) Small scale industries (iii) Medium scale industries (iv) Large scale industries	* State the classification of industries on the basis of capital investment. * illustrate will suitable example of such industries.
(B) Others. (i) Rural industries (ii) Cottage industries. - Definition - Salient characteristics. such as ; Limited manpower Limited space and working capital and scope.	* Define rural and cottage industries. * Explain the salient characteristics rural and cottage industries. * List the advantages and limitations of rural and cottage industries.
(C) Forms of Business Organization such as ; - Proprietorship - Board & Co-operative. - Partnership - Public Ltd. - Pvt. Ltd. - Jt. Sector - Govt. Co-operative/ Undertakings. - Definition - Salient features - Application areas.	* Understand the concept related to the forms of business organization. * List the different forms. * Give salient features of different forms of business organization. * List the advantages , limitation and disadvantages (if any)of given forms of business organization.
2.3. Details of Tiny and small scale industries.	* Understand the concepts related with Tiny and small scale industries in india.
(i) Its significance in National Development.	* Explain the significance of Tiny and Small scale industries for the Development of country.
(ii) Govt. Policies for SSI promotion.	* State the govt. Policies for SSI promotion.

(iii) Sector/ Products reserved for SSI.	* List the name of sector/ product reserved for SSI.

3. INSTITUTIONAL ASSISTANCE.

Types of Assistance (1) Information/ Guidance/ Counseling Viz SISI, MPCON,CEDMAP,ASK,CSIR, NRDC etc. (2) Infrastructural Viz DIC, AKVN etc. (3) Finance Viz SIDBI, MPPC, NABARD, Banks, NSIC, KVIB, MPAVVN etc. (4) Quality Control Viz BIS, MPLUN, Agriculture Marketing Board, FPO, FDA.	* Applies the concepts about Institutional assistance in a given situation. * State the functions of the Institutions which provide (1) Information/ Guidance/ Counseling Assistance. (2) Infrastructural Assistance (3) Financial Assistance (4) Quality Control Assistance. * Given a situation suggest the sources from which the needed assistance could be made available.	* Provide necessary current information regarding the different resources for various Assisting Institutions and their limitations.

4. INCENTIVES/ CONCESSION/ FACILITIES, AVAILABLE TO SSI INTRAPRENEURS (M.P. STATE)

4.1. Seed money. - Concept of seed money - Seed money and relation ship with specific application area.	* Understand the concept of Seed Money. - Define the Seed Money. - Co-relate the Seed Money as applied for different areas.
4.2. Incentives/ Concessions. - Definition. - Role need of Incentive - Clarify cation Viz. . Capital Incentive . Incentive for Expansion/ Diversification	* Understand the concept of Incentives. - Define the incentive. - Explain he need of incentive. - List the different types of incentives. - Summerise the self schemes of incentive. - List the different Agencies supporting the S.S.I. Entrepreneurs.

- Scheme of incentives in operation. - Implementing Agencies. - Claims for incentives for an entrepreneur.	- Eligibility of S.S.I. entrepreneur to get the incentives.
4.3. Subsidies. - Definition. - Differentiate with other terms Viz. - Incentive - Concessions. - Different types of Subsidies. . Capital subsidies. . Transport subsidies. . Other types.	* Understand the concept of Subsidies. - Define the term subsidy. - Explain the self of subsidy with other terms. - Explain the different types of subsidies.
5. PLANNING OF AN INDUSTRIAL UNIT (SSI).	
(1) Pre-planning stage. a) Scanning the Environment. b) Market Survey. c) Seeking information. d) Product/ Project Selections. (2) Implementation stage. a) PPR. Preparation. b) DIC. registration c) Arrangement of Land. d) Arrangement of power. e) Obtaining NOC/ Licances from various deptt. f) DPR Preparation. g) Seeking Financial Assistance. h) Commercial Production. (3) Post Implementation stage. a) Permanent requestration from DIC. b) Availing Subsidies. c) Diversification/ Modification. d) Setting up of Marketing Chanel/ Distribution.	- Applies the concept of planning for setting up on industrial unit. - Name the stages of planning. - viz. Preplanning, Implementation Post implementation stage. - State the factors to be considered at various stages . - Explain the above stages, different factors. - Under a given situation procure the necessary data and prepare the documents PPR, DPR.

* Prepared DPRs can be shown in the class-room.
* DPR can be seen Entrepreneur Magazine.
* DPR can be collecting from DIC.
* Science Technology entrepreneur quarterly publicati-on of NSTIDR, DST, Coni & india.

ACHIEVEMENT MOTIVATION.

- Definition of Motivation.
 	
- Entrepreneurial motivation.
  - Need for achievement
  - Need for power.
  - Need for affiliation
	* Understand the concepts of related with achievement motivation.
	- Define motivation.
	- Explain the needs causing entrepreneurial motivation.
		* Ref: Trainers manual on developing Entrepreneural motivation.
		- National Institute for entrepreneurship and small Business development New Delhi.

- Achievement Motivation
  - Definition.
  - Significance.
  - Characteristics of persons with high.
- Need for achievement
  - As Entrepreneurial motivation.
	* Define achievement motivation.
	- Explain the significance of achievement motivation.
	- State the characteristics of persons with high need for achievement.
	- Explain the importance of achievement motivation as an important factor for Entrepreneurial motivation.	

- Exercises for entrepreneurship motivation.
 	
  - Objective of exercise
  - Procedure
  - Evaluation.
 	
Following to be included at least
- Thermatic Apperception Test
- Who am I ?
- Ring- Toss Exercise
- Achievement Planning Exercise
- Tower- Building
- Convince and Crown
- Creativity.
	* Understand the essentials of exercises conducted for reinforcing concepts of entrepreneurship motivation.
	- State the different exercises undertaken.
	- Describe the procedure of conduction of exercises.
	- Summarizes the inferences drawn from the exercises performed.
		* Provide practice for some/ all the exercises as to reinforce the concepts.

	industrial unit with reference of small scale industries.
7.2. Purpose of Financial Management.	* Know the purpose of Financial Management.
7.3. Understanding Financial Statements -	* Understand different types of financial statements.
7.3.1.Construction and Analysis of Balance sheet -	
- Introduction.	* Understand balance sheet.
- Conceptual basis of a balance sheet.	* Know the conceptual basis of a balance sheet.
- Construction of a balance sheet.	* Construct a balance sheet for a given data.
- Contents of a balance sheet.	* Understand the concept of balance sheet.
- Classification of items of balance sheet.	* Classify items of a balance sheet.
7.3.2.Construction and Analysis of Profit ans Loss account.	
- Introduction.	* Understand Profit and Loss account.
- Link between Profit and Loss Account and balance sheet.	* Know the link between Profit and Loss account and balance sheet.
- Measurement of income.	* Define measurements of income.
- Preparation of Profit and loss account.	* Know the procedure for preparation of Profit and Loss account.
- Methods of depreciation.	* Describe various Methods of depreciation.
- Form of Profit and Loss account.	* Explain the forms of Profit and Loss account.
- Cost of goods sold.	* Know the procedure of calculating cost goods sold.
- Methods of inventory valuation.	* Describe the methods of inventory valuation.
- Gross profit.	* Define Gross Profit.
- Net Profit.	* Define Net Profit.
7.3.3.Construction and Analysis of Fund flow statement.	
- Introduction.	* Understand the Fund flow statement.

- Working capital and its need.	* Define Working capital and Explain its need.
- Working capital requirement.	* Determine the Working capital requirement.
- Sources of funds.	* Describe the Sources of funds.
- Application/ Uses of funds.	* Give the Application/ Uses of funds.
- Factors affecting fund requirement.	* Discuss the Factors affecting fund requirement.
- Preparation of fund flow statement.	* Preparing of fund flow statement from a given data.

7.4. Financial & Instrument Analysis.

7.4.1. Ratio Analysis.

- Introduction.	* Understand Ratio analysis.
- Classification.	* Classify ratios.
- Norms for Evaluation.	* Discuss the norms for evaluation.
- Computation procedure and its purpose.	* Describe the computation procedure of different ratios and their purpose.

7.4.2. Leverage Analysis.

- Introduction.	* Understand leverage analysis.
- Concept of financial leverage.	* Describe the concept of financial leverage.
- Effects of financial leverage.	* Explain effects of financial leverage.

7.4.3. Budgeting and Budgetary Control.

- Introduction.	* Understand Budgeting and Budgetary Control.
- Financial Planning.	* Describe financial planning.
- Budget.	* Define Budget.
- Budgetary Control.	* Define Budgetary Control.
- Classification of budgets.	* Classify of Budgets.
- Control Ratios.	* Define Control Ratios.
- Performance Budgeting.	* Describe Performance Budgeting.
- Zero base Budgeting.	* Describe zero base Budgeting.

7.5. Financial Decisions.

7.5.1. Management of working capital.

- Introduction.	* Understand Management of working capital.
- Significance of working capital	* Give the significance of working capital
- Operating Cycle.	* Explain Management of an enterprise.
- Concept of working capital	* Describe operating cycle.

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- Components of working capital. - Management of working capital.	* Give the different kinds of working capital. * Explain different component of working capital. * Explain the management of working capital.
7.5.2. Managing Cash needs. - Introduction. - need for Cash. - Optimal Cash balance. - Cash management.	* Understand management of cash needs. * Define need for cash. * Determine Optimal Cash Balance. * Explain Cash Management.
8. MARKETING MANAGEMENT.	
8.1. - Role of Marketing in Small industry and business, - Importance of consumers point of view. - Consumers Behavior - Buying habits - Marketing. - Product policies and Brand policies.	* Understand the marketing concepts and its process. - Know the role of marketing in small industry and business. - Recognize the importance of consumers point of view. - Describe consumer behavior. - Distinguish habits of a consumer. - Define Marketing. - Describe the established product policies and Brand policies. - Prepare a product/ brand policy for a particular product. - Inter the product/ brand policy of an established product.
8.2. Packaging. - Objectives. - Requirement - Packaging methods.	* Know the concepts of packaging. - Explain the objectives of packaging. - List the requirements of packaging. - Describe commonly used packaging methods.
8.3. Channels of distributor.	* Know the channels of distributor. - Describe different channel of distribution, their importance and specific application area.

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8.4.	Pricing Policies and Practice. - Objective of pricing. - Finding the profit maximizing price. - Selection of a pricing method - Make-up Pricing. - Target Return Pricing. - Perceived- Value Pricing. - Going rate pricing. - Sealed Bid pricing.	* Understand the pricing policies and practices. - Knows the objective of pricing. - Explain the technique of finding profit maximizing price. - List and describe in brief different pricing methods.

9. PERSONNEL MANAGEMENT AND INDUSTRIAL RELATIONS.

* Should understand Personnel Management.
- Be able to define Personnel Management.
- Explain the aims, objectives & Functions of Personnel Management.
- Explain the Recruitment and Selection of employees.
- Define and explain the need for Training.
- Explain the methods.of Training.
- Explain the systems, forms & kinds of Training for different levels of staff an Industry.
- Define and explain the Causes of Accidents.
- Define Labour Turnover.

10. INTRODUCTION TO COMMERCIAL AND TAX LAWS APPLICABLE TO SSI UNITS.

(a) The Indian sale of goods Act, 1930.

* Know the Indian sale of goods Act, 1930.

The Students should state -
(i) Preliminary
(ii) Formation of Contract of sale.

	(iii) Conditions and Warranties. (iv) Transfer of Property. (v) Unpaid Seller rights.
(b) The Negotiable Instruments Act,1981.	* Know the Negotiable Instruments Act,1981. State the : (i) Negotiable Instruments. (ii) Parties to a Negotiable Instruments. (iii) Promissory Note. (iv) Bills of Exchange. (v) Endorsement. (vi) Maturity, Dishonover, Noting & Protesting.
(c) The Indian Partnership Act,1932.	* Know the Indian Partnership Act, 1932. State the : (i) Nature of Partnership. (ii) Relations between Partners. (iii) Relations of Partners to third Parties. (iv) Partners and Registration of firms.
(d) The Income Tax Act,1961.	* Know the Income Tax Act, 1961. State the : (i) Nature if Income. (ii) Income Tax Authorities. (iii) Heads of Income & Computation. (iv) Income Tax Returns. (v) Residential status. (vi) Miscellaneous.

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REFERENCE BOOKS

1. Entrepreneurial Development by Vasant Desai, "Himalaya Publishing House" Volume 1,2,3.

2. A Practical Guide to Industrial Entrepreneurs by S.D. Srivastava, " Sultan Chand and Sons ".

3. Dynamics of Entrepreneurial development and Management by Vasant Desai, " Himalaya Publishing House" .

4. Trainers Manual on Developing Entrepreneurial Motivation, National Institute for Entrepreneurship and Small Business Development, NEW DELHI.

5. Environment and Entrepreneur by Arvind Rai N. Desai.

6. Entrepreneurship and Venture Management By Clifford M. Baumback, Joseph R. Mancuso, " D.B. Taraporevala Sons and Co. Pvt. Ltd. Published by arrangement with prentice- Hall, inc.

7. Entrepreneurial Development Programme Series, Entrepreneur Enterprise and Growth options by P. Subba Rao and M. Sundaram, " Kanishka Publishers Distributors ".

8. Industrial Engineering and Management By O.P. Khanna, "Dhanpat Rai and Sons."

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Curriculum

for

Sixth Semester

Diploma in Production Engg.

(Under Indo-German Project)

Implemented from 1995-96
(Based on Semester System)

M.P. Board of Technical Education,
Office Complex, Block A/IV, Gautam Nagar, Bhopal - 462-023

M. P. BOARD OF TECHNICAL EDUCATION, BHOPAL

SIXTH SEMESTER DIPLOMA IN PRODUCTION ENGG. **(REVISED, IMPLEMENTED FROM 1995-96 AT BHOPAL & INDORE)**

S. No.	Name of Subjects	Scheme of study			Scheme of Examination										
		THEORY	LAB	TOTAL	SESSIONALS		PROGRESSIVE ASSESSMENT		BOARD EXAMINATION						REMARK
					TERM WORK	Lab. WORK	I	II	THEORY PAPER	DUR-ATION	MARKS	PRACT.	DUR-ATION	MARKS	
1.	Computer Aided Manufacturing (P.C. 2072)	4(64)	4(64)	8(128)	20	30	10	10	I	3HRS	100	I	3HRS	50	220
2.	Maintenance Engg. & Safety (P.C. 2073)	6(96)	2(32)	8(128)	20	30	10	10	I	3HRS	100	I	3HRS	50	220
3.	Entrepreneurship Project (P.C. 2074)	2(32)	3(48)	5(80)	20	30	10	10	I	3HRS	100	I	3HRS	50	220
4.	Process Planning, Tooling & Costing-II (P.C. 2075)	4(64)	4(64)	8(128)	20	30	10	10	I	3HRS	100	I	3HRS	50	220
5.	Pneumatic, Hydraulic Controls & Instrumentation (P.C. 2076)	3(48)	4(64)	7(112)	20	30	10	10	I	3HRS	100	I	3HRS	50	220
6.	Industrial Training (Imparted after V semester)	-	-	-	50	-	-	-	-	-	-	I	3HRS	50	100
	TOTAL	19 (304)	17 (272)	36 (576)	100+ 50	150	50	50	5	-	500	5+1= 6	-	250 +50	1200

NOTE:

1. No. of theory paper:05
7. Total theory marks: 500
8. No. of Practical: 05
9. Total Practical Marks: 250
10. In-plant Training Marks: 100
11. Total marks of Sessionals, Prog. Assessment, Pract. & In-plant training: (100+150+50+50+250+100=700)
12. Total of V + VI semester marks=800+1200

7. Ratio of theory marks and total of: 500:700 sessional, Prog. Assess., Pract. and i.e.1:1.4 In-plant training
8. Total marks: 1200

9. Passing marks for
a. Theory: 33%
b. Practical : 40%
c. Sessional: 60%
d. Inplant training: 50%

NOTE: Assessment of Industrial Training will be done as per the evaluation criteria given in the course curriculum.

Amendment as approved in the Board of Studies meeting held on 6/6/2000:

Evaluation of Phase-III training (imparted after fourth semester) and Phase-IV training (imparted after fifth semester) shall be done together in sixth semester examination.

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PROGRAMME: DIPLOMA IN PRODUCTION ENGG.
SCHEME: REVISED, IMPLEMENTED FROM 1995-96
SEMESTER: SIXTH
COURSE: Computer Aided Manufacturing (P.C. 2072)

COMPUTER AIDED MANUFACTURING

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COMPUTER AIDED MANUFACTURING

WORKING GROUPS

1. Mr. P.K. Basak, Sr. Manager, BHEL, Bhopal.

2. Dr.C.M. Agrawal, MACT, Bhopal.

3. Mr. A.K. Tuli, Lect., S.V. Govt. Polytechnic, Bhopal.

4. Mr. Sharad Saxena, Lect., S.V. Govt. Polytechnic,Bhopal.

5. Mr. R.L.Shrimali, Course Co-ordinator, PDU, Bhopal.

COMPUTER AIDED MANUFACTURING

RATIONALE

With the advancement in technology and Manufacturing technology in particular, knowledge of CNC systems is essential for any production engineer. It has been fully reflected in job requirement survey undertaken by PDU in 1991 & also in a meeting for Curriculum design involving large no. of industrialist from different fields & Teachers from Engineering collages & Polytechnics.

Based on the recommendation this subject is introduced at final year level & it derives its support from a subject named " Introduction to Computer & Programming" as well as Manufacturing Technology I, II, & III. Thus this subject curriculum not only provides additional information in the field of Manufacturing Technology but also interlinks the above subjects alongwith "Process Planning, Tooling & Costing" & "Production Management".

The Curriculum revision group appreciates that there is a likelihood of difficulty in finding appropriate teaching learning material & thus the curriculum is mostly based upon the book "COMPUTER NUMERICAL CONTROL (CNC) MACHINES" By Dr. P. RADHAKRISHNAN, However, support from PDU may be expected as & when required.

Industrial visit and expert Lectures of knowledgeable industrial personnel may prove to be big support. Manual part programming should be emphasized and a number of practical/ Tutorial exercise will be great help.

NAME OF SUBJECT :- COMPUTER AIDED MANUFACTURING

	Theory	Practical/Tutorial
	84	56

SNo.	Name of Topics	Theory	Practical/ Tutorial
1.	Computer Hardware For CAM.	3	-
2.	Automation and NC Machines.	4	-
3.	Computer Aided Manufacturing Systems.	6	2
4.	Different Types of CNC Machines.	5	-
5.	CNC Machine Control System.	6	4
6.	Part Programming Fundamentals. (Including APT)	5	2
7.	CNC Part Programming Techniques. (Include manual part programming)	8	20
8.	Constructional Features of NC Machine Tools.	7	5
9.	CNC Feed back System & Drives.	5	3
10.	CNC Tooling.	5	3
11.	CNC Maintenance.	5	8
12.	Economy of Manufacturing Using CNC.	3	3
13.	Sensorics, Machine Vision & Robotics.	7	4
14.	CAPP, MRP II.	4	2
15.	CIM, FMS.	5	-
16.	Revision	6	-
	Total Hours	84	56

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COMPUTER AIDED MANUFACTURING
SCHEME OF EVALUATION/ ASSESSMENT

SNo.	Topics	Th.+ Prac.	Kn.	Comp.	H.level	Total
1.	Computer Hardware for CAM	- 03	- 02	- 04	- -	06
2.	Automation & N.C. Machines	- 04	- -	- 05	- -	05
3.	Computer aided Manufacturing systems	- 08	- 06	- 04	- -	10
4.	Different types of CNC Machines	- 05	- 05	- -	- -	05
5.	CNC Machine Control Systems	- 10	- 05	- -	- -	05
6.	Part Programming Fundamentals	- 07	- -	- 05	- 05	10
7.	CNC Part Programming Technology	- 28	- 07	- 05	- 12	20
8.	Constructional Features of N.C. Machine tools	- 12	- 05	- -	- -	05
9.	CNC Feed back System & Drives.	- 08	- 05	- -	- -	05
10.	CNC Tooling.	- 08	- 05	- -	- -	05
11.	CNC Maintenance.	- 13	- 04	- 05	- -	09
12.	Economy of Manufacturing Using CNC.	- 06	- -	- -	- 05	05
13.	Sensorics, Machine Vision & Robotics	- 11	- 05	- -	- -	05
14.	CAPP, MRP II.	- 06)	-			
		)	05	- -	- -	05
15.	CIM, FMS.	- 05)	-			
16.	Revision	- 06	- -	- -	- -	-
	Total	40	0	7	17	100

NAME OF SUBJECT :- COMPUTER AIDED MANUFACTURING

SNo.	Topic/Sub Topic	Intended Learning Outcome (ILO) (Objectives)	Remarks
1	2	3	4
1.	COMPUTER HARDWARE FOR CAM. (3 hrs.) * Input devices * Output devices * Storage devices * Workstation configuration for CAM requirement.	* List the main units of the Computer such as CPU, Memory unit, Hard disk, ALU etc. * Describe in brief the functions of each of the units listed above. * List various Input, Output and storage devices. * State the meaning of work-station configuration. * Comprehend that work-station configuration for CAM includes- RAM, Hard disk capacity, 486 system, Graphic monitor, Printer & Plotter, Floppy devices, etc.	* It is desirable to take the students to a computer room to show the work-station configuration.
2.	AUTOMATION AND N.C. MACHINES. (4 hrs.) * Types of production systems. * Automation Vs Job Production. * Flexible automation. * Role of N.C. Machines in Flexible automation. * Advantages, Disadvantages & Limitations of N.C. machines. * Basic concepts of Group Technology.	* Classify the types of Production systems on the basis of output Vs-Job, Datch, Mass etc. * Conclude that Batch & Mass Production are akin to Automatic Production. * Conclude that computers in manufacturing may be adopted for all types of production based on economic considerations.	

* Describe the meaning of flexible automation.
* Infer flexible automation is feasible using CAM.
* Conclude that the N.C. machines play an important role in flexible automation.
* Describe the advantages & Limitations of N.C. machines in CAM.
* Explain the meaning of Group technology.
* Enumerate the benefits of Group technology.
* Comprehend that part families classification concept is useful in effective use of CAM.

3. COMPUTER AIDED MANUFACTURING SYSTEMS.

(Th.6 hrs.+Tuto.2 hrs.)

Introduction to :-

* Computer aided Design (CAD)
* Computer aided Manufacturing (CAM)
* Computer aided Planning (CAP)
* Computer aided Quality Assurance.
* Computer aided Inspection (CAI)

* Knows the meaning, principle & advantages of different computer aided manufacturing systems such as -
  - CAD
  - CAM
  - CAP
  - Computer aided Quality assurance
  - CAI etc.
* Comprehend that the modern industry in India is adopting it fast to be competitive.
* Conclude that quality, repeatability and flexibility is best achieved by computer support.
* Briefly describe scope of & Industrial examples of
  - CAD
  - CAM
  - CAP
  - CAQA
  - CAI.

4. DIFFERENT TYPES OF CNC MACHINES.
(5 hrs.)

Introduction to :-
* Machining centres
* CNC Turning
* CNC Drilling
* CNC Milling
* CNC Grinding
* Electric discharge Machining
* Gear Hobbing
* Other CNC Machines
* CNC machine as Inspection machines.

* State different types of CNC machines.
* Define the term machining centre.
* Briefly describe the working of different CNC machines such as - CNC Turning, Drilling, Milling, Grinding, EDM, Gear Hobbing etc.
* List other CNC machines such as- CNC presses, Bending machines, Forming machines, Turret punches, auto notching machine, cropping lines, Laser cutting etc.
* Explain the use of CNC as Inspection machine.

* CNC Retrofitting
  - Introduction & Meaning.
  - Elements of CNC retrofits.
  - Procedure & need.

* Know the meaning of retrofitting.
* State the elements of CNC retrofits such as - Ball screw, Motors, Recondition, guideways, Encoders, Turret tool head etc.
*. Describe the need & Procedure of CNC retrofitting.
* Describe CNC retrofitting.

5. CNC MACHINES CONTROL SYSTEM :-
(Th. 6 hrs.+Tuto.4 hrs.)

* Machine Tool Controls
  - Open loop control
  - Closed loop control
  - Path control
* Description of a simple control system.
* Interpolation systems.
- Interpolator and its type.
- Requirements of an Interpolator
* Functions of CNC systems.
* Features available in a typical CNC system

* Name various CNC machine control systems.
* Briefly describe & sketch different types of CNC machine control systems.
* Distinguish between open loop & Close loop control.
* Explain functions of CNC system.
* Describe the use of absolute & incremental systems in control systems.
* Briefly explain, Using suitable sketches the Linear interpolation, Circular interpolation, Parabolic interpolation, Helical interpolation, 3-D interpolation etc.

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	* State the fields of application of each of these interpolation. * State features available in a typical CNC system. * Identify features of Fanuc & Sinumeric control systems.	* Study/ Demonstration of special features of various control systems on shop floor.

6. PART PROGRAMMING FUNDAMENTALS.
(Th. 5 hrs.+ Tuto. 2 hrs.)

* Programming Geometry. - Coordinate systems - Dimensioning - Zero & Reference points - Machine travers & Interpolation - Shifting of reference points - Process planning - Programming in APT.	* Briefly describe meaning & contents of part programming. * State the use of part programme. * Explain the following terms- Co-ordinate systems, Dimensioning, Zero & Reference points, Machine traverse & interpolation, Shifting of reference points etc. * Explain the need of locating & selection of machine tools reference points before making a program using cutting tools, fixtures & gauges. * Select suitable Co-ordinate system, interpolation method & shifted location of reference points. * Prepare process plan prior to programming by selecting machine tools, cutting tools, cutting parameters, Fixtures & sequence of operations etc. * Describe the meaning of APT (Adaptive Programming Tool). and its advantages. * Prepare a program using APT.

7. CNC PART PROGRAMMING TECHNIQUES.
(Th. 8 hrs.+ Tuto. 20 hrs.)

* Manual part programming - Introduction - Programming codes	* State meaning & process of manual part programming. * State the meaning of following programming-	* Simple practical exercises involving use of these codes.

- Block format & program format - CANNED cycles for turning - Planning & Programming for CNC turning & milling. - Offsets & Compensations. - Subroutines.	codes and use those in programme. (At least 5) - Preparatory Functions - Miscellaneous Functions - Feed word - Spindle speed word - Tool word etc. * Prepare Block format & program format. * Select appropriate cutting tool, feed, cutting speed,& accessories for CNC work. * Explain in brief Canned cycles for turning operation on CNC Viz. linear and circular interpolation, Taper turning, Threading etc. * Prepare manual part program using codes and Canned cycles giving suitable tool offset & tool compensation for given simple job drawing to be produced by CNC Turn and CNC Mill. * Diagnose faults in a given manual part program & modify it.	* Simple practical exercises involving use of these codes. (At least 5) * At least 5 exercise. * At least 2 exercise. * Each of the above exercises should involve it.

6. CONSTRUCTIONAL FEATURES OF CNC MACHINE TOOLS.
(Th. 7 hrs.+ Tuto.5 hrs.)

* Drives for CNC machine tools. - Spindle drives - Axes Feed drives - Transmission Belting * Slideways for machines. * Ball Screws. * Accessories for CNC Turning machines & Machining centres.	* Name different drives used on CNC for Spindle & Axes Feed motions. * Briefly describe using suitable sketch Drive & Transmission Control system. * List, Requirements, & Selection criteria for slideways & bearing systems on CNC. * Identify & State the limitations of lead screw & box nut. * State advantages of using ball screw on CNC. * Describe general arrangement of ball screw. * Describe need & Advantages of Pre-loading the ball screw & Bearings. * List the accessories of machining centres	* Tutorials.

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		such as ATC, Pallet, Work tables, Chip conveyers etc.
* Introduction to in-process gauging.	* State the meaning & Use of in-process gauging.	
* Application & Procedure.	* Describe the application & Procedure of inprocess gauging by giving suitable examples.	

9. CNC FEED BACK SYSTEM & DRIVES.
(Th.5 hrs.+Tuto.3 hrs.)

* Feed back devices - Encoders - Resolvers - Inductosyn - Tachometers.	* List different feed back devices & their use on CNC. * Explain working principle of different feed back devices such as - Encoders (Incremental & Absolute), Resolvers, Inductosyn, Tachometers etc.	* Tutorials
* Drives. - D.C. Motors - D.C. Stepping Motors - D.C. Servo Motors - A.C. Motors.	* List different drives on CNC. * Explain Working,advantages & limitations of different drives on CNC such as - D.C. Motors, D.C. stepping motors, D.C.Servo Motors, A.C. Motors. * List the selection criterion for drives on CNC.	
* Specification of CNC.	* State the parameters to be mentioned while specifying a CNC machine tool.	

10. CNC TOOLING.
(Th. 5 hrs.+Tuto.3 hrs.)

* Introduction * Preset & Qualified tools * Tool planning * Work Holding * Tool Holders.	* List the factors influencing the tooling used on CNC. * Explain in brief meaning of preset & qualified tools, Tool planning. * Identify commonly used Work-holders & Tool holders used on CNC. * Describe the factors considered in selection of proper work holding device.	

11. CNC MAINTENANCE.
(Th.5 hrs.+ Tuto./Demo.8 hrs.)

* Introduction * Preventive maintenance. * Breakdown maintenance. * Documentation of maintenance program. * Maintenance features.	* Describe the importance of maintenance of CNC machines. * Explains, in brief, preventive maintenance Schedule & procedure ,breakdown maintenance procedure & records,maintenance program & different features of maintenance. * Execute activities the documents of maintenance program & schedule sheets. * Draw inference from the data given in maintenance documents.	* Demonstration.

12. ECONOMICS OF MANUFACTURING USING CNC MACHINES.
(Th. 3 hrs.+ Tuto.3 hrs.)

* Introduction * Factors affecting Selection of CNC Machines.	* Know the concept of economics of manufacturing using CNC machines. * State the factors such as – Labour skill & Cost, repetition, complexity, No. of operations, Time spans, Cutting time ratio, spare parts, design change, Tooling, cost of scrap etc.	
* Cost of operation.	* Given necessary data, Calculate the cost of operation which includes- Preparation cost, related costs & Production costs. * Compare the cost of operation of NC Vs. Conventional, Given relevant data.	* Tutorial.

13. SENSORICS, MACHINE VISION & ROBOTICS.
(Th.7 hrs.+ Tuto.4 hrs.)

* Introduction of Robots.	* Define an industrial Robot. * Briefly describe its use & importance in mode[illegible] industry.	

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* Different types & Classification. * Control systems. * Key features & Specifications. * Programming. * Programming Languages. * Performance capabilities & Industrial applications.	* State different types & Classification of Robots. * Briefly describe Robot Control systems. * Explain key features & Specifications of Robots. * Name different programming methods for Robots. * List different programming languages. * List performance capability assessment criteria & Industrial applications of robots.	* Industrial visit/ demonstration.

14. CAPP, MRP II.
(Th. 4 hrs.+Tuto.2 hrs.)

Computer-aided Process Planning (CAPP) : * Meaning & Scope. * Retrieval CAPP Systems. * Generative CAPP Systems. * Benefits of CAPP.	* State the meaning of CAPP. * Describe the scope of CAPP in Modern industry. * Establish its links with Route sheets. * Name the two approaches of CAPP as Retrieval (or Variant) CAPP Systems & Generative CAPP Systems. * State the principle of Retrieval CAPP Systems. * Schematically represent the general procedure for using the retrieval CAPP Systems. * State the principle of generative CAPP Systems. * State that in a generative CAPP System process sequence would be planned without human assistance & predefined standard plans. * State that 'Expert systems' computer program is used for this purpose. * List the ingredients required for this are technical knowledge of Manufacturing, computer compatible description & process Knowledge & Planning logic. * Summarize the benefits of CAPP as : - Process rationalization & standardization. - increased productivity of process planners.	* Give suitable practical exampl & if available shop CAPP - computer program.

- reduced lead- time for process planning.
- improved legibility &
- incorporation of other application programs such as cost estimates, Work-standards etc.

Material Requirements Planning (MRP):

* Meaning & Scope. * Scope of MRP-I & MRP-II. * Fundamental concepts of MRP-II. * Inputs to MRP-II works. * Output reports & benefits of MRP.	* Explain the meaning & Scope of MRP. * Describe the fundamental concepts in MRP such as : - Independent versus dependent demand. - Manufacturing lead time. - Common use items. * Explain the meaning of terms used above. * List the inputs to the MRP system such as master production schedule, Bill of materials file & inventory record file. * Describe in short the contents of each input. * Briefly describe how MRP works. * Describe the difference between MRP-I & MRP-II. * State the scope of application of MRP-II. * State the contents of Output reports. * Describe in brief, the benefits of MRP-II.	* Give suitable practical example & if available show MRP-II computer program.

15. CIM, FMS.
(Th. 5 hrs.)

* Introduction. * FMS Compared with other manufacturing approaches. * Types, * Benefits, * Operational elements & their synchronisation. * Introduction to Automated Material Handling. * Automatic guided vehicles	* State meaning & Scope of FMS. * Compare FMS with other manufacturing approaches. * State types of FMS. * State benefits of FMS. * Describe operational element of FMS & Their synchronisation. * State meaning & Scope of automated material Handling. * Describe automated material Handling system & its elements. * Explain Automated storage & retrieval systems.

* ASRS. * Integration of manufacturing systems. * Task to be automated * Tools for manufacturing.	* State the benefits of integration of various manufacturing systems. * Describe 'link between design, manufacturing planning & production. * Enlist & describe different tools for manufacturing automation such as - Computer techniques, Computer aided Engineering, Automation technology & Manufacturing systems.	
* Functions of CIM.	* State meaning & function of CIM based on - Levels of system control, types of data & manufacturing information.	
* Scope & applications if CIM.	* State scope & industrial applications of CIM.	* Industrial visits/ demonstration.

16. REVISION. (6 hrs.)

PROGRAMME: DIPLOMA IN PRODUCTION ENGG.
SCHEME: REVISED, IMPLEMENTED FROM 1995-96
SEMESTER: SIXTH
COURSE: Maintenance Engg. & Safety (P.C. 2073)

MAINTENANCE AND SAFETY

WORKING GROUPS

MAINTENANCE AND SAFETY

1. Prof. Dr. A.D.Telang, MACT, Bhopal.
2. Mr. Raj Mohan, HDME, S.V.Govt. Polytechnic, Dhopal.
3. Mr. B.K.Saxena, Sr.Lect., S.V.Govt. Polytechnic, Bhopal.
4. Mr. R.M. Khan, Sr. Lect., S.V.Govt. Polytechnic, Bhopal.
5. Mr. V.K. Jain, W/S Supdt., S.V.Govt. Polytechnic, Bhopal.
6. Mr. S.G.Deo, Expert Teacher, PDU, Bhopal.
7. Mr. K.C.Verma, Course Co-ordinator, PDU, Bhopal.

MAINTENANCE AND SAFETY

RATIONALE

Job of maintenance is similar to that of a physician which has a vital effect on productivity of the industry as a whole. The curricula provides the basics of maintenance and general practices in the industry.

A knowledgeable production engineer appreciates the importance of maintenance in planning and scheduling production by collecting and using the information (e.g. keeping downtime to a minimum and its estimate) to meet the production targets.

Safety practices are equally important.

Any amount of lectures will not help to develop the skill to diagnose the maintenance problem, thus the subject must be profusely supported by demonstrations and laboratory work.

MAINTENANCE AND SAFETY

CONTENTS

THEORY 96 PRACTICAL 32

NAME OF CONTENTS	THEORY	PRACT.	TOTAL
Introduction to Plant Maintenance -	12	2	14
Fundamentals of Basic Maintenance - Practices	14	8	22
Organizational Structure of Maintenance- Department and Organizing the Maintenance Function.	12	2	14
Wear and its Effects. -	10	5	15
Maintenance Cost. -	8	2	10
Maintainability -	8	2	10
Fault Tracing, Trouble shooting and Remedies. -	8	5	13
Lubrication -	14	4	18
Safety Engineering -	10	2	12
Total hrs.-	96	32	128

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NAME OF SUBJECT - MAINTENANCE AND SAFETY

SNo.	TOPICS/SUB-TOPICS	INTENDED LEARNING OBJECTIVES (I.L.O.)	TREATMENT/REMARKS
1	2	3	4
1.	INTRODUCTION TO PLANT MAINTENANCE		
1.1.	Introduction to Maintenance, its need and economic significance, effects on productivity, energy conservation,man-machine relationship, increased life of machines, equipments and their enhanced availability.	* Understand the significance of maintenance function in an industry. - Explain the need and importance of maintenance function in terms of increased productivity, and quality of product produced. - etc.	
1.2.	Scope and Functions of Maintenance.	* Know about the Scope and functions of maintenance.	
1.2.1.	scope of maintenance function depends on plant Size, Type, company policy etc. - Encompasses the maintenance, construction, utilities generation and distribution and miscellaneous servicing phase of plant operations.	- State the factors on which the scope of maintenance function depends. - State the activities area considered in maintenance.	
1.2.2.	Classification of functions (a) Primary function such as : - Maintenance of existing plant Equipment. - Maintenance of existing plant Buildings. - Equipment inspection and lubrication. - Utilities generation and distribution - Alteration to existing equipment and buildings.	* Classify the maintenance functions. - State the Primary and Secondary functions. - etc.	

10.7.97 (Shamim Uddin) 10.7.97 B.K. Saxena 10.7.97 R M Khan

- New installation of equipments and buildings.
- etc.

(b) Secondary functions such as :

- Store Keeping
- Plant protection
- Waste disposal
- Salvage
- Insurance administration
- Other services including janitorial service, property accounting, Pollution and noise control etc.

1.3. Responsibilities of Maintenance inquiring department, to include, e.g. :

- Engineering and execution of planned maintenance, repairs, minor installations, and replacements.
- Generation and distribution of power other utilities.
- Administration and supervision of craft groups.
- Technical consultation on Mechanical problems with production supervision.
- Providing adequate plant fire protection.
- Establishing and maintaining adequate property and accounting records covering plant, equipment and property.
- etc.

* Understand the responsibilities of maintenance department.

- Explain the responsibilities of maintenance department.
- etc.

1.4. General nature of maintenance problems in industries in reference to :

- Machines and equipments.

* Know about the general nature of problems in industries.

- State the different types of problems normally met in field.

* Give suitable examples.

- Inter departmental co-ordination problems.	- State the inter- departmental co-ordination problems. - etc.	
1.5. Development trends in maintenance. - Application of computers in maintenance. - Advantages of a computerized system such as :- - Standardization - Development of a data base - Analytical capabilities - Historical data - etc. - Application of C.P.M. and P.E.R.T. in maintenance activities.	* Understand the importance of computerization and concepts of CPM and PERT as applied to maintenance activities. - Explain the increasing role of computers in maintenance activities. - Enumerates the advantages of computerization. - Illustrate the application of the concepts of CPM and PERT in maintenance field.	
1.6. General nature of Maintenance problems.	* Understand the general nature of maintenance problems occurring in industry.	
1.6.1. Introduction.		
1.6.2. Maintenance of rotating parts such as : Shafts,Spindles, Bearings, Couplings,Clutches, Gear wheel, Worm wheel, Pulleys etc. Possible defects normally occurring and repair.	* State the different types of maintenance problems faced in industry. * Enumerate the different rotating components. * Explain the different types of defects occurring in rotating components and reasons. * Describe the procedure for repair of these defects.	- Provide information about the functions of the different rotating components. - Display the components with defects.
1.6.3. Maintenance of reciprocating parts such as : - Machine tool bed ways of different machine tools, Piston and cylinder, reciprocating pump, compressors etc. - Possible defects their reasons and repair undertaken.	* Enumerate the different types of reciprocating components. * Explain the different types of defects occurring in the reciprocating components and reasons.	- Display the defective reciprocating components.

- Methods and procedures for maintenance of reciprocating parts. - Reasons for more maintenance requirements in reciprocating parts as compared to rotating parts.	* Explain the methods and procedures for maintenance of reciprocating parts. * Give reasons for more maintenance requirements in reciprocating parts. * etc.
1.6.4. Maintenance of fixed joints. - Definition - Maintenance problem of; - Threaded - Keyed - splined - etc.	* Understand the methods of maintenance of fixed joints. * Define the term fixed joint. * Give the types of wear occurring in threaded, keyed, splined joints and the methods of restoration.
1.7. Pipe Joints. - Methods of joining. - Leak proofing. - Reclaiming of leaking pipes.	* Understand the maintenance methods of pipe joints. - Give the methods of joining of pipes. - Give the methods of making a pipe joint leak proof. - Explain the methods of reclaiming of leaking pipe joint. - etc.

2. FUNDAMENTALS OF BASIC MAINTENANCE PRACTICES.

2.1. Different Maintenance practices such as : - Normal or routine maintenance. - Corrective maintenance. - Scheduled maintenance. - Predictive maintenance. - Design-out-maintenance. - Break down maintenance. - Servicing. - Preventive maintenance. - Overhauling/Re-conditioning.	* Understand the different maintenance practices in vogue in industries. - List the different maintenance practices as used in practice. - Explain the principles for the different types of maintenance practices. - Describe the procedures of the different maintenance practices. - etc. * Understands the significance of equipment repairs history (record keeping of

- etc.	maintenance function) for different equipments and the methods followed.	
2.2. Equipment- repairs history (records keeping) and history analysis. - Significance and methods.	* Explain the importance of equipment- repairs history and history analysis. - Explain the methods employed for records keeping. - etc.	
2.3. Condition monitoring of equipments through : - Oil/Wear particle analysis. - Vibration - Noise - Temperature - Data obtained from instrumentation on line/Off line (Signatures) - etc.	* Understands the condition monitoring of the machines/ equipments. - Explain the sources for monitoring the condition of equipments. - etc.	
2.4. Sequence of activities in Break Down maintenance such as : - Location of fault. - Prepare to disassemble. - Disassemble components. - Clean components. - Inspect and measure amount. and nature of wear. - Decide reusability. - Fit-in/ repair/ replace. - Lubricate components. - Prepare to assemble, make assembly .	* Know about the sequence of activities of Break Down maintenance. - Describe the steps to be followed in case of a break down maintenance.	- Display the method adopted for break down maintenance by creating a simulated situation in practical class.
2.5. Servicing and overhauling - concept and procedure.	* Understand the concept and procedure of servicing and overhauling of machines & equipments. - Explain the concept of servicing and overhauling. - Describe the servicing and overhauling procedure generally adopted.	

.6. Principles and procedure for Preventive maintenance(P.M.) - Definition. - Significance and advantages. - Criteria of P.M., cost and criticality. - Cost of P.M. to include downtime and repairs/ replacements. - Inspection. - What to inspect ? - Process equipments. - Safety equipments. - Utility equipments. - Tanks and auxiliary equipments, gauges and instruments. - Plant buildings including transportation equipments. - Fire protection equipments.	* Understand the concepts of P.M. and procedure adopted. * Give definition of P.M. * Explain the significance of P.M. * State the advantages of P.M. * State the criteria of P.M. * Define criticality in relation of machines and equipments. * Explain the cost factors of P.M. * State the various equipments to be inspected from P.M. point of view in an industry.	* Illustrations can be given of various equipments where P.M. can be applied such as : - Process equipments- Furnaces, Heat exchanges, piping,pumps, motors, instruments etc. - Safety equipments- Vacuum and pressure relief valves, flame arresters, emergency relief equipments. - Utility equipments- Main boilers, electric generators, Supply and distribution system for water steam and compressed air pipe lines etc.
- What not to inspect ? - Non-critical equipments - Where stand by units are available. - Cost of P.M. exceeds down time and cost of repair or replacement.	* State the equipments which need not to be inspected for P.M.	
- What to inspect for ? - Check list	* State the purpose of check list.	

- How aften to inspect ?
  (Frequency)
  - Factors to be considered such as :
    - Engineering analysis based on age, condition and value of equipment.
    - Severity of service.
    - Hours of operations.
    - Susceptibility to wear, damage and losing adjustment.
    - Other sources- Manufactures recommendations, service record analysis, Quality control charts.

  * Explain the different deciding factors for frequency of inspection.

- Statistical check to decide for P.M.
  - Over, under or right amount of maintenance.

  * Explain the economic significance of statistical checks to decide the amount of maintenance done on an equipment.

- When to inspect (Schedules) ? such as to undertake;
  - Routine upkeeps
  - Periodic inspection
  - Contingent work.

  * State the situations for undertaking P.M.

- Types of schedules for P.M. to include :
  - Overall charts for all machines and equipments.
  - Individual cards for each machine/ equipment.
  - Master schedule
  - Detailed scheduling.

  * State the types of schedules prepared for P.M. programmes.

* Job scheduling for P.M. items to include :
  A definite day, method, tools, equipments, level of skill and time required.

  * Explain the items to be considered for scheduling of job under P.M.

- Size of P.M. work force and local conditions.

  * State that the size of P.M. work-force depends on local conditions.

- Inspection reports - Significance, - Information content.	* State the significance of inspection reports. * State the information content to be contained in inspection reports.	* Proformas used for inspection report can be displayed.
* Factors to improve effectiveness of inspection Methods such as : - Planning of step-by-step procedure. - Application of concepts of industrial engg. such as Time and Method studies. - Provision of better tools and instruments. - Redesign of equipment. - etc.	* State the factors which can be applied to improve effectiveness of inspection method.	
* Aids to good P.M. to include : - Materials research to make use of better materials. - Design changes. - Maintenance training of maintenance personnels. - Equipment study. - Standard practice manuals. - Standardization of tools, methods, process standards, materials etc. - Protective methods- Surface coatings etc. - Well organized maintenance store room. - Record analysis. - Avoid over maintenance. - Get accurate costs. - Check inspection frequencies. - Use modern diagnostic tools (Stethoscope, Vibration analyzer, non-destructive tests etc.) - Apply Industrial Engg.concepts. - Utilize statistical aids.	* Explain the significance of different contributing factors for a good P.M. programme.	

- Design for low-cost maintenance.
- etc.

* Group replacement concept.

* Understand the concept of group replacement.
- Explain the concept of group replacement with suitable example.

. ORGANIZATIONAL STRUCTURE OF MAINTENANCE DEPARTMENT AND ORGANIZING THE MAINTENANCE FUNCTION.

Refer Maintenance Hand Book by Lindly R. higgins.

.1. Factors to be considered for maintenance operation.

* Understand the factors to be considered for maintenance operation.
- Explains the factors to be considered for maintenance operation.

- Lowest manufacturing cost per unit produced.
- Minimum Scrap or off-standard material during maintenance.
- Minimum downtime for maintenance (Critical equipment).
- Minimum maintenance cost (Non-critical equipment)
- Separation of functions-
  - Administrative
  - Engineering support

.2. Basic concepts of good organization (Correlate with and recall from the subject of production Management)

* Understand the basic concepts of good organization.
- Define the term organization.
- State the basic concepts of good organization.

- Basic concepts of good organization
  1. Establish reasonably clear division of authority with little or no over lap.
  2. Keep vertical lines of authority and responsibility as short as possible.
  3. Maintain optimum

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number of people (three to six in most of the cases) reporting to one individual.
-etc.

local problems affecting maintenance organization:
- Type of operation
- Continuity of operation.
- Geographical situation.
- size of plant.
- Scope of plant maintenance department.
- Reliability of work force.
- etc.

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.1.Organization chart of maintenance Department for large and small industries.	- Show the organization chart for maintenance department.	
.2.Controls in Maintenance department by using suitable planning and scheduling. - Definition. - Advantages. - Procedure.	* Understand the importance of proper planning and scheduling of the maintenance activity. - Define the planning and scheduling. - State the advantages. - Explain the procedure.	planning & Scheduling - Collect data necessary for making a maintenance schedule. - Estimate maintenance time with consideration for various time allowances and delays. - Take cognizance of backlog. - Decide urgency of work normal, urgent

		as to or emergency. - Prepare master schedule. - job assignment ticket. - weekly plan id manpower schedule. - etc.
3.3. Maintenance records.	* Understand the significance of the various records pertaining to maintenance function.	
3.3.1.Reference cards for machine and equipments. - Purpose.	- State the purpose of reference cards for machines and equipments. - etc.	
3.3.2. Maintenance records. - Machine certificate - Machine reference cards - Maintenance log book - Lubrication plans for machines - Histograms.	* Understand the importance of Maintenance records keeping. * Explain different type of maintenance records and its significance. * Illustrate the use of Histograms.	
3.3.3.Lubrication plans, Log books.	- State the purpose of lubrication plans. - State the purpose of log book.	
3.3.4. Maintenance Catalogues(manuals) - Definition. - Purpose. - Types. - advantages and Disadvantages.	* Understand the importance of maintenance manuals.	- Maintenance manual A Maintenance manual outlines the policies, organization and management, concepts, procedures, standard methods, for maintenance repair of plant facilities and equipments. Types :- -Instructional manual.

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- Procedural manual
- Policy manual
- Technical manual
- organizational manual
- etc.

Advantages :-

- Elimination of duplication of effort.
- Elimination of overlapping organizational responsibilities.
- establishment of a control mechanism.
- Ready reference for the guidance.
- etc.

Disadvantages :-

- Rigid adherence results in reduced efforts for innovation.
- Continued revision is a must. for the manual to be effective.

4. Work simplification in maintenance
   - (Recall from the method study part of industrial engg. and correlate)
   - Definition
   - Approach and procedure

* Understand the significance and procedures of work simplification as applied to maintenance function.

- Define the term work simplification.
- Explain the approach and procedure.

- Procedure:-

1) Select the task look for
- bottlenecks,
- Time consuming operations,
- Chasing around,
- Waste.
- Observing the present way
- Exploring opportunities for improvement

		- Implementing the new method. 2) Observe the present way of task performance. 3) Challenge everything being done - what, where, when, who, How. 4) Explore opportunities for improvement- - Elimination/ Cumbination of tasks performed. - evaluate, compare and select the best alternative. 5) Implement the new method.
1.5. Principles of Motion economy (Recall from motion study and correlate) Approach and procedure.	* Understand the significance of Motion economy as applied to maintenance function. - Explain the approach and procedure of affecting motion economy in maintenance field.	-Principles of Motion Economy (Correlate) 1) Physical activities or motions should be productive. 2) Path of all motions involved should be rhythmic and smooths. 3) Motion should be as simple as possible. 4) Worker should be at ease.
1.6. Maintenance stores and inventory control (Refer and Recall the knowledge pertaining to this topic as taught in the subject of Production Management) - Store keeping of consumable and non-consumable materials	* Understand the significance of proper methods followed in maintenance stores keeping inventory control. * State the items normally stored in maintenance stores. * Define inventory. * Explain the significance of inventory control.	

and spare parts. - Inventory and inventory control - Methods of storing different classes of materials. - Centralized and decentralized stores and associated advantages with each.	* Explain the methods of storing different classes of materials. * List the advantages of centralized and decentralized stores.
4. WEAR AND ITS EFFECTS.	
4.1.- Definition. - Causes of wear. - Types of wear with examples. - Effects of wear on performance.	* Understand the phenomena of Wear and Measurement methods. - Define Wear. - Give the Causes of Wear. - Give the types of Wear with examples. - Explain the effects of Wear on performance.
4.2.- Methods of measurement of wear on : - Flat surfaces - Cylindrical surfaces - Gear.	* Explain the methods of Wear measurements on different types of surfaces.
4.3. Significance of concept of permissible Wear and amount of permissible wear on different surfaces such as Guide ways, Shafts in different type of bearings, gears, etc.	* Give the significance of concept of permissible wear. - Give the amount of permissible wear on different surfaces.
4.4. Factors upon which permissible Wear depends.	* Explain the factors on which permissible wear depends.
4.5. Wear reduction factors.	* Explain the factors on which control of Wear depends.
4.6. Component replacements	* Explain the deciding factors to repair/

- Deciding factors.		replace the worm out parts.
4.7. Vibrations. - Types Mechanical and Electrical. - Ill effects of Mechanical Vibration. - Methods of determination of presence of Vibration. - Causes of Mechanical Vibration. - Vibration meter analyzer.		* Understand the phenomena and effects vibration. * Give the types of vibration. * Give the ill effects of Mechanical vibration. * Explain the methods of determination of vibration . * Explain the Causes of Mechanical vibration. * Describe the working of vibration meter analyzer.
5. MAINTENANCE COST.		
5.1. Maintenance cost estimate.		* Understand the concepts related with estimation of maintenance cost. - Define the cost estimate for maintenance.
5.1.1.- Definition.		
5.1.2.- Maintenance job classification. i.e. planned, repetitive and emergency services.		- Classify the maintenance job .
5.1.3.- Maintenance cost components to include labour, material and % overheads costs.		- State the cost components.
5.1.4.- Estimation of maintenance labour cost methods. - analysis(resolving into elements) - Judgment based on personal experience. - Slotting (job classified within a cost or time bracket and compared with common jobs for which actual cost is known termed as bench marks) - Spreadsheets- similar to slotting but "bench marks" are based on		* Explain the different methods applied for estimation of labour costs.

5.1.5. Estimation methods of material cost.

(a) For repetitive jobs with the help of Past records of machine repair.
(b) For non-repetitive jobs by comparing with similar jobs.
(c) Establish ratios based on labour estimates.

5.1.6.Overhead cost.

* Define overhead cost.
* Give the procedure for finding overhead cost.

* Procedure : Dividing the total overhead cost for a given period by the total maintenance labour hours charged to specific jobs and establishing an overhead rate per maintenance direct labour hour.

* Given necessary data prepare an estimate for the maintenance of a job.

5.2. Maintenance cost control -Significance, control indices.

* Understand the significance of maintenance cost control.

5.2.1. Productivity index.
- Definition.
- Factors affecting maintenance Productivity index.

- Explain the significance of effecting control on maintenance cost.
- State the use of control indices.
- Define the term Productivity index.
- Explain the various factors affecting Maintenance Productivity index.

5.3. * Maintenance Budget.

* Explain the importance of Maintenance budget.

4. MAINTAINABILITY .

* Understand the concepts related with maintainability and their significance

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- Definition of Maintainability.	* Define the term maintainability.
- Object of maintainability.	* State the object of maintainability.
- Cost effectiveness - definition and significance.	* Explain the variables involved in cost effectiveness. * Define cost effectiveness.
- Variables of cost effectiveness to include system effectiveness, acquisition cost and utilization cost.	* List the various factors on which maintainability depends.
- Factors related with maintainability such as :	* Explain the factors related with maintainability.
- Mean time between maintenance (MTBM), Mean time between replacement (MTBR), Mean time between failure(MTBF), Maintenance down time, Mean time to repair(MTTR), Maintenance indices (to include maintenance man-hours/equipment operating hour(MMH/OH) Maintenance man minutes -MMM/OM and maintenance cost per operating hour -Cost/OH). Logistic time or Supply time, Wait or Administrative time,	
- Definition and significance of all these factors.	
- Availability factors to include inherent availability, availability (achieved), operational availability,	* Explain the various availability factors.
- Definition and significance, and related mathematical expressions concerning maintainability.	* Give the various mathematical expressions concerning maintaibility.
* Reliability indices for equipment. - Definition and application.	- Define the terms reliability indices and reliability index number.
* Reliability index number. - Definition and significance.	- Give the significance of these terms.

* Factors on which reliability index number depends.	- Explain the factors on which reliability index number depends.	
* Replacement Economics. - Age of equipment, and significance of life-expectancy curve (bath-tub curve- drawn between failure rate vs. life of equipment) - Significance of total cost curve comprising of operating cost and Capital cost of equipment drawn between annual cost vs. age of equipment.	* Understand the concepts related with replacement economics. - Explain the concepts involved with replacement economics. - Explain the life expectancy curve and total cost curve and their importance.	
* Kelvin's graph. - Purpose and description.	* Understand the Kelvin's graph and its significance. - State the purpose of Kelvin's graph. - Explain the Kelvin's graph and its significance.	
* Optimum volume of maintenance.	* Understand the concepts of Optimum volume of maintenance. - Explain the concepts and its implications.	

7. FAULT TRACING, TROUBLE SHOOTING AND REMEDIES.

7.1. Definition and purpose.	* Understand the concepts about Fault tracing. * Define the term fault tracing, trouble shooting. * State the purpose.	- The concepts of drawing a decision tree and also developing a logical structure to be explained.
7.2. Sequence of activities in fault finding - drawing of a Decision tree and logical structure. - Methods and procedures of repair.	* Give the logical sequence of activities in fault tracing by developing a decision tree and logical structure. * Describe the methods and procedures of repair. * Given a situation applies the concept to locate the fault and take remedial action and also measures to prevent the	- The decision tree to provide a logical sequence for proceeding to trace the fault from the easy to difficult stages. -The logical structure

7.3. Measures to prevent repetition of similar faults.	repetition of similar faults.	method is based on cause and effect relationship. - Suitable examples be taken for developing a decision tree and logical structure.
8. LUBRICATION.		
8.1. Functions of Lubrication. Primary - Reduce friction and wear. Secondary - Cooling and prevention of corrosion.	* Understand the concepts and significance of lubrication. * Sate the function of lubrication.	- Refer Book lubrication A Practical Guide to Lubricant Selection by A.R. Lansdown Publisher : Pergamon press U.K.
8.2. Principle of liquid lubrication relationship of thickness of film, shaft speed, viscosity, load and friction.	* Explain the Principle of lubrication. * Correlate the thickness of film with shaft speed, Viscosity, Load and friction.	- Example of plain journal bearing can be taken.
8.2.1.Hydrodynamic Lubrication. - Definition. - Relationship with speed.	* Define the Hydrodynamic lubrication. * State the relationship with speed in hydrodynamic lubrication.	
8.2.2.Boundary Lubrication. - Definition. - Function of coating of oxide (alluminium/iron) film on contact surfaces.	* Define boundary lubrication. * Give the function of oxide coating film.	
8.2.3.Externally pressurized (Hydrostatic) lubrication. - Definition. - Purpose.	* Define the term hydrostatic lubrication. * State the purpose.	
8.3. Choice of Lubricants.	- Classify the lubricants. - List different types of oil lubricants.	

1.3.1.-Basic types of lubricants to include- - oils - Greases - Dry (solid) lubricants - Gases.	- State the application area of different type of lubricants.	- Lubricants oils includes circulating oils (Steam turbine grade, oils, Hydraulic oils, Heavy duty internal combustion engine oils) - Gear oils - Machine or engine oils - Refrigeration grade oils - Spindle oils. * Air is used as a lubricant for Dentists drills.
8.3..2 Additives. - Definition - Purpose. - Types.	- Define the term additives. - Give the purpose of additives. - State the different types of additives.	- Different additives include - - Pour point depressants, - Viscosity index improves, - Antioxidants, - Foam depressants, - Anticorrosion additives, - Extreme pressure the lubricant - Engine cleanliness, - Detergents, - Dispersant.
8.4.-Important properties of lubricants. (Recall of knowledge imparted in earlier semesters in the subject of Applied Chemistry)	- State the important properties of lubricants.	
8.5.-Main factors considered in choosing	- List main factors in the selection	- As speed is

include speed and of lubricant. additives load. - Relationship of speed and load with type of lubricant.	- Correlate the speed and load with the type of lubricant.	increasing in selection of lubricant used in sequence is shifting from grease- oil deceasing velocity- gas and opposite in the sequence in case of increase in load contact pressure.
8.6.-Oil feed systems to include - Direct and indirect systems, oil mist or fog systems, wick and pad system, Ring, Disc and Splash systems.	- State the different types of oil feed systems. - Give the application area of different type of systems.	
8.7. Carrying out oil changes. - Need - sequence.	- State the necessity of changing of oil. - State the sequence to be followed in carrying out the oil changes.	- The sequence to be followed for change of oil is ; - Draining - Flushing using special flushing oil - Dismantling the system if needed. - Cleaning of reservoirs only in case large system.. - Refilling the system.
8.8. Laundering. - Definition - Method.	* Define the term Laundering. - State the method employed for laundering.	- Laundering is the process of removing the undissolved contaminants from the used oil to make it again fit for use. - It is done by filtering through screens and high speed centrifuging.

.1. Re-refining. - Definition	- Define the term Re-refining.	- Re-refining is done to remove dissolved contaminants.
. Means provided for lubrication such as : - Hand pressure grease guns - Power guns - Centralized pressure for oil pumping and grease lubrication.	- State the different means employed for lubrication. - Give the situation for the different means adopted in practice.	-Centralized oil pumping systems are employed in paper and steel industries. - Centralized pressure grease lubrication system employed for steel rolling mill machinery and heavy units.
10. Timing of lubrication: significance, Methods:- schedules of lubrication,(daily, weekly, Monthly etc.) -Use of charts for lubrication.	- Explain the significance of lubrication timing. - State the purpose of lubrication schedule and charts.	
11. Causes of Lubrication failures.		- Lubrication failures occurs due to- - Unsuitable grade of oil. - Wrong type of lubrication system. -Contamination by dust, dirt, water or dilution by fuel oils. - Oxidation of lubricating oils at high temperatures(Oxidation inhibitors not used) - Fixed conditions of speed and load are changed by operator. - Internal friction of lubricant at

		higher speeds comes in to play.
1.12.- Blotter (blotting-paper) Test. - Purpose. - Procedure.	* Give the purpose of Blotter test. * Describe the Procedure of conducting a blotter test.	- Blotter test may be displayed in the practical class. The test is to performed as given below :- If a drop of oil is placed on a sheet of blotting paper or thick filter paper, it will spread slowly giving a more or less circular spot or blot. A new oil without any insoluble additives will give a uniform pole yellow, slightly transparent spot. An oil with solid additives or contaminants will leave them as opaque flecks near the centre of the spot. A degraded oil,or one containing dark contaminants, will give a darker brown spot, or may produce one or more brown or black rings.
8.13. - Lubricant handling and storage. - Procedure adopted for storing. - Safety precautions in storing. - Colour coding. - Date labelling(Shelf life)	* Understand the significance of proper storing procedure to be followed for lubricants. - Describe the procedure for storing the lubricants. - State the precautions to be observed. - State the purpose of colour coding of lubricants. - State the purpose of date labelling.	- Colour coding :- A particular colour is marked on machine, dispensing equipment, drum, rack position. Date labelling:- Sealed drums or cans of oil should be scheduled for use

8.14. Sealing.
- Purpose.
- Techniques, to include Static seal; semi-static Seal; sealing rotating shafts(Rotary seals); Sealing reciprocating shafts.

* Know the function of sealing.
* State the purpose of sealing.
* State the techniques used for sealing.

within a maximum of 1 year of purchase and greases within 6 months. This is done to ensure that containers are used in the same sequence as they are bought.

Sealing Purpose:-
To prevent a fluid from escaping from one place to another.

Sealing techniques:-
Static sealing : Surrounding shaft with stationary container, e.g., Magnetic stirrer.
Semi-static Sealing : used for movement of low amplitude e.g. Flexi sleeve is used for sealing in gear-change lever.

Rotary Seals:-
Rubber lip- Seal : They include used in Crankcase sealing reciprocating shaft also termed as dynamic sealing- O rings, chevron packings, Piston rings etc.

* Compression Packing or packed gland., Bearing seals, Mechanical seals, O-rings.

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9. SAFETY ENGINEERING.

	* Understand the underlying principles of safety engineering and significance.
9.1. - Safety Principles and practices.	- State the safety principles. - Explain the importance of safety principles being put in practice.
9.2. - Safe layout.	- Explain the significance of safety aspects in plant and machines/equipments layout.
9.3. - Safety aspects of machines/ equipments, to include putting guards, provision of interlocking and vibration damping etc.	* Explain the necessity of taking care of safety aspects in regard to individual machines/ equipments.
9.4. - Safety arrangements during manufacturing processes like welding, Grinding, Machining, Handling of chemical etc.	* Illustrate the steps taken to provide a safe working environment during various manufacturing processes.
9.5. - Regular Plant inspection and safety audit.	* Explain the importance of regular plant inspection from safety point of view. - Explain the terms safety audit and the various factors considered.
9.6. - Hazard analysis.	* State the purpose of hazard analysis.
9.7. - Safety of electrical installations and general electrical safety practices.	* Explain the steps taken in regard to safety aspects for electrical installations and general electrical safety practices.
9.8. - Machine maintenance, Lubrication.	* Explain the safety aspects taken care in machine maintenance & lubrication. - etc.
9.9. - Safety during material handling in shops.	* Explain the methods adopted for safety during material handling in shops. - etc.

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9.10.- Safety Management - accidents and their classification (Minor, reportable, fatal, dangerous occurrences)	* Understand the aspects of safety management. - State the meaning of accidents with illustrations. - Classify the accidents.	
9.11.- Salient points of safety regulations for with Mechanical and Electrical Machines/ Equipments and chemical products etc.	* Describe the salient points of safety regulations.	
9.12. Fire safety measures. - Fire potential areas - Fire fighting measures, equipments, training, requirements, regular drill.	* Understand the significance of Proper safety measures against fire hazards. - State the fire potential areas. - Describe the various fire fighting measures taken.	
9.13.- First aid.	* Describe the various aspects of first aid to be provided for different types of mishaps.	
9.14.- Safe working environment and safety consciousness.	* Explain the various steps taken by management to provide safe working environment in inculcating safety consciousness amongst the workers.	
9.15.- Industrial Housekeeping - Definition - Significance - Factors governing housekeeping to include : 1) Proper layout and equipment 2) Correct material handling and storage. 3) Cleanliness and Orderliness.	* Understand the significance of good industrial housekeeping. - Define industrial housekeeping. - Explain the factors governing housekeeping.	* Refer : Maintenance engineering handbook by Lindley R. Higgins page No.14-37 to 14-59.
9.16.- Basic requirements for good housekeeping - General organisation	* Explain the basic requirements of good housekeeping. e[illegible]	

- Proper equipment, tools and supplies
- Work schedules
- Assistance from other working groups.
- Housekeeping inspection.

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MAINTENANCE AND SAFETY

LIST OF PRACTICALS

1. Demonstration and operation of protective equipments.
2. Demonstration of operation of Fire Extinguisher equipments.
3. Measurement of Wear on flate surfaces by -
   (a) Microscope and steel string method.
   (b) Optical method
   (c) Hydrostatic method
4. Measurement on Wear on cylindrical surfaces by -
   (a) Vernier Caliper
   (b) Micrometer
   (c) Dial indicator and V block.
5. Measurement of Wear of gears by thickness gauges and gear tooth vernier gauge.
6. Estimation of time in minutes for dismantling and removing piston of pump.
7. Demonstration and operation of grease gun in lubricating various components of any available machine or engine.
8. Study of various tools and gauges used in mechanical maintenance.
9. Visit of large/medium/small/ scale industries for collecting information regarding the safety measures taken during material handling, handling of electrical devices, fire, accidents, processes etc.
10. Visit of large/medium/small/ scale industries for collecting information in respect of (a) Keeping record for condition of equipment maintenance and replacement of parts, if any (b) lubrication plate etc.

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MAINTENANCE AND SAFETY

LIST OF SUGGESTED TEXT BOOKS / REFERENCE BOOKS

1. Accident Prevention Manual for Industrial operations by Frank E. McElroy, P.E., C.S.P. Editor in chief National Safety Council, Chicage, U.S.A.

2. Accident Prevention Manual for administration and programmes by Frank E. McElroy, P.E., C.S.P. Editor in chief National Safety Cpuncil, Chicage, U.S.A.

3. Commentary on - Factories Act with M.P. - Rupees by Krishanlal Sethi The Lawyers Home, Indore-7 .....Rs. 120/-

4. Industrial accident Prevention
   By H.W. Heinrich
   MeGraw Hill Book Company, IWC.

5. An Introduction to Safety Engineering and Management
   by N.V. Krishnan
   CPS Publishers Pvt. Ltd. Culcutta- 700 001.

6. Maintenance of Industrial Equipment by B. Gelberg. G. Poklis.

7. A guide to efficient Maintenance Management By H.V. Mstwatt.

8. Modern Maintenance Management by Miller and Blood.

9. Maintainability-by Benjamin S. Blanshard, E. Edward Lowery.

10. Maintenance Engineering Hand Book by MoRROW.

11. Repair of industrial Equipment by B.G.glberg, G- Peklis.

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PROGRAMME: DIPLOMA IN PRODUCTION ENGG.
SCHEME: REVISED, IMPLEMENTED FROM 1995-96
SEMESTER: SIXTH
COURSE: Entrepreneurship Project

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(P.C. 2074)

ENTREPRENEURSHIP PROJECT

ENTREPRENEURSHIP PROJECT

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WORKING GROUP

1.	Prof. N.K.Mittal	- Principal MACT, Bhopal.
2.	Prof. P.N.Mishra	- MACT, Bhopal
3.	Mr. Rajmohan Shrivastava, HDME	- S.V.Govt. Polytechnic, Bhopal.
4.	Mr. S.R.Madan, HDME	- S.V.Govt. Polytechnic, Bhopal.
5.	Mr. Shamim Uddin, HDME	- S.V.Govt. Polytechnic, Bhopal.
6.	Mr. B.K.Saxena, Sr.Lect.	- S.V.Govt. Polytechnic, Bhopal.
7.	Mr. R.M.Khan	- S.V.Govt. Polytechnic, Bhopal.
8.	Mr. K.C.Verma , Course Co-ordinator, Bhopal.	

RATIONALE

The Subject Entrepreneurship project has been designed keeping in view of the employment scenario of the country. The country is passing through srcio-economic changes imposed by internal pressures on one hand and impact of globalization on the other hand. Up till now the government (both centre and state) were the major source of the job potential. But with the adoption of the open market policy and growing stress on privatization of various sectors pertaining to the heavy industries , Public undertakings and service systems such as Railways, Tele-communications etc. , the job potential in the governmental sector is receding at quite a fast rate.

To keep pace with these changes and the National policy this subject of Entrepreneurship Project has been designed as to prepare Diploma pass-outs in the field of production Engineering to go for self-employment ratherthen become the job seekers.

The curriculum is divided in two parts. The theoretical input input of 28 hours is dedicated to the concepts formation about entrepreneurship and the 84 hours partaining to practicals, is spanned through three phases namely.

Phase -I : Product/ Project selection.

Phase-II : Product Manufacturing/Project implementation.

Phase-III : Preparation/Presentation of feasibility report.

ENTREPRENEURSHIP PROJECT

S.NO.	CONTENTS	TIME ALLOTTED
1.	THEORY	
	Knowledge on the following topics & areas should be imparted to the students as a ground preparation for	
	* Introduction to Entrepreneurship.	- 6 Hrs.
	- Definition of Entrepreneur/Intrapreneur/ Entrepreneurship/Intrapreneurship. - Difference between Entrepreneur/Intrapreneur. - Need for Entrepreneurship. - Qualities of a successful Entrepreneur/ Success stories. - Concept of an Industry or Enterprise. - Classification of Industry.	
	* Institutional Assistance.	- 8 Hrs.
	- Informational. - Infrastructural. - Financial and - Marketing Assistance.	
	* Incentives.	- 3 Hrs.
	- Seed Money - Subsidies and - Others (like phones/Lands etc.)	
	* Planning the Product/Project.	- 3 Hrs.
	- Pre-Planning stage - Implementation stage - Post Implementation stage	

- 4 Hrs.

* Achievement Motivation.

- Concepts
- Significance and
- Components of Achievement Motivation

- 4 Hrs.

* Financial Management.

- Book of Account
- Principles of Accounting
- Profit and Loss Account
- Balance Sheet

- 4 Hrs.

* Marketing Management.

- Concept of 4 Ps of Marketing
- Marketing strategy
- Packaging and Distribution
- After sales service

2. PRACTICAL

Practical assignments will be complete by undertaking the following activities sequentially in 3 phases.

* Phase- I : Product/Project selection - 10 Hrs.

* Phase-II : Manufacturing the Product/Project Implementation - 24 Hrs.

* Phase-III: Preparation/Presentation of Feasibility Report. - 14 Hrs.

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GUIDANCE

INSTRUCTION TO THE TEACHERS

1. Different project items should be taken for different groups.

2. Each group should consist of 3 - 5 members.

3. For guidance and supervision maximum number of faculty may be involved for effective and efficient supervision.

4. 28 Theory periods should be utilised for imparting the THEORETICAL background knowledge for entrepreneurs/ entrepreneurship.

5. The Product/ Project selected may be such that the students end up with a completed or finished output.

6. The Product/Project selected should involve as far as possible the different operations, the different machines/equipments.

7. Steps should be taken to avoid copying, repetition and Duplication.

8. The assessment of the Entrepreneurship Project should be done strictly as suggested to judge the cognitive, psychomotor and affective a skills achievement of students.

SUGGESTED STEPS FOR PRODUCT SELECTION

Following steps are suggested for identification of product (s) and selection of the product to be manufactured as a project by the students.

A - 1. IDEONOMICS :

- Individual
- Team approach
- Brain storming
- Research Methods

2. NEED HEEDOLOGY :

(a)
- Biological
- Bychological- Social

(b)
- Need analysis

3. INFONOMICS :

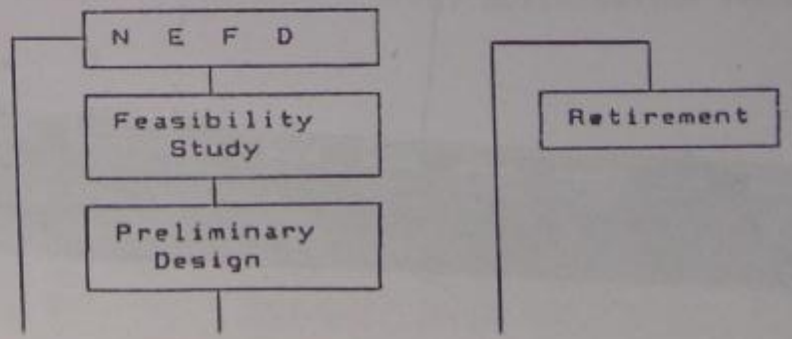
- Drawing
- Specification
- Performance predechons
- Bill of material
- Technical advise

4. DESCRIPTION

5. STRUCTURE AND MORPHOLOGY OF DESIGN :

6.

Primary Design Phases



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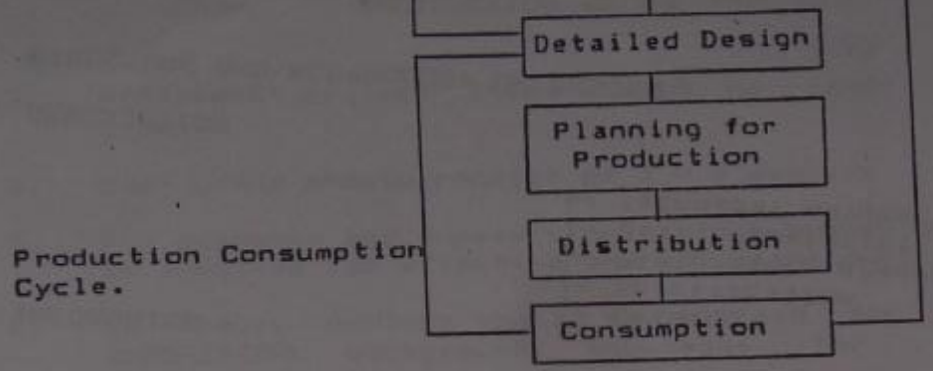
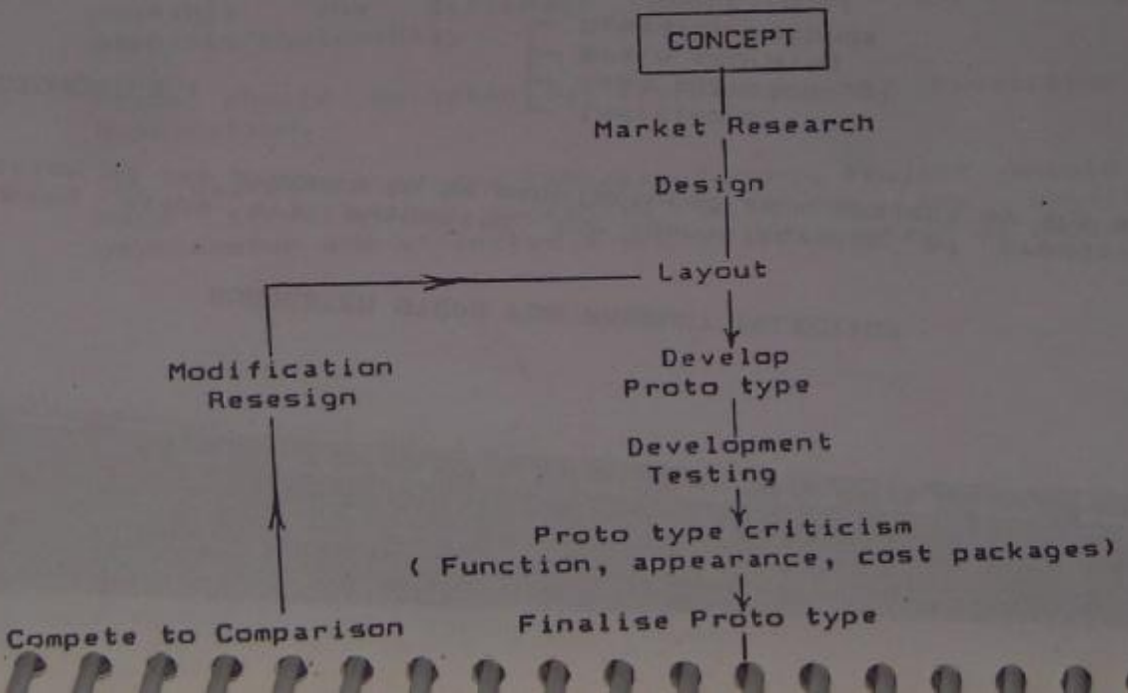


Production Consumption Cycle.

7. DESIGN

(a) By evolution
(b) Creatanuo



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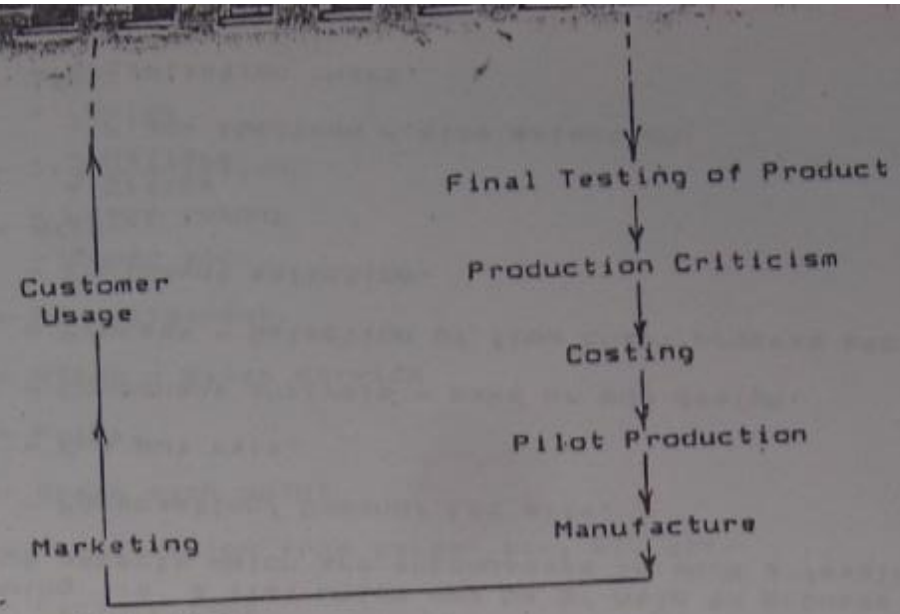

8. Identification

9. Standards of Performance

10. Resources & Environmental Factor

11. Synthetics Group theory for stimulative (Imaginative Idea)

12. Qualifying Design Concept

13. Economics in Engineering Design.

(a) Value analysis
(b) Optimisation Techniques

14. Reliability analysis

15. Ergonomics & Human factors

16. Maintainability

17. Synthetics

18. In-put Out-put Model

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SUGGESTED STEPS FOR FEASIBILITY REPORT

A Feasibility report pertaining to the project selected be prepared, assuming that an industry is to be launched manufacturing the product which has been selected and prepared in the shop/lab of the institution.

The feasibility report is to be designed such as normally required to be submitted for the registration of industry with the D.I.C. and various govt. agencies involved for seeking permission to start such an enterprise as well as for the purpose of raising loans from the various financial institutions.

Following is a list which may be of help to provide an insight regarding the various aspects which are encompassed in such a feasibility report.

1 A - Forecasting/ Demand/ Lot size.

1 B - Out put rate.

2 - Component analysis - make or buy design.

3 A - Process - Selection of flow chart process etc.

3 B - Equipment selection.

4 - Plant layout
- Office
- Welfare
- Place location - site selection.

5 - Organization chart.

6 - Man power requirement.
- Materials
- Method

7 - Raw materials
- Tools

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8 - Cost.

8 A - Taxes
- Levies

8 B - Transportation

8 C - Water
- Power etc.

8 D - Advertisement.

8 E - After - Sales service

9 - Price.

10 - Break even point

11 - Registration from sales- tax, DIC etc.

12 - Factory laws

12 A - Subsidies, seed money, working capital.

12 B - Money requirement.

12 C - Resources for procuring money, Bank interest rate.

13 - Charges of water connection.

14 - Rate of return.

14 A - Product/ Project selection.

14 B - Feasibility report.

(i) Resources

(ii) Official procedure.

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ASSESSMENT SCHEME

* THEORY EXAM (Based on theory content)	- 50 Marks	- of 3 hrs. duration.
* PRACTICAL EXAM	- 100 Marks	- As per distribution show below -
	- Viva Voice	- 25 Marks.
	- Presentation of the project	- 25 Marks.
	- Marks for the internal assessment	- 50 for product manufacturing/ Project implementation.

PROGRAMME: DIPLOMA IN PRODUCTION ENGG.
SCHEME: REVISED, IMPLEMENTED FROM 1995-96
SEMESTER: SIXTH
COURSE: Process Planning, Tooling & Costing-II (P.C. 2075)

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PROCESS PLANNING, TOOLING & COSTING

II

PROCESS PLANNING TOOLING & COSTING -II

		THEORY	PR./TUTORIAL
		44	96
(A) TOOL DESIGN		THEORY	PR./TUTORIAL
1) Jig & Fixture design	-	14	25
2) Press working tool design	-	08	12
3) Bending, Forming, and Drawing die Design	-	08	14
4) Forging Die design	-	04	10
5) Introduction to Plastics mould design	-	08	10
		44	71
(B) ESTIMATING			
6) Estimation & its importance	-	2	-
7) Actual Cost Estimation	-	3	5
8) Machine Shop Estimation	-	5	8
9) Sheet metal shop Estimation	-	4	6
10) Detailed Cost Estimation	-	2	1
		16	20
11) Revision	-	4	5

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PROCESS PLANNING TOOLING & COSTING -II

	THEORY 64	PR./TUTORIAL 96				
	TH.	PR./TU.	Kn.	Comp.	Higher Level	Total
(A) TOOL DESIGN						
1) Jig & Fixture design	- 14	25	2	8	15	25
2) Press working tool design	- 08	12	2	4	5	11
3) Bending, Forming, and Drawing die Design	- 08	14	2	5	5	12
4) Forging Die design	- 06	10	2	4	5	11
5) Introduction to Plastics mould-design	- 08	10	4	4	5	13
	44	71				
(B) ESTIMATING						
6) Estimation & its importance	- 2	-	2	-	-	2
7) Actual Cost Estimation	- 3	5	1	4	-	5
8) Machine Shop Estimation	- 5	8	2	3	5	10
9) Sheet metal shop Estimation	- 4	6	2	5	-	7
10) Detailed Cost Estimation	- 2	1	1	3	-	4
	16	20	20	40	40	100
11) Revision	- 4	5				

NAME OF SUBJECT : PROCESS PLANNING, TOOLING AND COSTING -II

SNo.	Topic/ Sub Topic	Intended learning Outcome (ILO) (Objective)	Remarks
1	2	3	4
(A)	TOOL DESIGN		
1.	JIG & FIXTURE DESIGN (Th. 14 hrs.+Tuto. 25 hrs.)		
	* Functions.	-* Define & Describe need of Jig & Fixtures. * State basic principles of jig & fixture design.	-* Design & sketch a simple Draw Jig for a given job.
	* Types.	* State & Explain types of Jig & Fixtures. * Explain six degrees of freedom.	* Design & sketch Fixture for a given job.
	* Location, Clamping & Restraining.	* Understand the need & Elements used for location, clamping & restraining. * Select locating surface on a given component. * Describe methods of improving efficiency of Jig.	
	* Need of guiding elements.	* Explain the need of bushes to guide the cutting tool. * State need of avoiding sharp corners, using quick action clamps, 'C' washers etc.	
	* Design considerations.	* Understand design principles for Jig & Fixture. * State the importance of time element in location & clamping, Loading & unloading, Cleanliness in maintenance of locating & guiding surfaces, Renewability of locating & supporting surfaces.	

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	* State what is meant by fool proofing. * Compare Cast Jigs & Fabricated Jigs with respect to cost & Tool life. * Design drill jigs for a given simple job. * Design simple Fixtures for given simple jobs.	
* Selection of Method of preparing Jig or Fixtures.	* Summarize & Comprehend selection of method for producing jigs/Fixtures.	

2. PRESS WORKING TOOL DESIGN.
(Th. 8 hrs.+ Tuto. 12 hrs)

* Introduction to Press work, equipment used and their operation.	* State the scope of type of work done in press work. * Name commonly used equipment in press work. * Describe the constitution & working of equipment used.	* Sketch layout of blanks on sheets, sketch main component of press dies. * Lab demonstration. * Industrial visit.
* Basic design concepts of press working tools.	* State & Explain design concepts of press working tools.	
* Sheet metal Die- tool elements.	* Describe main elements of die-tools like punch supporting, stock-stops, pilots, strippers, knockouts etc. * Understand shear action in die cutting, centre of pressure, clearance etc.	
* Design considerations of – - Piercing die - Progressive die - Blanking die - Progressive blanking die	* Explain design considerations for piercing dies, progressive dies, progressive dies & blanking dies. * State types of dies such as simple,compound & transfer. * State the type of jobs where each of these types of dies are economical to use. * State type of die-cutting operations.	
* Various commercially/ commonly available jobs from press work.	* Identify & name some of the commercially available products out of press work.	

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* Materials suitable for press working jobs.	- state the properties of the materials which are suitable for press work. - List at least two commercially most used material for press work and their composition.

3. BENDING , FORMING & DRAWING DIE DESIGN. (Th. 8 hrs.+ Tuto.14 hrs.)

* Bending, Forming & Drawing operations, Scope, equipment and die used. * Development & Design of die.	* Explain bending, Forming & Drawing operations. * Describe the scope of use of these operations. * State equipment & type of Dies used. * Describe general principles in design of bending dies, forming dies & drawing dies. * Working principles of bending dies, Forming dies & drawing dies. * Explain constructional details of these dies. * For bending dies, define the terms bend radii, bend allowances, bending methods, bending pressure & spring back. * Among forming dies, distinguish between solid forms dies & forming dies with pressure pads. * Explain the operations such as embossing, beading & Curling, bulging, twisting, coining, swaging, hope flanging or extruding etc. * Explain the action of drawing dies & metal flow phenomenon. * Describe construction of single action & double action drawing dies with their parts and functions. * For drawing dies, define the terms blank diameters, reduction factors, drawing pressure & blank holder pressure etc.	-* Develop & Sketch bending dies for a simple job showing die drawing & component name. * Develop & sketch forming die for a simple job showing die drawing & component. -* Develop & Sketch drawing die for a simple job showing die drawing & & component.

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4. FORGING DIE DESIGN.
(Th. 6 hrs.+ Tuto. 10 hrs.)

* Forging, scope, equipments & Dies used.

-* Explain the term forging .
* State and Explain its scope, equipments & dies used.

* Development & design of forging dies.

* State forging die design consideration such as - machining allowances, forging tolerances, fillets and corner radii, draft and parting allowance, thermal aspects etc.
* Sketch and label parts of different types of forging dies such as - drop hammer die , crank press die, friction press die, trimming die etc.
* State general considerations during manufacturing of forging dies.

5. INTRODUCTION TO PLASTICS MOULD DESIGN.
(Th.8 hrs.+ Tuto.10 hrs.)

* Understand that there are different methods to produce plastic products such as Injection moulding, compression moulding, blow moulding, vacuum forming etc.
* Understand that each of these processes have different mould requirements.
* Considering moulds for injection moulding and compression moulding, name & Label the major parts of mould.
* Comprehend that core and cavity are designed for products and the bolster plate and other parts of moulds are standardized items.
* Mention the steps in mould manufacturing such as still selection, operations to be perform on special machines (Jig boring, Die sinking, EDM, lapping etc.).
* Comprehend that the cost of good quality mould is enormous. -* Industrial visits.

(B) ESTIMATING.

1. ESTIMATION & ITS IMPORTANCE.
(2 hrs.)

* Define Estimation & its Importance.

2. ACTUAL COST ESTIMATION.
(Th. 3 hrs.+Tuto.5 hrs)

* Understand terminology associated with Estimation.
* Define and Explain the associated terms such as - Batch production time, No. of product/ cycle, No. of cycle per batch, cleaning time, Production overhead time, Batch overhead time etc.
* Explain the term scrap, waste & spoilage.
* Understand that scrap waste & spoilage can not be completely eliminated & kept around 2 to 3%.
* Compute time element, give relevant data.
* Estimate Volume, Weight & Cost of material, given relevant data.

-* Given relevant data Compute different time elements.
* Given data, calculate Volume, Weight & cost of material.

3. MACHINE SHOP ESTIMATION.
(Th. 5 hrs.+ Tuto.8 hrs)

I)* Define the terms cutting speed, Feed, depth of cut, approach length & over travel.
II)* Select feed & Cutting speed for different operations of a given job from standard tables.
III)* Determine time elements for various machining operations of given jobs.
IV)* Calculate necessary RPM, batch Production time, manpower requirement & Labour cost/ batch from given data.

- * Given relevant data
* Use & formula to calculate actual machining time for different operations
* From the given data calculate Production operation time per product per cycle, Batch Production time, Manpower requirement & labour cost per batch. (Complex jobs involving use of more than three type of machine tools need not be considered.)

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4. SHEET METAL SHOP ESTIMATION.
(th. 4 hrs.+ tuto.6 hrs.)

* Explain concept & meaning of sheet metal work.
* State some examples of types of products which can be made by sheet metal work.
* Determine various sheet metal operations such as bending, edge stiffening, hemming, hollowing, grooved joints etc.& allowances to be provided.
* State different sheet metal shop work as general purpose type, Laying & preparing of blanks, container, construction, housing & hood making.
* Calculate from the given data, Production time required in piece work, batch production & Mass production. -* Given relevant data, compute Production time required.
* Calculate cost of given sheet metal job alongwith labour cost & material cost from the given data. * Given relevant data, compute cost of given sheet metal job.

5. DETAILED COST ESTIMATION
(Th. 2 hrs.+ tuto. 1 hrs.)

* Understand the concept of fixing-up selling price per unit of the given job on the basis of earlier discussions. * Given relevant data,carry the detailed cost estimation for a given job.
* Calculate prime cost, works cost, selling cost and selling price from the given data.

6. Revision.

PROCESS PLANNING TOOLING & COSTING - I & II

LIST OF BOOKS RECOMMENDED FOR REFERENCE

SNo.	Title	Name of Author	Publishers
1.	Fundamentals of Tool design	- By Americal Society Of Tool and Manufacturing Engineers	-Prentice Hall of India Delhi
2.	Tool Design	- Herman W. Pollack	-D. B. Taraporevala Sons & Co.Pvt. Ltd.
3.	Tool Design	- C. Donaldson & George H. Lecain	-M.C.Graw Hill Book Company
4.	Production Tooling Equipment	- S.A.J. Persons	-Cleaver- Hume Press Ltd. (B.I.Publications, Bombay, Delhi)
5.	Engineering Manufacturing Processes	- D. Maslou, V. Danilevsky V. Sasor	-Mir Publishers Moscow
6.	Fundamentals of Process Engineering	- V. Kavan	-Foreign languages Publishing House Moscow.
7.	Process Engineering for Manufacturing	- Donald F. Eary and Gerald E. Johnson.	-Prentice Hall
8.	Manufacturing Engineering	- Wage	-Machine Graw Hill
9.	Manufacturing Engineering	- V. Danilevsky	-
10.	Engineering Economy	- Degarmo	-
11.	Managerial & Engg. Economy	- Taylor	-East West Press
12.	Mechanical Estimating & Costing	- R.L. Shrimali P.C. Jain	-Jain Publishing House
13.	Machine Shop Estimation	- Nordoff	

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PROGRAMME: DIPLOMA IN PRODUCTION ENGG.
SCHEME: REVISED, IMPLEMENTED FROM 1995-96
SEMESTER: SIXTH
COURSE: Pneumatic, Hydraulic Controls & Instrumentation (P.C. 2076)

PNEUMATIC & HYDRAULIC CONTROLS & INSTRUMENTATION

PNEUMATIC & HYDRAULIC CONTROLS & INSTRUMENTATION

WORKING GROUPS

1. Mr. Uttam Ganguli, M/S Band Joint, Bhopal.
2. Prof. S.L. Nema, MACT, Bhopal.
3. Mr. G.S. Sharma, HOD, Govt. Polytechnic, Dhar.
4. Mr. S.R. Madan, HOD, S.V.Govt. Polytechnic, Bhopal.
5. Mr. A.I.M. Khan, lect., S.V.Govt. Polytechnic, Bhopal.
6. Mr. R.L. Shrimali, Course Co-ordinator, PDU, Bhopal.

PNEUMATIC & HYDRAULIC CONTROLS AND INSTRUMENTATION

RATIONALE

With the growth of world trade and advancement in technology, manufacturing of quality goods at competitive rates is the demand of time in industry. This can only be achieved by varying extent of automation according to technology level, product function and market being explored.

The industry at large & small scale industry in particular, at present, broadly speaking, depends upon manual skills. Need for gradual shift to automation is beyond doubt in all walks of life. Low- cost automation - Pneumatic & Hydraulic Controls offers a good stepping stone to this end.

The basic concepts of the system and the working of elements in the system is essential to design & maintain the system. Its performance is monitored through instrumentation which forms an essential component for the system's success. The Curriculum thus, emphasizes this goal and introduces this subject. It is of a very recent origin in Polytechnic Education System of the country. Thus, a lucid, simple and more demonstration- based teaching would help the students grasp & understand. The passout Students of Polytechnic would not be required to design the system parameter, or elements and as such intentionally the system parameter, system element design & Mathematical treatment has NOT been included in the Curriculum .

However, it is necessary for the passouts to be able to design simple pneumatic or hydraulic circuit using commercially available elements (Valves, Cylinders, motors, etc.) and diagnose faults in a Circuit.

PNEUMATIC & HYDRAULIC CONTROLS & INSTRUMENTATION

Theory - 32 hrs.
Practical - 32 hrs.

SNo.	Topic	Theory	Tutorial/ Practicals
	PNEUMATIC & HYDRAULIC CONTROLS.		
1.	Control & regulation	- 2	-
2.	Introduction to Pneumatic Control System.	- 3	2
3.	Production of compressed air its treatment & distribution.	- 3	-
4.	Pneumatic control Components & circuits & their Maintenance.	- 1	12
5.	Introduction to Hydraulic control system.	- 2	-
6.	Hydraulic power Unit.	- 1	4
7.	Hydraulic cylinders, Motors & Accessories	- 2	-
8.	Hydraulic control circuit.	- 1	12
9.	Proportional Control Systems.	- 2	-
10.	Hybrid Control Systems.	- 3	2
		20	32

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INSTRUMENTATION

11. Introduction to Instruments & Instrumentation.	-	1	-
12. General Characteristics of Instruments.	-	3	-
13. Measurement of Pressure.	-	2	-
14. Measurement of Temperature.	-	2	-
15. Measurement of Flow.	-	2	-
		10	-
REVISION	-	2	-

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PNEUMATIC & HYDRAULIC CONTROLS & INSTRUMENTATION

SCHEME OF ASSESSMENT

Theory - 32 hrs.
Practical - 32 hrs.

SNo.	Topic	Theory	Tuto/ Pract.	Kn.	Assessment Comp.	High.level	Total
	PNEUMATIC & HYDRAULIC CONTROLS.						
1.	Control & regulation	- 2	-	1	-	-	1
2.	Introduction to Pneumatic Control System.	- 3	2	1	-	-	1
3.	Production of compressed air its treatment & distribution.	- 3	-	3	6	-	9
4.	Pneumatic control Components & circuits & their Maintenance.	- 1	12	-	10	10	20
5.	Introduction to Hydraulic control system.	- 2	-	1	2	-	3
6.	Hydraulic power Unit.	- 1	4	2	2	3	7
7.	Hydraulic cylinders, Motors & Accessories	- 2	-	2	3	-	5
8.	Hydraulic control circuit.	- 1	12	-	10	10	20
9.	Proportional Control Systems.	- 2	-	1	4	3	8
10.	Hybrid Control Systems.	- 3	2	2	3	-	5
		20	32				

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INSTRUMENTATION							
11. Introduction to Instruments & Instrumentation.	-	1	-	2	-	-	2
12. General Characteristics of Instruments.	-	3	-	1	3	2	6
13. Measurement of Pressure.	-	2	-	2	3	-	5
14. Measurement of Temperature.	-	2	-	1	2	-	3
15. Measurement of Flow.	-	2	-	1	4	-	5
		10		20	52	28	100
REVISION	-	2	-	100			

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NAME OF SUBJECT - PNEUMATIC & HYDRAULIC CONTROL & INSTRUMENTATION

S.No.	Topic/Sub Topic	Intended learning Outcome (ILO) (Objective)	Remarks
1	2	3	4
1.	CONTROL AND REGULATION (Th.2 hrs.)		
	-Scope, Elements of Control chain. -Working media for control systems. -Close and Open loop system. -Flow diagram for steps/Mechanism of control chain.	* Describe the meaning of terms Control and regulation. * Describe of control technology. * State various steps/ mechanism relating to control system and regulation systems with their functions. * State the basic Principle used. * Identify the following control systems with their working principle, Guidance control system. Programme control system. * Comprehend that the control may be based on time pattern, Path pattern and Operational cycle Control. * Sketch a Flow diagram of any Control chain showing sensorics, Actorics, Processors, Software network.	* Charts and OHP slides may be used. * Adequate examples from field may be highly helpful.
2.	INTRODUCTION TO PNEUMATIC CONTROL SYSTEM. (Th.3 hrs.+ Tuto.2 hrs.)		
	-Meaning and scope of Pneumatic Control System. -Limitations.	* State the meaning,and Scope of Pneumatic Control system. * Describe advantages of Pneumatic control system. * List a few applications of Pneumatic control system. * Describe the limitation of Pneumatic Control System.	

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- Fluid and its properties.	* Name the fluid used and state its properties.	
-Unit of Measure pressure in Pneumatics .	* List different units used for measuring Pneumatic pressure. * Convert or Correlate different unit of Pneumatic pressure- bar, psi. pa, kgf/cm².	* A few numerical examples.

3. PRODUCTION OF COMPRESSED AIR ITS TREATMENT & DISTRIBUTION.
(Th. 3 hrs.)

-Need and characteristics of Compressed Air. -Compressors Positive-displacement Compressors. -Method of conditioning -Filtration of Compressed Air -Compressed Air lubrication.	* Explain the need and characteristics of Compressed Air. * Describe construction & Working of the following types of Compressors. a) Reciprocating Compressors. (Single and two stage compressors). b) Rotary Compressors. (Sliding-vane rotary compressors) * Describe the methods of conditioning of Compressed Air. * List the treatment to compressed air to make it moisture free and oil free such as- - Drying Processes. a) Absorption drying. b) Adsorption drying. c) Low temperature drying. * Explain in brief the working principle of each of the above. * List the requirements of Air Filters. * Sketch & Describe working principle of any one type of air filter. * State the advantages of mixing lubrication in air.
-Service Unit.	* Explain the functions of Service Unit.

-Air filter
-Pressure Regulator with pressure gauge.
-Compressed Air lubricator.

* Sketch and Name the Sub-Unit of Service Unit.
* Describe the precaution to be observed for effective working of Service Unit.

4. PNEUMATIC CONTROL COMPONENTS AND CIRCUITS.
(Th. 1 hr.+ tuto. 12 hrs.)

- Pneumatic Cylinders.
* Single acting cylinders.
* Double acting cylinders.

- Pneumatic Valves, their construction & Use.

- Explain and describe the construction & working of Pneumatic control components.
- Sketch and state the meaning of various symbols used as per is in pneumatic control systems.
- Sketch and design different basic circuits, for the following.
* Control of a single acting cylinder
* Control of a double acting cylinder.
* Control with shuttle valve.
* Speed regulation on single acting cylinder and double acting cylinder.
* Raising the speed of single acting and double acting cylinders with quick exhaust valve.
* Control with two pressure valve and series connection.
* Indirect control of a single acting cylinder and double acting cylinder.
* Automatic return of a double acting cylinder using a limit switch.

- Design & sketch general logic control circuits.

- Identify and designate various elements used in circuits.
* Working elements cylinder.
* Actuating elements.
* Signal elements.
* Supply elements.
* Auxiliary devices.

* See the list of experiments.

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- State and explain the fields of application of pneumatic controls such as- Clamping, ejecting, Feeding, assembly, cutting, forming,materials handling etc.

MAINTENANCE OF PNEUMATIC EQUIPMENT AND SYSTEMS.

- Fault tracing
  - * Systematic approach towards detection and rectification of faults.
  - * Locate the source of the fault
  - * Make a fault list for disturbances or failure which can occur with the element.
  - * Rectifying the disturbance.
- Fault localization. (List of faults)
  - * Knowledge of individual elements.
    - Functional description.
    - Drawing.
    - Wearing parts.
    - List of faults (Type of disturbance, possible cause and rectification)
- Rectification of fault.

5. INTRODUCTION TO HYDRAULIC CONTROL SYSTEM. (Th.2 hrs.)

i) Recapitulate the Principles of Hydraulics.

ii) Various working media used, their characteristic, properties & Limitations.

i) Explain the relation between pressure, Density and Head.
- Describe the Continuity Equation.
- State the Pascal's Law.
- State the Bernoullis Theorem.
- Describe the Venturimeter.
- List the Various losses of Head.

ii) Name the type of oils used in Hydraulic Control system.
- Describe the Functions, Characteristics & Properties of Hydraulic oil.

iii) State the limitations of Hydraulic oil as working media in Hydraulic control system.

* Only a brief Summary is desired.Charts or OHP slides may be helpful.

6. HYDRAULIC POWER UNIT.
(Th.1 hrs.+ Tuto.4 hrs.)

- Construction of Hydraulic Power pack and function of its Sub-Units.	- Sketch the Power pack, its symbol. - State the purpose of - Reservoir, Filter/Strainer, Pump, Drive (Motor, I/C Engine), Oil level indicator in a power pack, pressure regulator & pressure relief valve.	* OHP Slides may be used.
- Types of Pump used.	- Sketch & Explain the Working of Gear pumps, Vane Pump, and Piston Pump. - Describe Applications and Limitations of each of the above types of Pumps.	* Characteristic Curv for given Hydraulic Pump.
- Types of Valve used.	- Sketch symbol and describe the working of Flow Control Valves,(FCV) Pressure Control Valves,(PCV) Non- Return Valves (NRV). - State the Principle of Guidance Control, Programme Control system. - Comprehend that the Control may be based on Time pattern, Path pattern and Operational Cycle Control. - Sketch & Explain Block flow, Line diagram of Control Chain showing Sensorics, Actorics, Processors, Soft ware, network.	* OHP slides transpar ncies may be used. * Adequate examples. from field be giver

7. HYDRAULIC CYLINDERS, MOTORS AND ACCESSORIES.
(Th.2 hrs.)

- Working of Hydraulic cylinders (SA & DA) with their sketches, symbols & Applications. - Accessories used in Hydraulic Control System. * SA = Single acting DA = Double acting	* Explain the construction and working of various types of Hydraulic cylinder.(SA & DA). - Sketch the symbols for different types of cylinders. - State the function & Use of Hydraulic motors. - Sketch ,symbols & Describe function of Pressure switches, Hydraulic

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Accumulators, Pressure Intensifiers.
- Describe the function & Application of different accessories used in Hydraulic Control Systems.

8. HYDRAULIC CONTROL CIRCUIT.
(Th. 1 hrs.+ Tuto.12 hrs.)

- Application of Hydraulic control systems.
- Symbols used.
- Design & Assemble Hydraulic control circuits for simple industrial situations.
- Time Motion diagram.

* Sketch and draw a Hydraulic circuit for plotting Pump characteristics.
* List at least five industrial applications of Hydraulic control systems.
* Sketch/ read the symbols used in Hydraulic control circuits as per I.S.
* Design simple hydraulic control circuits for given industrial situations
* Given a set of different valves, select, correct type of valve for a required function/ purpose.
* Diagnose a fault in Hydraulic circuit and rectify it.

* List suggested of experiments enclosed.

9. PROPORTIONAL CONTROL SYSTEM.
(.Th 2 hrs.)

* Importance and its Scope.
* Advantages and Limitations.
* Industrial applications.

* State the need of proportional Hydraulics.
* Describe Limitations of simple Hydraulic & Electro-hydraulic control system.
* Describe scope, advantages & limitations of proportional hydraulic control system.
* List at least five industrial applications.
* Sketch & Explain principle of proportional control system.
* Comprehend that the most commonly used type of hydraulic control system is proportional hydraulics.

10. HYBRID CONTROL SYSTEMS.
(Th. 3 hrs.+ Tuto.2 hrs.)

- Electro-pneumatic control.
- Electrically actuated solenoid Valves.
* Air-hydraulic control (Hydro-pneumatics)

* Comprehend that electrical circuit. Work on low voltage D.C. or A.C. 12 Vor, 24volts only, rarely with 220V power.
* Conclude that Electro-pneumatics makes it feasible to transmit signal at larger distances.
* Comprehend that commonly pneumatics is used for control circuit and for operating circuit hydraulic is used.
* State the advantages of hydro-pneumatic control system.

INSTRUMENTATION

11. INTRODUCTION TO INSTRUMENTS AND INSTRUMENTATION.
(Th. 1 hrs.)

* Introduction to Instruments.
  * Appreciate the need of instruments and Instrumentation.
  * Define the term "Instruments" and "Instrumentation".
* Measurement Methods.
  * Defferentiate among (a) Primary, Secondary and tertiary measurements and (b) direct and indirect methods.
* Generalized Measurement Systems and its functional elements.
  * State the scope of (a) primary sensing elements and variable conversion elements, (b) Data transmission element and data processing element, (c) Data presentation element.
* Classification of Instruments.
  * Define the terms (a) Automatic and manual instruments (b) Self operated and power operated instruments (c) Self contained and remote indicating

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instruments and (d) Analog and digital instruments.

12. GENERAL CHARACTERISTICS OF INSTRUMENTS.
(Th. 3 hrs.)

* Static terms and characteristics of Instruments.	* State the importance of static behavior of instruments. * Define the terms Used to represent instrument characteristics Differentiate those with giving appropriate examples- (i) Range and span (ii) Error and accuracy (iii) Hysteresis and dead zone (iv) Threshold and resolution (v) Drift and reproducibility. * State the need of calibration. * Define the terms used with calibration of instruments. * Describe the procedure used for calibration of instruments.
* Dynamic terms and characteristics of instruments.	* (A) State the importance of dynamic behaviour of instruments. (B) Define the terms used in dynamic systems. (i) Speed of response and measuring log. (ii) Fidelity and dynamic error. (iii)Overshoot. (iv) Dead zone and dead time. (v) Frequency response.
* Zero, first and Second order instruments/ systems.	* Define the terms with appropriate examples. (i) Zero order systems. (ii) First order systems. (iii) Second order systems.

13. PRESSURE MEASURING INSTRUMENT. (Th. 2 hrs.)

* Introduction.	* Define the need and use of pressure measuring instruments.	* Only a bird's eye-view treatment to this topic is required to develop an awareness and general knowledge of pressure measuring instruments in industry
* Terminology used in pressure measurements.	* Define the terms generally associated with pressure and its measurements. (i) Atmospheric pressure. (ii) Absolute pressure. (iii) Gauge pressure and vacuum. (iv) Static and total pressure.	
* Types of Pressure Gauges.	* Name the type of gauges for measurement of pressure such as Pressure transducer, Manometers, Mechanical gauges.	
* Mechanical displacement type pressure gauge. (i) Ring balance manometer. (ii) Bell type pressure gauge. (iii) Bourdon tube pressure gauge.	* Briefly describe using suitable sketches, principle, construction and operations (with advantages and limitation) of- (i) Ring balance manometer. (ii) Bell type pressure gauge. (iii) Bourdon tube pressure gauge.	
* Diaphram gauges for pressure measurements.	* (a) State the principle of diaphram gauges. (b) List the basic types of diaphram elements. (i) Metallic diaphram (ii) Non-metallic or stock diaphram. (c) State the simple construction and working (with simple sketch) of diaphram gauges.	

14. TEMPERATURE MEASURING INSTRUMENTS. (Th. 2 hrs.)

* Introduction.	* Define the need and use of temperature measuring instruments in industries.	
* Types of temperature measuring instruments.	* List the type of temperature measuring instruments with the appropriate	

	temperature range of each category such as Glass thermometer, pressure gauge thermometer, Optical pyrometers,Radiation Pyrometer, Colour temperature charts etc.
* Solid expansion or Bimetallic strip thermometer.	* (a) Explain the principle of bimetallic strip thermometer. (b) Name the different metals for construction of bimetallic strip thermometer. (c) Describe the geometrical shapes commonly used in construction and working of bimetallic strip thermometer. (d) State the application of bimetallic strip thermometer.
* Filled system thermometers.	* Explain the principle of filled (pressure) system thermometer. * Describe the construction and working of filled system thermometers with advantages and limitations. * Comprehend that the choice of a specific type of thermometer depends upon the situation & requirements in industry. * Quote at least two suitable examples for field of application of each of the above type of thermometer.
15. FLOW MEASURING INSTRUMENT. (Th. 2 hrs.)	
* Introduction.	* Define the need of flow measurement in industrial systems/machines.
* Types of Pressure measuring Instruments.	* Name the type of pressure measuring instruments such as Venturi flow meter, flow nozzel,orifice flow meter, pitot tubes, anemometers, rotameters etc.

	* Rotameter.	* (a) Describe the construction and working of rotameter for measuring flow. (b) Describes the advantages and limitations of rotameter.
	* Hot wire anemometer for flow measurements.	* (a) State the principle of operation of hot wire anemometer.
16.	Revision (2 hrs.)	

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PNEUMATIC & HYDRAULIC CONTROLS & INSTRUMENTATION

PROPOSED LIST OF EXPERIMENTS

PNEUMATIC CONTROL SYSTEM

1. A Single acting cylinder has outward stroke by manually operating a Pneumatic valve.
2. Setting up of service unit for control circuits operation.
3. Assemble a Pneumatic Circuit with a 3/2 way manually operated valve in line with a Pilot operated 3/2 way valve to control a single acting cylinder.
4. Design pneumatic circuits under a some each of the following conditions for a Single acting cylinder-

   (i) Travels out slowly.
   (ii) Returns to initial position very quickly.
   (iii) Operated through a shuttle valve & two 3/2 way valve.
   (iv) Operated through two pressure valve & two 3/2 way valves.

5. Design a pneumatic Circuits under each a some of the following conditions for a double acting cylinder.

   I. Through 4/2 way valve.
   II. Through 4/2 or 5/2 way valve & metering-in or metering out of air.
   III. On operating a push-button & after having traveled out to full extent automatically travel in again & for continuous cycle.

6. Design a pneumatic circuit such that a workpiece when fed via a magazine is clamped by a cylinder and second cylinder stamps the component.

HYDRAULIC CONTROL SYSTEM

7. Setting up of a power pack for Hydraulic control circuits operation.
8. Assemble and test for function-designed in simple hydraulic control circuits using single acting cylinder.

9. Assemble and test for function designed circuits using double acting cylinder. The circuit may involve use of any one or two or more elements with gradual increasing complexity of circuits.

a) Pressure relief vale, direct control.
b) Directional control valve.
c) Check valve.
d) Single acting cylinder.
e) Double acting cylinder.
f) Pilot controlled check valve.
g) Flow control valve.
h) 2-way flow control valve.
i) Variable return orifice check valve.
j) Flow resistance.
k) 4/3-way directional control valve.
l) Smooth piston forward motion.
m) Meter in and out flow control.
n) Differential control
o) Pressure regulator
p) Pilot controlled pressure relief valve.
q) Sequence valve.
r) Regenerative fast control.
s) Hydraulic motor.
t) Accumulator.

POLYTECHNIC DEVELOPMENT UNIT (AN INDO- GERMAN PROJECT), BHOPAL.

LIST OF THE BOOKS - (TEXT & REFERENCE)

Pneumatic & Hydraulic Controls and Instrumentation.

Date - 2.4.96 to 4.4.96

SNo.	Accession No. of Book.	Title	Author
1.	492	Industrial Control & Instrumentation	W. Bolton
2.	540	Technology of the Metal Trade	Appold, Feiler
3.	-	Maintenance of Pneumatic Equipment	Festo Didactic
4.	-	Pneumatics course for Vocational Training	Festo Didactic
5.	-	Hydraulic Course for Vocational Training	Festo Didactic
6.	-	Hydraulic Course Advance for Vocational	Festo Didactic
7.	-	Hydraulic Course for Vocational Training	Bundersinstitute fur Berufsbildungs forschung Berlin
8.	-	Hydraulics	Festo Didactic
9.	359	Instrumentation, measurement and Feedback	Barry E. Jones.
10.	1781	Instrumentation	Kirk, Rimboi
11.	207	Industrial Instrumentation	Forrest C. Tyson
12.	1456	Industrial Hydraulic System	D.D.Banks, D.S.Banks
13.	1765	Engineering Metrology (Text).	R.K.Rajput.
14.	210	Engineering Instrumentation and Control IV	L.F. Adams
15.	211	Mechanical Measurements & Control	Dr. D.S.Kumar
16.	1055	Cutting Costs with Pneumatics	Werner Deppert/ Kurt Steil
17.	1626	Metrology for Engineers	J.F.W.Galyer, C.R.Shotbolt.
18.	-	Industrial Instrumentation.	Eckmem

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INDUSTRIAL TRAINING

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PROGRAMME: DIPLOMA IN PRODUCTION ENGG.
SCEHEME: REVISED, IMPLEMENTED FROM 1995-96
COURSE: INDUSTRIAL TRAINING

INDEX

Amendment for Phase-I, Phase-II, Phase-III and Phase-IV of training as approved in the Board of Studies meeting held on 6/6/2000:

i) All students have to undergo **TCPC training of TWO weeks** immediately **after second semester examination**.

ii) All students have to undergo **TCPC training of TWO weeks** immediately **after THIRD semester examination**.

iii) All students have to undergo **Training of FOUR WEEKS (two weeks TCPC and two weeks Industrial Training)** immediately **after FOURTH semester examination**.

iv) All students have to undergo **Training of FOUR WEEKS (two weeks TCPC and two weeks Industrial Training)** immediately **after FIFTH semester examination.**

v) Evaluation of Phase-III training (imparted after fourth semester) and Phase-IV training (imparted after fifth semester) shall be done together in sixth semester examination.

WORKING GROUP

1. Mr. Jacob Mani - Dy. General Manager, HEG , Mandideep, Bhopal.
2. Prof. P.C. Jain - T.T.T.I., Bhopal
3. Mr. U.K. Jain - HOD Production Engg., S.V. Polytechnic, Bhopal.
4. Mr. Shamim Uddin - HOD Maintenance Engg., S.V.Polytechnic, Bhopal.
5. Mr. S.R. Madan - HOD Mechanical Engg., S.V. Polytechnic, Bhopal.
6. Mr. B.K. Saxena - Sr. Lecturer, S.V. Polytechnic, Bhopal.
7. Mr. R.M. Khan - Sr. Lecturer, S.V. Polytechnic, Bhopal.
8. Mr. S. Saxena - Lecturer, S.V. Polytechnic, Bhopal.
9. Mr. K.C. Verma, Course Co-ordinator, PDU, Bhopal.

RATIONALE

Technological Developments are taking place at a very fast rate. Indian industries are adopting new techniques and technology to compete with the time. The technical institutes whether engineering colleges or Polytechnics have not been able to keep pace with industry and are lagging. Declining competence of technical passouts has seriously forced to change and improve instructional methods and strategies.

To provide real work situation to students it is thought of providing opportunities to 'INDUSTRIAL TRAINING' to students. Regular and well planned " INDUSTRIAL TRAINING " can help students broader their views and appreciate the importance of practical work in their life and will also help in enriching and reinforcing class room learning. The successful implementation of the INDUSTRIAL TRAINING programme is a teamwork and administrative support from its conception to completion stage is pre requisite. it is expected that the necessary facilities such as clarical/ office support and transport facilities will be made available at the institution. level.

The industrial training to be imparted to the Production Engineering students is planned as detailed below:-

Phase-I - after II Semester, of 4 Weeks duration.
Phase-II - after III Semester, of 4 Weeks duration.
Phase-III- after IV Semester, of 6 Weeks duration.
Phase-IV - after V Semester, of 6 Weeks duration.

The contents for the different phases are designed keeping in view of the entry behavior of the students, i.e., the knowledge and skills which has been already imparted in the previous semesters and also the important aspects of some of the areas which students have to undergo in the next Semester.

The last phase of the industrial training is designed with a holistic approach covering almost all aspects of expected knowledge and skills for a technician i.e., technical skills, possible exposure to hi-tech areas and supervisory skills. Due care has also been taken to suffice the need of developing competencies as identified by a group of industrialists and academicians in the workshop held earlier.

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INDUSTRIAL TRAINING

SNo.	CONTENTS	TIME ALLOTTED	REMARKS
1.	**INDUSTRIAL TRAINING PHASE - I (4 WEEKS DURATION)**		
	Training to be imparted at Polytechnic Workshop and to be supported by industrial visits and Metrology at TCPC.		
	(A) Industrial visits related to the following areas. * Foundry * Forging * Fitting * Welding * Casting	- 1 week (including one day for orientation	
	(B) Production Practice at Polytechnic Workshop A product to be produced from its inception to finish stage. - Conceive a product to be manufactured in one of following shops : Foundry, Forging, Fitting shop, Welding, Casting. - Prepare drawing of the product to be manufactured. - Estimation of the raw material required. - Manufacturing of the product.	- 2 weeks (including three days feed back seminar)	* Daily Diary has to be maintained for every industrial visits and observatory type of training.
	(C) Measuring of the product through Metrology measuring instruments.	- 1 week TCPC	

2. INDUSTRIAL TRAINING, PHASE- II (4 WEEKS DURATION)

(A) Exhaustive Practical Training to be imparted in following areas at Polytechnic/Supported by industry visits : - 3 weeks (including one day for orientation)

* Gas Welding
* Arc Welding
* TIG Welding
* MIG Welding

For each of the above welding processes the following distinct steps to be taken :-

* Selection of product to be fabricated
* Preparation of drawing
* Fabrication of product (inclusive of pre and post heat- treatments, if any)
* Finishing operations.

(B) Observation and study of metal cutting machine tools, accessories, jigs and fixtures, measuring instruments, quality control methods, exposure to reading of industrial drawings (blue prints) etc. - 1 Weeks at TCPC

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3. INDUSTRIAL TRAINING, PHASE- III (6 WEEKS DURATION)

(A) Practice under guidance at TCPC encompassing. - 2 Weeks TCPC
The following activities from product inception to final production stage.

(1) Reading of Production Drawing.

(2) Machine Tool operation .
- Setting cutting tools
- Feeding and using cutting tools, cutting fluids.
- Setting cutting speed, (rpm) feed, depth of cut etc.
- Preventive Maintenance.

Observation :

(3) Quality control measures.

(4) Layout.

(5) Marketing/ Sales inventory management.

(6) Production planning procedure.

(7) Manufacturing of a product from raw material to final stage including Quality control.

(B) Training In Industry (ies) Covering the following areas as deemed feasible locally :- - 4 Weeks (including three days for feed back seminar)

* Pneumatic and Hydraulic Controls.
* Steel fabrication.
* Plastics.
* Computer aided Manufacturing.
* Semi-automates and automates.
* etc.

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4. INDUSTRIAL TRAINING, PHASE- IV (6 WEEKS DURATION)

(1) This being final phase of industrial training, a Synthesis approach is to be employed, so as to provide reinforcement to the various facets of the knowledge and Skill imparted at institution. With this concept the training at TCPC/industry should encompass the following areas :- - 6 Weeks (including one day for orientation & three days for feed back seminar)

* TCPC : - 2 weeks

(1) Reading of Production drawing of a component.
(2) Estimation of Material.
(3) Production planning including operation and their sequence selection of machine tools, cutting tool/fluids, jigs, fixtures etc. for production of component.
(4) Estimation of time.
(5) Its material handling means.
(6) Manufacture of components.
(7) Final inspection.

* INDUSTRY : - 4 weeks.

* Organizational structure.
* Materials management.
* Plant layout.
* Material Handling.
* Production Planning procedure.
* Quality Control.
* Inspection.
* Maintenance.
* Human Resource Development.
* Marketing Management.

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GUIDANCE TO THE TEACHERS FOR PLANNING AND IMPLEMENTING THE INDUSTRIAL TRAINING PROGRAMME

The industrial training programme which is spreaded in four phases of 4 to 6 weeks duration each. has to be designed in consultation with local industries keeping in view of the need of the contents for different phases. Following are some of the salient points :

* Spelling out the objectives of the industrial training in behavioral terms to be informed in advance to the students, to the industries and the supervising faculty members.

* Discussing and preparing the students for the training for which meetings with the students have to be planned.

* Meeting of the industrial personally and orienting them regarding the objective of the training and the expectations of the Polytechnic system.

* Correspondence with the industries.

* Orientation classes for the students on how to make the training most beneficial- monitoring daily diary, writing weekly reports, how to interact with various categories of industrial personnel, how to behave to undertake responsibilities, how together information form the industry, some work ethics etc.

* Guiding the students to make individual week wise/ day wise plans to undertake industrial training.

* Developing a system of maintaining training records by teachers for every batch of students for easy retrievability.

* If available, inviting industrial personnel to deliver lectures on some aspects of training.

ACTION PLAN FOR PLANNING STAGES

SNo.	Activity	Commencing Week	Ending Week	Remarks
1.	Meeting with Principal			
2.	Meeting with Colleagues			
3.	Correspondence with industries			
4.	Meeting with industrial personnel			
5.	Orientation of students for industrial training			
6.	Scrutinizing of individual training plans of students			
7.	Commencing of industrial training			
8.	First monitoring of industrial training			
9.	Second monitoring of industrial training			
10.	Finalization of Training report			
11.	Evaluation of performance during industrial training			
12.	Evaluation of total industrial programme.			

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INDUSTRIAL TRAINING

DAILY DIARY

Name of the Trainee : _____ Polytechnic:

Industry : Week No. :

Department/ Section : Date :

Date	Brief of observation made, work done, problems/ project undertaken, discussion held, literature consulted etc.

Signature of Shop Supervisor Signature of Trainee

Signature of Officer incharge of Training

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