CURRICULUM

FOR

ADVANCED DIPLOMA

IN

MECHATRONICS

(FIRST TO EIGHTH SEMESTERS)

CURRICULUM DEVELOPMENT CENTRE
M.P. BOARD OF TECHNICAL EDUCATION,
OFFICE COMPLEX, BLOCK A-1, GAUTAM NAGAR,
BHOPAL-462023.

30/1

CURRICULUM

FOR

ADVANCED DIPLOMA

IN

MECHATRONICS

(FIRST TO EIGHTH SEMESTERS)

CURRICULUM DEVELOPMENT CENTRE

M.P. BOARD OF TECHNICAL EDUCATION

OFFICE COMPLEX, BLOCK A-4, GAUTAM NAGAR,

BHOPAL.-462023.

30/2

MADHYA PRADESH BOARD OF TECHNICAL EDUCATION, BHOPAL

Scheme of Studies and Examination
Advanced Diploma in Mechatronics

FIRST SEMESTER

Sl. No.	COURSE TITLE	HOURS/WEEK		SESSIONAL MARKS		PROGRESSIVE ASSESSMENT		BOARD EXAMINATION		THEORY MARKS	PRACTICAL/VIVA		PRACTICAL MARKS
		TH.	PR.	TERM WORK	LAB. WORK	I	II	PAPER'S	DURATION Hrs.		PRACT.	DURATION Hrs.	
1.	Communication Skills	5	-	15	-	10	10	1	3	100	-	-	-
2.	Mathematics - I	5	-	15	-	10	10	1	3	100	-	-	-
3.	Engineering Physics	5	2	15	25	10	10	1	3	100	1	3	50
4.	Engineering Chemistry	3	2	15	25	10	10	1	3	100	1	3	50
5.	Engineering Drawing	0	8	40	-	10	10	1	4	100	1	3	50
6.	Workshop Practice - I	0	6	-	50	-	-	-	-	-	1	4	50
		18	18	100	100	50	50			500			200

(a) Total Theory Marks = 500

(b) Total (Sessional, Progressive Assessment + Practical) Marks = 500

(c) Ratio of Theory Marks to (Sessional + Progressive Assessment + Practical Marks) = 1 : 1

5

(2)

30/3/3

MADHYA PRADESH BOARD OF TECHNICAL EDUCATION, BHOPAL

Scheme of Studies and Examination
Advanced Diploma in Mechatronics

SECOND SEMESTER

SL. NO.	COURSE TITLE	HOURS/WEEK		SESSIONAL MARKS		PROGRESSIVE ASSESSMENT		BOARD EXAMINATION		THEORY MARKS	PRACTICAL/VIVA		PRACTICAL MARKS
		TH.	PR.	TERM WORK	LAB. WORK	I	II	PAPER	DURATION Hrs.		PRACT.	DURATION Hrs.	
1.	Mathematics - II	5	-	15	-	10	10	1	3	100	-	-	-
2.	Applied Mechanics	3	2	15	25	10	10	1	3	100	1	3	50
3.	General Mechanical Engineering	4	2	15	25	10	10	1	3	100	1	3	50
4.	Basic Electrical Engineering	4	2	15	25	10	10	1	3	100	1	3	50
5.	Basic Electronic Engineering	5	2	15	25	10	10	1	3	100	1	3	50
6.	Workshop Practice - II	1	6	-	75	-	-	-	-	-	1	4	50
		22	14	75	175	50	50			500			250

(a) Total Theory Marks = 500

(b) Total (Sessional + Progressive Assessment + Practical) Marks = 600

(c) Ratio of Theory Marks to (Sessional + Progressive Assessment + Practical Marks) = 1 : 1.2

ADVANCED M.P. BOARD OF TECHNICAL EDUCATION, BHOPAL.

30/4

THIRD SEMESTER DIPLOMA PROGRAMME IN "MECHATRONICS"

REVISED CURRICULUM

(To be introduced from 1996 - 97) SESSION: JULY TO DECEMBER

S.No.	NAME OF SUBJECT	SCHEME OF STUDY. CONTACT HRS PER WEEK (SEMESTER) THEORY	LAB.	TOTAL	SCHEME OF EXAMINATION. SESS. MKS. TERM WORK.	LAB. WORK	PROG. ASSM. I	II	BOARD EXAMINATION. TH. PAPER	DURATION (HRS)	MKS	PRACTICAL	DURATION (HRS)	MKS	REMARK TOTAL
3.1	BASICS OF COMPUTER	4 (64)	2 (32)	6 (96)	15	50	10	10	1	3	100	1	3	50	PRAC.+VIVA 215
3.2	ELECTRICAL & ELECTRONICS MATERIALS	4 (64)	-(-)	4 (64)	15	—	10	10	1	3	100	—	—	—	135
3.3	ELECTRICAL MACHINES	4 (64)	2 (32)	6 (96)	15	30	10	10	1	3	100	1	3	50	PRAC.+VIVA 215
3.4	DIGITAL ELECTRONICS	4 (64)	2 (32)	6 (96)	15	30	10	10	1	3	100	1	3	50	PRAC.+VIVA 215
3.5	MACHINE DRAWING & ELECTRICAL DRAWING	-( )	8 (128)	8 (128)	—	50	10	10	1	4	100	1	3	50	VIVA+SKETCH 220
3.6	ELECTRICAL AND ELECTRONICS WORKSHOP	-(-)	6 (96)	6 (96)	—	50	—	—	—	—	—	1	3	50	PRACT.+VIVA 100
		( )	( )	( )											
8.		( )	( )	( )											
9.		( )	( )	( )											
10.		( )	( )	( )											
	Total :	16 (256)	20 (320)	36 (576)	60	190	50	50	5	—	500	5	—	250	1100

NOTE: (1) No. of theory paper: 05
(2) Total theory marks: 500
(3) No. of practicals : 05
(4) Total Pract. Marks.: 250
(5) Inplant Training Ms : Nil
(6) Total Mks. of sessional, Prog. Assessment, Pract. & Inplant Training. : 600
(60+190+50+50+250 = 600)

(7) Ratio of theory marks 500 :: 600 and (sessional + prog. Assess + Practical + Inplant Training) i.e. 1 : 1.2
Marks.
(60+190+50+50+250 = 600

(8) Total Marks : 1100

(9) Passing marks for -
(a) Theory -35%
(b) Practicals-40%
(c) sessionals-60%
(d) Inplant Training -50%

Note: X common with Basics of computer of IInd sem. Manufacturing Engg. of second semester Advanced Diploma in Industrial Electronics.
+ common with Electrical and Electronics materials of third semester of Advanced Diploma in Industrial Electronics
□ common with Electrical machines of fifth sem. of Diploma in Electronics
Δ common with Digital Electronics of fifth sem. of Diploma in Electronics & Diploma in Industrial Electronics

30/5

MADHYA PRADESH BOARD OF TECHNICAL EDUCATION, BHOPAL.

ADVANCED DIPLOMA PROGRAMME IN MECHATRONICS IV SEMESTER

(To be introduced from January 1997)

S.No.	NAME OF SUBJECT	SCHEME OF STUDY. CONTENT HRS PER WEEK(YEAR)			SCHEME OF EXAMINATION: SESSIONAL MARKS		PROGRASSIVE ASSESMENT		BOARD EXAMINATION						
		THEORY	LAB.	TOTAL	TERM WORK	LAB. WORK	I	II	THEO. PAPER	DURA-TION HRS.	MKS.	PRACT-ICAL	DURA-TION HRS.	MKS.	REMARKS
4.1	Production Technology-I	4 (64)	4(64)	8(128)	15	25	10	10	1	3	100	1	3	50	
4.2	Mechanics of Machines	4 (64)	2(32)	6(96)	15	25	10	10	1	3	100	-	3	50	
4.3*	Microprocessor & Interfacing	4 (64)	3(48)	7(112)	20	20	10	10	1	3	100	1	3	50	Common To CSE 401 (Theory Paper)
4.4	Industrial controls	4(64)	2(32)	6(96)	15	25	10	10	1	3	100		3	50	
4.5 **	Computer Applications	4(64)	5(80)	9(144)	20	20	10	10	1	3	100	1	3	50	Common To CSE 404 (Theory PAPER)
7-															
8-															
9-															
10-		20	16	36	85	115	50	50	05		500			250	

NOTE:- (1) No. of Theory paper: 05

(2) Total theory marks: 500

(3) No. of Practicals : 05

(4) Total Pract.Marks : 250

(5) Inplant Training Mks: Nil

(6) Total Mks.of Sessional+ Prog.Assessment,+Pract. &Inplant Training :550

(7) Ratio of theory marks : 1:1.1 and(Sessional+prog.Assess +Practical +Inplant Traingin Marks)i.e.

(8) Total Marks: 1050

(9) Passing marks for :
(a) Theory-33%
(b) Practicals-40%
(c) sessionals-60%
(d) Inplant Trg-50%

* Theory paper of subject 4.3 Microprocessor and Interfacing is common with CSE 401 (as per MPBCS)

** Theory paper of subject 4.5 computer application is common with CSE 404 (as per MPBCS) ly PC softwares.

30/6

(5)

ANNEXURE-A

Advanced Diploma in Mechatronics

FIFTH SEMESTER

Inplant Training(Duration 16 weeks)

	Component of Assessment	Marks Alloted
A.	In Industry	
	I Attendance and General discipline	25
	II Daily diary Maintenance	25
	III Initiative & Participative attitude	50
	IV. Assessment of Training by Industrial Supervisor	100
B.	In Institution	
	V. Training report	100
	VI Seminar	50
	VII Viva-Voce	50
	Total	400

Sd/-
(B.K.Rawat)

Sd/-
(K.C.Mahajan)

Sd/-
(V.K.Joshi)

MADHYA PRADESH BOARD OF TECHNICAL EDUCATION, BHOPAL

3017

ADVANCED DIPLOMA PROGRAMME IN MECHATRONICS

(To be introduced from 1998-99)

AS PER AIBTE NORMS

TOTAL TIME FOR SEMESTER = 16 WEEKS @ 36 PERIOD PER WEEK
TOTAL HOURS = 576

SCHEME OF STUDIES AND EXAMINATION
VI SEMESTER

S NO	NAME OF SUBJECT	SCHEME OF STUDY			SCHEME OF EXAMINATION										
		CONTENT HRS. PER WEEK (SEMESTER)			SESSIONAL MARKS		PROGRESSIVE ASSIGNMENT		BOARD EXAMINATION						
		THEORY	LAB	TOTAL	TERM WORK	LAB WORK	I	II	THEORY PAPER	DURA - HRS	MKS	PRACTICAL	DURA -HRS	MKS	REMARKS
1	PRODUCTION TECHNOLOGY - II	80	48	128	20	25	10	10	1	3 Hrs	100	1	3 Hrs	50	
2	INSTRUMENTATION	80	48	128	20	25	10	10	1	3 Hrs	100	1	3 Hrs	50	
3	C A D	48	80	128	20	25	10	10	1	3 Hrs	100	-	-	-	
4	BUSINESS COMMUNICATION	64	-	64	20	-	10	10	1	3 Hrs	100	1	3 Hrs	50	
5	C. N. C. - I	80	48	128	20	25	10	10	1	3 Hrs	100	1	3 Hrs	50	
	TOTAL	352	224	576	100	100	50	50	5	-	500	4	-	200	

1. No. of Theory Paper	: 05	7. Ratio of Theory Marks and (Sessional+Prog.Assess+ Practical+Inplant Training Marks) i.	: 500 / 500 1 / 1	9. PASSING MARKS FOR	
2. Total Theory Marks	: 500			(a) Theory	- 33%
3. No. of Practicals	: 04			(b) Practicals	- 40%
4. Total Practical Marks	: 200			(c) Sessionals	- 60%
5. Inplant Training Marks	: -	8. Total Marks	: 1000	(d) Inplant Trg.	- 50%
6. Total Marks of Sessional + Prog. Assessment + Pract. & Inplant Training	: 300				

30/8

ADVANCED DIPLOMA PROGRAMME IN MECHATRONICS

(To be introduced from 1998-99)

AS PER AICTE NORMS

VII Semester

PERIOD PER WEEK

TOTAL TIME FOR SEMESTER = 16 WEEKS @ 36

TOTAL HOURS = 576

SCHEME OF STUDIES AND EXAMINATION

S NO	NAME OF SUBJECT	SCHEME OF STUDY			SCHEME OF EXAMINATION										
		CONTENT HRS. PER WEEK (SEMESTER)			SESSIONAL MARKS		PROGRESSIVE ASSIGNMENT		BOARD EXAMINATION						
		THEORY	LAB.	TOTAL	TERM WORK	LAB. WORK	I	II	THEORY PAPER	DURA - HRS	MKS	PRACTICAL	DURA -HRS	MKS	REMARKS
1.	INDUSTRIAL MANAGEMENT	80	-	80	20	-	10	10	1	3 Hrs.	100	Nil	Nil	Nil	
2.	C. N.C. II	80	48	128	20	25	10	10	1	3 Hrs.	100	1	3 Hrs	50	
3.	MAINTENANCE ENGINEERING	80	48	128	20	25	10	10	1	3 Hrs.	100	1	3 Hrs	50	
4.	COMPUTER INTEGRATED MANUFACTURING	80	48	128	20	25	10	10	1	3 Hrs.	100	1	3 Hrs	50	
5 *	ENTREPRENEURSHIP PROJECT	48	64	112	20	25	10	10	1	3 Hrs.	100	1	3 Hrs	50	
	TOTAL	368	208	576	100	100	50	50	5	-	500	4	-	200	

* Theory Paper ONLY Common with ' Entrepreneurship Project' of VI semester of Production Engg. Course

1. No. of Theory Paper	: 05	7. Ratio of Theory Marks and (Sessional+Prog. Assess+ Practical+Inplant Training Marks) i.e	500 / 500 1 / 1	9. PASSING MARKS FOR (a) Theory - 33%	
2. Total Theory Marks	: 500			(b) Practicals - 40%	
3. No. of Practicals	: 04			(c) Sessionals - 60%	
4. Total Practical Marks	: 200			(d) Inplant Trg. - 50%	
5. Inplant Training Marks	: -	8. Total Marks	1000		
6. Total Marks of Sessional + Prog. Assessment + Pract.	: 300				

3019 (ii)

MADHYA PRADESH BOARD OF TECHNICAL EDUCATION, BHOPAL

Scheme of Evaluation
Advanced Diploma in Mechatronics

VIII SEMESTER

Industrial
~~Inplant~~ Training (Duration 16 Weeks)

	Component of Assessment	Marks Alloted
A.	In Industry	
I.	Attendance and General discipline	25
II.	Daily diary maintenance	25
III.	Initiative & participative attitude during training	50
IV.	Assessment of training by Industrial Supervisor	100
B.	In Institution	
V.	Training report	100
VI.	Seminar	50
VII.	Viva-Voce	50
	Total	400

The purposed scheme, in my opinion is best for students of mechatronics.

(O.P. ...) T.P.O. Poly. Bpl

(P. ...)

श्री आर.के. ... सदस्य पा. स. से कोन पर ... किया, वे भी ... सहमत हैं।

CURRICULUM

30/10

ADVANCED DIPLOMA

IN

MECHATRONICS

(FIRST AND SECOND SEMESTER)

CURRICULUM DEVELOPMENT CENTRE

TECHNICAL TEACHERS' TRAINING INSTITUTE,
SHAMLA HILLS, BHOPAL-462 002

ADVANCED DIPLOMA

IN

MECHATRONICS

FIRST SEMESTER

ADVANCED DIPLOMA IN MECHATRONICS

30/12

I Semester

S. No.	Course Title	Theory	Practica
1.	Communication skills	5	0
2.	Maths - I.	5	0
3.	Engineering Physics	5	2
4.	Engineering Chemistry	3	2
5.	Engineering Drawing	0	8
6.	Workshop practice (Mech.) - I	0	6
		18	18

(12)

30/13

FIRST YEAR DIPLOMA IN CIVIL ENGG./MECH.ENGG/ELECT.ENGG./ CHEMICAL ENGG./METALLURGY/REFRIGERATION & AIR CONDITIONING/ REFINERY & PETRO CHEMICALS/COMPUTER SCIENCE/AUTOMOBILE ENGG./ ELECTRONICS & TELE COMMUNICATION

* * *

SUBJECT - COMMUNICATION SKILLS-I/COMMUNICATION SKILL for Mechotronics

(To be implemented from Academic Session - 1995-96)

1) Salient features of the new curriculum.

Teaching of English is based on text book approach The book which is being prepared now, makes almost a total departure from the previous book. 10 new topics have been written. Some of the topics that the book includes are 'Entrepreneurship', 'Environment', 'Safety' and 'Non-Conventional sources of Energy', In addition to the above, one part of the book includes 5 short stories from the international and Indian writers of fame.

While the approach to teaching of applied grammer can not be changed, altogether new exercises have been framed, particular emphasis has been laid in preparation of topics like the 'Auxiliaries' and 'Conditionals'.

(2)
RATIONALE

(2) English occupies an important place in our curriculum. Besides functioning as one of the important library languages in India, it acts as a window to technical and scientfic knowledge. After obtaining their diploma as and while in job they have to communicate with personnel belonging to different hierarchy. Therefore, acquiring proficiency in the language for effective communication is absolutely essential. Exphasis is being laid on the development of communication skills among the students.

30/15 (14)

SKILLS TO BE DEVELOPED (5)

(A) WRITING : -

(a) Understand & use the vocabulary items of general use besides words from the register of physical and social sciences.

(b) Given a passage use substitues for identified words and expressions in an appropriate manner.

(c) Ensure that the intended communication through a written passage occurs in practice.

(d) Express ideas contained in the prescribed units.

(e) Write both guided and free compositions based on the prescribed text.

(f) Construct grammatically correct sentences in English.

(g) Express ideas contained in passages outside the text.

(h) Write paragraphs on topics of general interest like - Day to day happenings; Match that you have seen; Scene in a railway compartment ; Picnic; Your parents etc.

Paragraphs should be of descriptive nature avoiding those on abstract topics/ proverbs.

(B) READING :

(a) Develop the ability to read silently as well as aloud.

(b) Involve students in reading paragraphs from the prescribed text.

(c) Recognize main ideas, supporting details, sequence of events and causal relationship.

(d) Develop competence and habit of using dictionaries and other reference books.

(C) LISTENING :

(a) Ability to follow spoken instructions.

(b) Develop competence in taking notes while listening.

(c) Ability to listen to news bulletins - Radio Doordarshan, B.B.C.

30116 (15)

(D) SPEAKING :

(4)

(a) Develop the ability of speaking in the class.

(b) Develop the ability to ask pertinent questions as well as to answer them.

(c) Develop the ability to assert one's point of view.

(d) Develop the ability to use conversational skills in situations like ; (i) Introductions/Greetings.
(ii) Seeking/giving information.
(iii) Discussing weather.
(iv) Asking about arrivals/departure of trains.
(v) Making enquiries about health.
(vi) Making enquiries about market places/ banks/ any other public places.
(vii) In order to develop the above, the following components of spoken English may be included.

- Short answer; additions to remarks; agreement/disagreement with remarks; question tags; simple pr/pr.perfect; question words; phrasal verbs.

(4) SCHEME OF STUDIES & EXAMINATION.

S.No.	Topics.	Lecturer Hrs.
1.	Section A	
	The Text.	
	Part-I - Passages for comprehension.	27
	Part-II- Short Stories.	15
	Part-III-Applied Grammer.	22
2.	Section B .	
	(a) Paragraph writing on topics of general Interest.	10
	(b) Unseen passage.	10
	Total:-	84

NOTE:- For spoken English integrated approach may be adopted.

SECTION - A

COURSE CONTENTS.

PART - I

PASSAGES FOR COMPREHENSION.

1. Language of science.
2. My Thousandth Goal.
3. Rip Van winkle Comes to Tour.
4. Robotic Revolution.
5. Nondestructive Testing.
6. Designing a car.
7. The wonders of camera.
8. Desalination or Desalting process.
9. Non conventional sources of Energy.*
10. Our Environment. *
11. Entrepreneurship. *
12. Safety.X *

* Units against which asterisk marks have been made may be taught to students of IInd year Diploma in Engineering.

PART - II

2. SHORT STORIES.

(1) Selfish Giant - Oscar Wilde.
(2) A letter to God - Gregario Lopex Y. Fuentes.
(3) An Astrologer's Day - R.K.Narayan.
(4) The Last Leaf - O' Henry.
(5) The Malefactor - Anton Chekov.

PART - III

APPLIED GRAMMAR.

(1) Determiners.
(2) Auxiliaries.
(3) Tenses.
(4) Conditionals.
(5) Passive.
(6) Infinitives.
(7) Modifiers.

(8) Prepositions.
(9) Subject - Verb Agreement.
(10) Clauses & connectors.

SECTION - B

Besides the topics included in the text book, the course includes paragraph writing on topics of general interest and unseen passages.

(6) SCHEME OF ASSESSMENT.

S.No.	Topic/Sub-Topics.	Distribution of marks.
1.	Paragraph Writing on topics of general interest.	10
2.	Unseen Passages.	08
3.	The Text.	
A.	Passages.	
	(a) One - word.	08
	(b) Fill in the blanks with appropriate forms of listed words.	04
	(c) Single sentence answers.	12
	(d) Answers in 5-6 lines.	08
	(e) Essay type/Guided Comp.	10
B.	Short Stories.	
	(a) Answers in 5-6 lines.	06
	(b) Composition type.	09
C.	Applied Grammar.	25
	Total :-	100 Marks.

(7)

For achieving the aforesaid objectives the textbook titled"Communication skills for Technical Students Book-I"is being prepared for the Ist year of M.P., Maharastra, Gujrat & Goa, may be prescribed. This shall be published by M/s Somaiya Publications, Pvt.Ltd., Marathi Granth Sangrahalaya Marg, Dadar, Bombay which is based on the revised curriculum. This book is likely to come out in July/August,1995.Besides this, the following reference books. may be used :-

I. Living English structure - Allen.
II. Practical English Grammar (Exercises I by Thomson & Martinet.
III. English Conversation Practice by Grant Taylor.

(8) RECOMMENDATIONS FOR AWARDING SESSIONAL MARKS.

In order to make the implementation of spoken English meaningful, the sessional marks of Comm.Skill be awarded as follows:-

Term Work	- 10 Marks.
Testing of Spoken Skills.	- 10 Marks.

Advanced Diploma in Mechatronics

First Semester

MATHEMATICS - I

Theory per week: 5 Hrs. Practical per week:

Topic No.	Title	Theory Hrs.
1.	Algebra	32
2.	Trigonometry	24
3.	Vector Algebra	14
4.	Statistics	10
	Total	80

Advanced Diploma in Mechatronics

First Semester 30/21

MATHEMATICS - I

Theory per week: 5 Hrs. Practical per week: Nil

COURSE CONTENTS

1. Algebra

Quadratic Equation - General solution, nature of roots, relation between the roots & coefficients of the equation, formation of an equation from given roots.

Indices

Logarithms

Sequences & series - Arithmetic and Geometric progressions.

Permutations & Combinations - Factorial notation, symbols nPr, nCr, Simple problems.

Binomial theorems - Statement of theorem to any index, General term middle term/terms, greatest term.

Determinants
Partial Fractions

2. Trigonometry

System of measurement of angles, trigonometric ratios & identities, T.R. of standard angles & angle of any magnitude, use of T.tables, graphs of T.functions, inverse T.functions, solution of T.equations, T . ratios of compound angles, multiple & submultiple angle, C-D formula, A-B formula, properties of triangle & solution of triangle, height and distance.

3. Vector Algebra

Vectors & scalors, i, j, k. vectors.
Addition of vectors, multiplication by a scalor, dot product, cross product, cross product with geometrical and physical applications.

4. Statistics

Definition of Descriptive statistics,scales, frequency distribution, measures of central tendency, mean, mode, measures of dispersion, variance, standard deviation, concept of normal distribution.

30/22

(2-1)

REFERENCES

1. Mathematics for polytechnics - Vol I & II; T.T.T.I.,
2. Plane tigonometry - Part I & II by S.L.Loney
3. Algebra by K.P.Basu
4. Mathematical Statistics by M.Ray & Sharma
5. Mathematics for polytechnics by S.P.Deshpande
6. Vector Algebra by Shanti Narain
7. Higher Engineering Mathematics by G.S.Grewal

30/23

22

Advanced Diploma in Mechatronics

First Semester

ENGINEERING PHYSICS

Theory per week : 5 Hrs. Practical per week : 2 Hrs.

Topic No.	Title	Theory Hrs.	Practical Hrs.
1.	S.I.Units	4	6
2.	General properties of matter	15	6
3.	Heat Transfer	10	3
4.	Thermodynamics	10	0
5.	Electricity	10	6
6.	Cells, batteries and their maintenance	6	3
7.	Electromagnetism	10	6
8.	Basic Electronics	10	2
9.	Optics	5	-
	Total	80	32

30/24

(2)

Advanced Diploma in Mechatronics

First Semester

ENGINEERING PHYSICS

Theory per week : 5 Hrs. Practical per we

COURSE CONTENTS

1. S.I.Units

Significance of S.I. Units, Fundamental Units, S
Derived units in terms of base units and notation

2. General Properties of Matter

* Molecular kinetic theory of matter, Ki
potential energy of molecules, concept of
energy and heat energy, gas laws and their e
by kinetic theory.

* Cohesive and adhesive forces, surface tensio
energy, rise in capillary tube.

* Fluid viscosity, streamline and turbulen
Stroke's law, kinematic viscosity, Coeff
viscosity by Poiseulle's method.

* Elasticity, Hook's law, elastic limit, Young's
Bulk modulus.

3. Heat Transfer

Distinction between heat and temperature, modes
transfer, variable and steady state coefficient o
conductivity for good and bad conductors, co
natural and forced heat transfer during heat
radiation, emissive and absorptive power, bl
radiation, Stefan Boltzman law, Newton's law of co

4. Thermodynamics

First law of thermodynamics, second law of therm
thermodynamic process-reversible and irreversible
carnot cycle.

5. Electricity

Electric current, free electron, theory of
conduction, current voltage relation, work and
electrical circuits.

30/25

(24)

6. **Cells, Batteries and their Maintenance**

Comparative study of the chart specifying the primary and secondary cells electrodes, electrolyte, depolariser, principle of potentiometer, EMF, internal resistance of different types of cells. Maintenance of primary and secondary cells (when in use or when they are stored).

7. **Electro Magnetism**

* Magnetic induction, magnetic induction of a current element, straight conductor, circular coil, magnetic flux.

* Motion of a charged particle in a magnetic field, current carrying conductor in a magnetic field, moving coil galvanometer, conversion of galvanometer into ammeter and voltmeter.

* Magnetic properties of materials, permeability, susceptibility.,

* Elementary idea of transformer.

. **Basic Electronics**

* Thermoionic emission, photoelectric emission, photocell, photovoltaic cells.

* Semiconductors, intrinsic and extrinsic semiconductor, P-type, N-type, P-N junction as a rectifier.

Optics

Dual nature of light, wave theory, Huygen's principle, concept of wave front, wave as rap, principle of superim-position, interference of light, conditions of interference, speed of light in different media, optical density, refractive index, diffraction of light.

30126

(25)

LIST OF EXPERIMENTS

1. Precise measurement of length by
   (a) Vernier calliper
   (b) Micrometer Screw
   (c) Screw gauge

2. To determine surface tension of liquid by capillary r method.

3. To determine coefficient of viscosity of liquid Poiseulle's method.

4. To determine coefficient of thermal conductivity of a gc conductor (Searle's method)

5. To determine Young's modulus.

6. To verify Ohm's law.

7. To measure resistance by ammeter and voltmeter a verification of series and parallel combination resistance.

8. To convert a galvanometer into a voltmeter of a give range.

9. To convert a galvanometer into an ammeter of a given range

10. To investigate the relation between current flowing through the resistance and heat generated.

11. To observe the variation of magnetic field by varying the current in coil.

12. To determine the internal resistance of cell by potentiometer.

13. To investigate the uni-directional property of p-j junctions.

(26) 30/27

REFERENCES :

1. Principles of Physics - TTTI, Bhopal
2. Principles of Physics - Brijlal and Subramanian
3. Modern college Physics - H.E.White
4. College Physics - Sears and Zee Manskey
5. A level physics - Roger Mumcaster

39/28

Advanced Diploma in Mechatronics

First Semester

ENGINEERING CHEMISTRY

Theory per week : 3 Hrs. Practical per week

Topic No.	Title	Theory Hrs.	Prac Hr
1.	Metals and Alloys	6	14
2.	Fuels and Combustion	5	2
3.	Lubrication and Lubricants	6	2
4.	Bonding	4	-
5.	Catalysis	2	-
6.	Corrosion and protection	6	4
7.	Protective coating	4	-
8.	Dielectrics	3	-
9.	Pollution - Water, Air and Industrial	6	8
10.	Oxidation and Reduction	5	4
11.	Industrial detergents	1	-
	Total	48	32

Advance Diploma in Mechatronics

First Semester

30/29

ENGINEERING CHEMISTRY

Theory per week: 3 Hrs. Practical per week: 2 Hrs.

COURSE CONTENTS

Metals and Alloys

General properties of metals, some important ferrous and non-ferrous alloys and their properties, Chemical analysis of metals and alloys.

Fuels & Combustion

Classifications of fuels, Calorific value, properties and applications of different fuels, Handling & storage of Fuel, Fire - protection.

Lubrication & Lubricants

Friction and wear, Lubricants, Mechanism, Classification and properties of Lubricants, Selection of Lubricants. Systems of lubrication, gravity forced, static and hydrodynamic, addition of agents for motor oil.

Bonding

Nature of Chemical Bond, Ionic and Covalent bonding, Physical bonding.

Catalysis

Types, characteristics of catalytic reactions, Autocatalysts.

Corrosion & Protection

Corrosion, types of corrosion, factors affecting corrosion, Protection against corrosion.

Protective Coatings

Introduction, cleaning and preparation of metal surfaces, types of coatings - metallic coatings and metal cladding, chemical conversion coatings, paints, varnishes, enaemels, laquers, ceramic protective coatings, sealents.

30130

(24)

8. **Dielectrics**

Introduction, Dielectric properties, classification of dielectrics, Gaseous Insulators, Liquid insulating materials, Solid insulating materials.

9. **Pollution**

Water Pollution - BOD, MPN, Purification of Water.

Air pollution - Major air pollutants, Air pollution and measures for its control.

Industrial pollution - Industrial wastes (effluents, garbage fumes etc.), measures for its control.

10. **Oxidation & Reduction**

Oxidation and Reduction, Electronic concept of oxidation and reduction, Oxidation number and Valency, Acid, Base, pH, determination of pH.

11. **Industrial Detergents**

Brief idea about industrial detergents.

10.

11.

12.

LIST OF EXPERIMENTS

30/31

. To measure the pH of different solutions by -

(a) pH meter
(b) colorimetric method

. To determine the percentage of copper in a sample of Brass by volumetric method.

. To determine the percentage of Iron in Ferrous Salt.

. Quantitative estimation of two metals in an alloy (Solder/Brass).

. To find out the flash point, fire point of dry/non-drying oils.

. To determine the viscosity of lubricants by viscometer.

. To determine the rate of corrosion on simple and galvanised nail by nail and acid method.

. To analyse the Cations and Anions in a given salt by macro analysis.

. To determine total dissolved solids (TDS)

0. To determine dissolved oxygen (DO)

1. To determine most probable number (MPN)

2. To identify the concentration of NH_3, CO_2, and SO_2.

30/32

(31)

REFERENCES

1. Advance Inorganic Chemistry by Behl & Tuli

2. Advance Inorganic Chemistry by Mitra

3. Applied Chemistry by Shrivastava & Singhal; PBS Publication, Bhopal

4. Objective Chemistry by Shrivastava & Shrivastava; Chandra Publication, Bhopal

5. Engineering Chemistry by P.C.Jain & Monica Jain; Dhanpat Rai & Sons Publication

6. Experiments in Applied Chemistry by M.Prasad; Chandra Publication, Bhopal

7. A text book of Engineering Chemistry by P.C.Jain

30/33

(32)

Advanced Diploma in Mechatronics

First Semester

ENGINEERING DRAWING

Theory per week - NIL Practical per week - 8 Hrs.

Topic No.	Title	Theory Hrs.	Practical Hrs.
1.	Introduction to drawing & drawing instruments	-	2
2.	Engineering Scales, Lines and Curves	-	12
3.	Lettering and Dimensions	-	8
4.	Projections of points, lines and planes	-	18
5.	Orthographic projections	-	16
6.	Projection of solids and section of solids.	-	18
7.	Projection of machine components by free hand sketching	-	18
8.	Development of surfaces	-	10
9.	Isometric Projections	-	12
10.	Standard convensions & symbols	-	4
11.	Element of Machine Drawing	-	10
	Total	-	128

30134

33

Advanced Diploma in Mechatronics

First Semester

ENGINEERING DRAWING

Theory per week - NIL. Practical per week - 8 Hrs.

COURSE CONTENTS

1. Introduction to Drawing and Drawing Instruments

Define engineering drawing, Display and explain the use of various drawing instruments.

2. Engineering Scales, Lines and Curves

Calculation of representative fraction and length of scale, construction of plain scale, diagonal and vernier scale, alphabets of lines - thick, medium, and thin lines. Conventional representation of centre line, full line, hidden line, cutting line, section line, dimension line, extension line etc., practice on sketch book. Engineering curves, method of construction of curves like ellipse, parabola, hyperbola cycloid, involute, helix, and spiral of archemedian. Uses of these curves.

3. Lettering and Dimensioning

Single stroke letters, gothicletters. Principles of dimensioning systems - Aligned and unidirectional. Arrangement of dimensions - chain, parallel and combined. Size and location dimensioning - superfluous dimensions. (IS 696 - 1972), Arrow heads & Extension lines, Practice problems on dimensioning techniques, Rules for dimensioning the isometric drawings.

4. Projection of Points lines and Planes

Introducion, elements of projections. Projection of points in different planes. Projection of line - True length. Projection of planes, practice problems.

5. Orthographic Projections

Meaning of orthographic projection, Planes of projections, Terms associated with orthographic projections front, side and top view. Differentiate between first angle and third angle projections on the basis of -

(a) Position of the object corresponding to the reference plane.
(b) Position of prjection plane in relation to that of observer's eye and that of object.

(c) Relative position of front view and top view.
(d) Relative position of side view.

6. **Projection of solids and section of solids**

Types of solids-terminology; position of solids with respect to reference planes. Practice problem to draw the projection of solids placed in various position with respect to the reference planes, (Cone, Cylinder, Cube, Prism & Pyramid), Define sectioning, need of sectioning, differentiate between full section, half section and Partial section. Simple problems.

7. **Projection of simple machine components by free hand sketching**

Techniques of free hand sketching, free hand sketching of simple machine components such as bearing cap, simple journal bearing, simple brackets, orthographic views of Hexagonal and square nut and bolts, simple practice problems.

8. **Development of surface**

Concept and importance of development in engineering applications. Development of cube, prism, pyramid, cylinder and cone. Practical problems of development of chimney, ducts and hoppers etc.

9. **Isometric Projections**

Need and use of isometric scale. procedure for preparing isometric drawing of rectangular, pentagonal and hexagonal blocks and sphere.

10. **Standard Conventions and Symbols**

Sign conventions and symbols used in CME engineering as per IS code 696-1972. Symbols of building material such as Brick work, stones, concrete, wood, glass and foundation Bolts. Conventional representation of features like, external and internal threads; compression, tension and leaf springs, knurling, bearings and gears.
Elementary electrical symbols like DC, AC, bulb fuse, earthing, plug, resistance, capacitance, inductance, bell, buzzer, loudspeaker.

11. **Elements of Machine Drawing**

Rivets and Riveted joints, forms of screw threads, conventional representation of pipe joints and valves.

30136

35

REFERENCES

1. IS Code 696-1972
2. Elementary engineering drawing by N.D.Bhatt; Charotar Book Stall, Anand
3. Engineering Drawing by Gujaral and Shende; Khanna Publishers
4. Machine Drawing by N.D.Bhatt; Charotar Book Stall, Anand
5. Engineering Drawing by R.B.Gupta; Satya Prakashan, New Delhi
6. Graphics for engineers by W.J.Luzzadar; Prentice Hall India Ltd., New Delhi
7. Fundamentals of engineering drawing by W.J.Luzzadar; Prentice Hall India Ltd., New Delhi

Advanced Diploma in Mechatronics

First Semester

30/137

WORKSHOP PRACTICE - I

Theory per week - Nil Practical per week - 6 Hrs.

Topic No.	Title	Theory Hrs.	Practical Hrs.
1.	Introduction to Workshop	-	2
2.	Carpentry shop	-	22
3.	Fitting Shop	-	24
4.	Sheet metal shop	-	24
5.	Smithy Shop and forging	-	24
	Total	-	96

NOTE: Theoretical inputs will be provided on shop floor during workshop practice.

30/38

37

Advanced Diploma in Mechatronics

First Semester

WORKSHOP PRACTICE - I

Theory per week - Nil Practical per week - 6

COURSE CONTENTS

1. **Introduction to Workshop**

   Familiarisation of different sections of a gene engineering workshop. Safety precautions and g housekeeping in the workshop. Layout of different secti of workshop, general safety rules of workshop.

2. **Carpentry shop**

   General layout of carpentry shop, Types of job produced carpentry, Basic information required by carpenter. materials, carpentry hand tools like saws, planer, chise hammers, pallet, marking gauge, vice, try squa engineering rule etc., use of carpentry tools for mak simple joint.

3. **Fitting shop**

   Introduction of tools and equipments used in fitting sho files, vice, chisels, punch, scriber, hammers, try squa callipers, surface plate etc.
   Fitting processes - filing, chipping, scraping, sawing et Preparation of Male-Female joints.

4. **Sheet-Metal shop**

   Metals used in sheet metal work - Black Iron, Galvanis Iron, Stainless steel, Copper, Aluminium, Tinned plate. Tools - stakes, hammers, scissors etc., sheet me processes - folding, hemming.

5. **Black-smithy and forging**

   Layout of shop, types of jobs produced in black-smithy a forging shop, Basic information required for jobs to made in these shops, Forging operations, furnan operations and type of heating systems used in forgi shop.

LIST OF EXERCISES

1. Study and sketch of various tools used in different shops such as - carpentry, fitting, sheet metal and smithy shop.
2. One job in carpentry shop with the use of different carpentry tools.
3. One job on different types of carpentry joints.
4. One job on fitting joints containing different operations such as hacksaw cutting, filling, slotting, fitting, drilling etc.
5. Filing and fitting of mating parts, checking gap with gauge.
6. One job on forging operations such as bending, upsetting, drawing down, and setting down etc.
7. One job on sheet metal work containing surface development of jobs and marking joints.
8. Filing to make a perfect square, marking and centre - punching.
9. Chipping and bending a copper sheet to make a cylinder.
10. Filing a L-channel sawing straight and slant slots on it.
11. Filing, marking number and letter - punching on a M.S. sheet in different ways.
12. Filing and forming a radius by flat hitting on a sheet metal.
13. Making boxes and cases for various equipments and other sheetmetal works.

---

* These experiences could be industry based to achieve the required performance skill.

REFERENCES

1. Workshop tech. Vol. I & II by Hazra Choudhary
2. Workshop Technology Vol. I & II by Chapman
3. Workshop Technology Vol. I & II by Gupta and Kaushik
4. Manufacturing Processes by Young

30/91

(40)

ADVANCED DIPLOMA

IN

MECHATRONICS

SECOND SEMESTER

30/42

(41)

ADVANCED DIPLOMA IN MECHATRONICS

II Semester

S. No.	Course Title	Theory	Practical	Total
1.	Maths II.	5	0	5
2.	Applied Mechanics	3	2	5
3.	General Mechanical Engg.	4	2	6
4.	Basic Electrical Engg.	4	2	6
5.	Basic Electronic Engg.	5	2	7
6.	Workshop Practice (Mech.) - II	1	6	7
		22	14	36

30/43

(42)

Advanced Diploma in Mechatronics

Second Semester

MATHEMATICS - II

Theory per week: 5 Hrs. Practical per week: Nil

Topic No.	Title	Theory Hrs.	Practical Hrs.
1.	Coordinate Geometry	24	-
2.	Complex Variables	12	-
3.	Differential calculus	22	-
4.	Integral Calculus	22	-
	Total	80	-

Advanced Diploma in Mechatronics

Second Semester 30/44

MATHEMATICS - II

Theory per week: 5 Hrs. Practical per week: Nil

COURSE CONTENTS

1. **Coordinate Geometry**

Cartesian & polar coordinates, point, locus.

Straight line - Equation of a straight line, Angle between two straight lines, Conditions for perpendicular & parallel lines, Length of perpendicular, Bisector of an angle between two straight lines.

Circle - Equation of a circle, Equations of tangent, normal & chord

Parabola - Equation of a parabola, its tangent & normal.

Ellipse - Equation of an ellipse, its tangent & normal.

2. **Complex Variables**

Complex Numbers : Basic defintion, operation and geometric representation of complex number, complex number as vector, complex conjugates, absolute values, polar forms, product powers.
Definition of Function of Complex Variable : Definition and Quotients.

3. **Differential Calculus**

Functions and limits, differentiation of all types of functions, partial differentiation, higher derivatives (upto second order).

4. **Integral Calculus**

Integration as reverse process of differentiation, standard formula, integration by substitution, integration by parts, integration by partial fractions, definite integral.

30145

REFERENCES

Mathematics for polytechnics - Vol. I & Vol.II; TTTI,Bhopal

Coordinate Geometry by S.L.Loney

Text book on Differential Calculus by Gorakh Prasad

Text book on Integral Calculus by Gorakh Prasad

Higher Engineering Mathematics by G.S.Grewal

Complex Variables and applications by Churchill Ago

30/46

(45)

Advanced Diploma in Mechatronics

Second Semester

APPLIED MECHANICS

Theory per week : 3 Hrs. Practical per week : 2 Hrs.

Topic No.	Title	Theory Hrs.	Practical Hrs.
1.	Introduction	2	-
2.	Forces	6	6
3.	Moment and Couple	5	2
4.	Motion	4	3
5.	Friction	7	4
6.	Simple machines	7	4
7.	Centre of gravity and Moment of Inertia	5	3
8.	Work, Power and Energy	5	4
9.	Stresses in frames	7	6
	Total	48	32

30/42

(4B)

Advanced Diploma in Mechatronics

Second Semester

APPLIED MECHANICS

y per week : 3 Hrs. Practical per week : 2 Hrs.

E CONTENTS

Introduction

Definition of Statics, Dynamics, Mechanics, Kinematics, scalar and vector quantities, units of measurement.

Forces

Definition, measurement of force, effect of a force, representation of force by vector , resultant force, composition of forces, Bow's notation, methods of finding resultant of coplaner forces by analytical and graphical methods simple laws of triangular and polygon forces, Lami's theorem.

Moment and couple

Definition, types, laws, effects, principle of moments and their application, levers and their types, reaction and fulcrum, couple and torque and their applications.

Motion

Definition of speed, velocity, acceleration, angular velocity angular acceleration and relative velocity, Newton's laws of motion, simple harmonic motion (SHM), periodic motion, phase and phase-difference, relation between SHM & circular motion, applications.

Simple Machines

Definition of Mechanical Advantage, Velocity Ratio, efficiency of machine, laws of machine, simple screw jack, wheel and axle, rope and pulley, Different types of lifting devices, simple numerical problems.

Friction

30/48
(47)

7. **Centre of Gravity and Moment of Inertia**

Definition, difference between centre of gravity & centroid, method of finding out centre of gravity of simple geometrical plane figures such as I, T & L sections. Definition of moment of inertia (M.I.), method of finding out M.I. of various geometrical shapes, M.I. of disc and rod etc.

8. **Work, Power and Energy**

Definition of work, unit, graphical representation of work, calculation of work done, pulling bodies on rough inclined plane. Definition of Power, types of engine power, mean effective pressure, mechanical efficiency, cylinder volume & power, measurement of BHP and types of dynamometer. Definition of energy, types of mechanical energy, laws of conservation of energy.

9. **Stresses in frames**

Definition of frame, perfect, deficient and redundant frames, assumptions made in finding stresses, method of joint, method of section and graphical method.

30/49

(48)

LIST OF EXPERIMENTS

1. Verification of law of triangle of forces.
2. Verification of law of parallelogram of forces.
3. Verification of law of polygon of forces.
4. Verification of the principle of moments.
5. Determination of coefficient of friction for surfaces of different materials on
   (i) Horizontal plane
   (ii) Inclined plane
6. Verification of Lami's Theorem by Jib-cranel method .
7. To find the V.R., M.A. and efficiency of the following:
   (i) Simple screw jack
   (ii) Differential pulley block
   (iii) Differential wheel and axle
   (iv) Simple and Double purchase creb
8. Determination of law of machine for a given device.
9. To study SHM with the help of a simple pendulum and investigate the effect of length, mass of bob and amplitude on time period.

30/50

REFERENCES

1. A text book of applied mechanics by R.S.Khurmi; S.Chand & Co., New Delhi
2. A text book of applied mechanics by I.B.Prasad; Khanna Publishers, Delhi
3. Engineering mechanics by Timoshenko & Young; McGraw Hills Book Co
4. Applied mechanics by Ramamurtham; Dhanpat Rai & Sons, Delhi
5. Applied mechanics by D.A.low
6. Engineering mechanics by Irving H. Shames; Publication Prentice Hall of India
7. Applied Mechanics by Sadhu Singh
8. Applied Mechanics by J.B.Gupta

Advanced Diploma in Mechatronics

Second Semester

GENERAL MECHANICAL ENGINEERING

Theory per week: 4 Hrs. Practical per week: 2 Hrs.

Topic No	Title	Theory Hrs.	Practical Hrs.
1.	Energy conservation	4	-
2.	Fluid measurements	4	8
3.	Properties of steam	6	-
4.	Steam generators	4	8
5.	Internal Combustion Engine	8	4
6.	Pumps	6	4
7.	Turbines	6	4
8.	Heat Exchanger and Cooling Towers	8	-
9.	Compressor, blower and fans	8	-
10.	Refrigeration and Air-Conditioning	10	4
	Total	64	32

Advanced Diploma in Mechatronics

Second Semester

GENERAL MECHANICAL ENGINEERING

Theory per week : 4Hrs. Practical per week : 2 Hrs.

COURSE CONTENTS

1. **Energy Conservation**

Introduction, Relation of mass and energy, Types of energy, Potential and kinetic energy, Internal energy, Definition of system, Law of conservation of energy.

2. **Fluid measurement**

Fluid, its definition, Properties, Types of fluid flow Stability of floating and submerged bodies, Manometers, Venturimeters, Orifice plate, Pitot tube.

3. **Properties of Steam**

Introduction, generation of steam, uses of steam, standard and dry steam, Wet and superheated steam, Properties of steam, Quality of steam, Use of steam tables.

4. **Steam Generators**

Function of generator, Classification, Description and working of Cochran, Lancashire, Babcock and Wilcox boilers, mounting and accessories, Drought- Natural and Artificial, Application of Boilers.

5. **Internal Combustion Engine**

Introduction, Classification, Components of I.C. engine, working of petrol and diesel engines (Four stroke and two stroke), Advantages and Disadvantages.

6. **Pumps**

Introduction, Types of pumps, Working of centrifugal and reciprocating pumps, Work done by a pump, comparison of centrifugal and reciprocating pumps, Discharge of a pump, Applications, Specifications.

7. **Turbines**

Concept, classification and main components of water, steam and gas turbines, comparision between water and steam turbines and field of applications.

30/53

(52)

8. **Heat Exchanger and Cooling Towers**

Introduction, LMTD, Parallel and Counter flowheat exchangers, Condenser, cooling towers-Natural and Artificial circulation type, Applications and specifications of heat exchangers and cooling towers.

9. **Compressors, blowers and fans**

Introduction, Classification, Working principle of rotary and reciprocrating compressors, Advantages and disadvantages of each type, Specifications. Fans- types, applications and specifications.

10. **Refrigeration and Air-conditioning**

Refrigeration effect, Unit of refrigeration, types of refrigeration system, Air-refrigeration, Vapour compression refrigeration, Schematic diagram and working of vapour compression refrigeration system, Commonly used refrigerants and their codification. Psychometric properties of air, Air-conditioning - Basic concepts, Applications.

LIST OF EXPERIMENTS

1. Pressure measurements through manometer.

2. Measurement of discharge through orifice.

*3. Study by models, charts and actual units of the following:

   (a) Common types of fire-tube and water tube boilers
   (b) Boiler mountings and accessories
   (c) Simple Steam engine
   (d) Steam Turbine
   (e) Surface Condenser
   (f) Cooling tower

4. To apply Bernoull's equation to flow of water in a given flow situation.

5. To study and use the following for flow measurement

   (a) Venturimeters
   (b) Orifice plate
   (c) Pitot tube

*6. To study different types water turbine.

*7. To study the puls operate Centrifugal pump.

*8. To study Four Stroke and Two Stroke

   (a) Petrol engine
   (b) Diesel engine

*9. To study different types of A/C plant used in Industry.

---

* These experiences could be industry based to achieve the required performance skill.

30/55

(54)

REFERENCES

1. General Mechanical Engineering by Hazra Choudhary
2. Thermal Engineering by P.L. Ballaney; Khanna Publishers
3. Thermodynamics and heat Engine by S. Domkundwar; Dhanpat Rai and Sons
4. Fluid Mechanics and Hydraulic Machines by K.D. Saxena; J.K Jain and Co
5. Hydraulic and Hydraulic machines by Jagdish lal; Sahu and Co
6. Heat Engine and Thermodynamics by pandya and Shah; Charotar Book stall
7. Mechanical Engineering by Mathur & Mehta; Jain publisher

55

30/56

55

Advanced Diploma in Mechatronics

Second Semester

BASIC ELECTRICAL ENGINEERING

Theory per week : 4 Hrs. Practical per week : 2 Hrs.

Topic No.	Title	Theory Hrs.	Practical Hrs.
1.	D.C. Circuits	6	4
2.	D.C.Potentiometer & Wheat-Stone bridge	4	4
3.	Magnetic Circuits	10	2
4.	Electromagnetic Induction	9	4
5.	Electrostatics	8	2
6.	A.C. fundamentals	13	4
7.	Polyphase circuits	4	4
8.	Measuring instruments	10	8
	Total	64	32

Advanced Diploma in Mechatronics

Second Semester

BASIC ELECTRICAL ENGINEERING

Theory per week - 4 Hrs. Practical per week - 2 Hrs.

COURSE CONTENTS

1. **D.C. Circuits**

   Resistance, temperature coefficient of resistances Kirchoff's laws & their applications for D.C. Circuits.

2. **D.C.Potentiometer & Wheatstone bridge**

   Study & use of simple D.C. Potentiometer and Wheatstone bridge (no numericals).

3. **Magnetic Circuits**

   Concept of magnetic flux, flux density, intensity, m.m.f., permeability, series magnetic circuit and numericals based on it, comparison of electrical and magnetic circuit, BH curve and hysteresis loop, hysteresis loss (Descriptive treatment only).

4. **Electromagnetic Induction**

   Faraday's laws of self and mutual induction, Lenz's law, energy stored in the magnetic field.

5. **Electrostatics**

   Electric charge, flux, flux density, intensity, permitivitty, capacitance of parallel plate capacitor, capacitors in series and parallel, rise and decay of current in RC & LC series circuits (formula not to be derived).

6. **A.C. fundamentals**

   Production of sinusoidal waveform, meaning of cycle, frequency, period, phase, phase difference, RMS value, average value, maximum value, form factor, peak factor. Current, voltage and power relations in pure resistive, inductive and capacitive circuits (no mathematical treatment required), concept of reactance, impedance and power factor, simple A.C. series circuits, J notation and numericals based on it, Resonance.

7. **Polyphase circuits**

Concept of polyphase, advantages over single phase, phase sequence, star and delta connections, current, voltage and power relations for three phase Star and Delta connections.

8. **Measuring Instruments**

Classification of measuring instruments, Accuracy and sensitivity, Measurement of current, voltage, power, energy and power factor, analog and digital multimeters.

30/54

(58)

LIST OF EXPERIMENTS

1. To verify Kirchoff's Laws.
2. To plot the variation of resistance with temperature.
3. To measure low resistance by Wheatstone bridge.
4. To Calibrate potentiometer using standard cell.
5. To plot BH curve of a magnetic material.
6. To determine the resistance and inductance of a choke coil.
7. To plot the charging curve of a capacitor.
8. To draw phasor diagram of RLC series circuit.
9. To verify the relation between line and phase values of currents and voltages in a balanced star connected circuit & in a balanced delta connected circuit.
10. To verify the relation between line and phase values of currents and voltages in a balanced delta connected circuit.
11. To measure voltage, current & resistance by multimeter.
12. To measure energy consumption of a circuit by 1 .. energy-meter.
13. To calibrate Ammeter by

    (i) Standard Ammeter
    (ii) Potentiometer.

14. To caliberate Voltmeter by

    (i) Standard Voltmeter
    (ii) Potentiometer.

15. To measure energy consumption of a 3 .. circuit by 3.. energy meter.

30/60

REFERENCES

1. Electrical Technology by H. Cotton
2. Electrical Technology by Edward Hughes
3. Electrical Technology by B.L.Theraja, Khanna Publication
4. Basic Electricity & Electrical Measuring Instruments by Dhir, Garg & Sharma
5. Electrical Engineering by S.L.Uppal
6. A course in Electrical Engineering, Vol. I & II by C. L. Daws
7. Basic Electrical Engineering by V.N.Mittle; Tata McGraw Hill
8. Basic Electrical Engineering by Fitzgerald AE & Higginbotham
9. A text book of Electrical Engineering by J.B.Gupta; Dhanpat Rai & Sons

30/61

Advanced Diploma in Mechatronics

Second Semester

BASIC ELECTRONIC ENGINEERING

Theory per week : 5 Hrs. Practical per week : 2 Hrs.

Topic No.	Title	Theory Hrs.	Practical Hrs.
1.	Semiconductor devices	25	12
2.	Rectifiers	10	6
3.	Amplifiers	12	-
4.	Oscillators	8	2
5.	Power supply	10	4
6.	Operational Amplifier	8	4
7.	Filters	4	2
8.	Integrated Circuits	3	2
	Total	80	32

BASIC ELECTRONIC ENGINEERING

Theory per week : 5 Hrs. Practical per week : 2 Hrs

COURSE CONTENTS

1. **Semiconductor Devices**

Characteristics and applications of the following:

- Semiconductor diode
- Zener diode
- Photo diode
- Light Emitting diode & LCD
- Bipolar Transistor
- FET and MOSFET
- UJT
- Photo Transistor
- SCR
- Diac
- Triac.

2. **Rectifiers**

- Half wave
- Full wave
- Bridge
- Rectifier output with filter (LC & $\overline{/\backslash}$)
- PIV, Controlled rectifier, phase angle control wit
  thyristor.
- Three phase controlled rectifier.
- Introduction to Invertor

3. **Amplifiers**

- Transistor as an amplifier
- CB, CE, CC configuration and comparison
- Biasing methods
- AC load line
- Stability
- Multistage amplifier

4. **Oscillators**

- Feedback principle
- Condition of oscillation
- RC - Oscillator
- LC - Oscillator
- Crystal Oscillator

5. **Power Supply**

- Zener regulator
- Voltage doubler
- Transistorized regulated power supply
- IC regulator circuit using 723, 7805, 7905 etc.
- Short circuit protection.
- S.M.P.S.

6. **Operational Amplifier**

- Differential amplifier
- Basic introduction to OPAMP.
- OPAMP characteristics
- Basic circuits and their applications.

  - Inverting, non-inverting amplifier
  - Adder, subtractor
  - Integrator, differentiator
  - Voltage follower
  - Voltage limitor

7. **Filters**

- Filter Fundamentals
- LPF, HPF, Band-Pass filter, Band stop filter.
- Constant K prototype filters.

8. **Integrated circuit**

- Concept of IC
- Type of IC
- Classification into SSI, MSI, LSI, VLSI.
- Advantage of ICs.

30/64

(63)

LIST OF EXPERIMENTS

1. Draw the VI characteristic curve of semiconductor diode.
2. Draw the characteristic curve of zener diode.
3. Draw the characteristic curve of Bipolar Junction Transistor.
4. Draw the characteristic curve of SCR.
5. Draw the characteristic curve of Photo Transistor.
6. Display on CRO output of HW rectifier.
7. Display on CRO output of FW rectifier.
8. Display on CRO output of Bridge rectifier.
9. Display on CRO output of Controlled rectifier using SCR.
10. Hook up a zener voltage regulator & find the voltage regulation.
11. Assemble an IC voltage regulator & test it.
12. Study of operational amplifier as

    (a) Adder
    (b) Subtractor
    (c) Integrator
    (d) Differentiator

13. Find out cutoff frequency of given filter.
14. Hook up a given oscillator circuit & measure the frequency.
15. Use IC tester to test analog IC's like 741, 723.

30163

(64)

REFERENCES

1. Electronic principles, Malvino; T.M.H.
2. Electronic Devices and circuits, Mottershed; P.H. India
3. Integrated Electronics by Milman & Hilkias
4. Electrical Engineering & Electronics by B.L.Theraja
5. Elements of Electrical Engineering & Electronics by V.N.Nertesan; CBS Publication, Delhi
6. Electronics Made Simple by Henry Jacobwitz; Rupa Publication
7. Electronic Devices & Circuits by G.K.Mithal; Khanna Publication
8. Semiconductor Approximation by Malvino; McGraw Hill
9. Network & Lines by Ryder; Prentice Hall

(65)

Advanced Diploma in Mechatronics

Second Semester

WORKSHOP PRACTICE - II

Theory per week : 1 Hr. Practical per week : 6 Hrs.

Topic No.	Title	Theory Hrs.	Practical Hrs.
1.	Marking and Measuring Instruments	2	10
2.	Pattern Making Shop	2	14
3.	Foundry Shop	3	20
4.	Welding Shop	3	20
5.	General Machine Shop (Lathe & Milling)	5	22
6.	Denting and Painting Shop	1	10
	Total	16	96

30167

(66)

Advanced Diploma in Mechatronics

Second Semester

WORKSHOP PRACTICE - II

Theory per week : 1 Hr. Practical per week : 6 Hrs.

COURSE CONTENTS

1. **Marking and Measuring Instruments**

   Knowledge of use of various marking and measuring instruments such as Vee Block, surface plate, centre punch, spirit level, vernier height gauge, vernier calliper, Bevel protector, micrometer, digital micrometer, dial indicator, digital indicator and gauges. Application and use of above instruments for linear and angular measurements.

2. **Pattern Shop**

   Knowledge of carpentry processes like cutting, sawing, planning, marking etc. Preparation of various joints, Dovetail, mortise and tennon, finishing and polishing of jobs.

3. **Foundry Shop**

   Knowledge of Moulds and Moulding sand, use of foundry shop, tools used - cape and drag, vent wire, shovel, runner, riser, lifter, trovel etc.

4. **Welding Shop**

   Knowledge of welding tools and equipment., Knowledge of various types of prints - Butt, V-joint etc. Safety precautions to be observed in welding shop. Preparation of Lap, Butt and Tee joints.

5. **General Machines Shop**

   Knowledge of various cutting tools, understanding the function of machine tools such as lathe, milling, drilling, Safety precautions to be observed while working in general machine shop.

6. **Denting and Painting Shop**

   Use of gas welding in denting, denting equipment and tools, preparation of surface for painting, modern painting techniques used in industries such as: spray painting, powder spraying and electrostatic painting.

(67) 30/68

LIST OF EXERCISES

1. Study and use of various marking tools in the shops.
2. Two jobs in pattern shop on different types of joints incorporating operations such as - planning, grooving, slotting, sizing etc.
3. Preparation of mould for any job involving the use of different moulding tools.
4. One job on casting involving different foundry operations.
5. To prepare joints using
   (a) Gas welding
   (b) Arc welding
6. Preparation of edges for welding.
7. Welding V-Butt joint.

*8. Use of vernier micrometer and dial indicator in machine shop.

*9. Practice of simple turning on lathe.

*10. Practice of grooving, knurling, and boring operations on a lathe machine.

*11. Simple drilling practice on drilling machine.

*12. Practice on milling machine.

*13. Practice on spray, powder and electrostatic painting.

These experiences could be industry based to achieve the required performance skill.

7.30/69

REFERENCES

1. Workshop Technology, Vol. I & II by Hazra Choudhary
2. Workshop Technology, Vol. I & II by Chapman
3. Workshop Technology, Vol. I & II by Gupta and Kaushik
4. Manufacturing Processes by Young
5. Welding Technology Vol. I by Asian Publication
6. Video Films on welding technology by T.T.T.I., Bhopal

CURRICULUM

ADVANCED DIPLOMA
IN
MECHATRONICS

(THIRD SEMESTER)

STATE CURRICULUM DEVELOPMENT CENTRE

M.P. BOARD OF TECHNICAL EDUCATION,
A/4, OFFICE COMPLEX, GAUTAM NAGAR, BHOPAL - 462023
TEL. : 576963, 767155, 571995

ADVANCED M.P. BOARD OF TECHNICAL EDUCATION, BHOPAL. 30/71

THIRD SEMESTER DIPLOMA PROGRAMME IN "MECHATRONICS"

(To be introduced from 1996 - 97) REVISED CURRICULUM SESSION : JULY TO DECEMBER

S.NO.	NAME OF SUBJECT	SCHEME OF STUDY: CONTACT HRS PER WEEK (SEMESTER)			SCHEME OF EXAMINATION: SESS. MKS.		PROG. ASSM.		BOARD EXAMINATION.						REMARK TOTAL
		THEORY	LAB.	TOTAL	TERM WORK.	LAB. WORK	I	II	TH. PER.	DURATION (HRS)	MKS	PRACTICAL	DURATION (HRS)	MKS	
X 3.1	BASICS OF COMPUTER	4 (64)	2 (32)	6 (96)	15	30	10	10	1	3	100	1	3	50	PRAC.+VIVA 215
+ 3.2	ELECTRICAL & ELECTRONICS MATERIALS	4 (64)	- (-)	4 (64)	15	-	10	10	1	3	100	-	-	-	135
□ 3.3	ELECTRICAL MACHINES	4 (64)	2 (32)	6 (96)	15	30	10	10	1	3	100	1	3	50	PRAC.+VIVA 215
△ 3.4	DIGITAL ELECTRONICS	4 (64)	2 (32)	6 (96)	15	30	10	10	1	3	100	1	3	50	PRAC.+VIVA 215
3.5	MACHINE DRAWING AND ELECTRICAL DRAWING	- ( )	8 (128)	8 (128)	-	50	10	10	1	4	100	1	3	50	VIVA+SKETCH 120
3.6	ELECTRICAL AND ELECTRONICS WORKSHOP	- (-)	6 (96)	6 (96)	-	50	-	-	-	-	-	1	3	50	PRACT.+VIVA 100
		( )	( )												
8.		( )	( )												
9.		( )	( )												
10.		( )	( )												
	Total :	16 (256)	20 (320)	36 (576)	60	190	50	50	5	-	500	5	-	250	1100

NOTE; (1) No. of theory paper: 05
(2) Total theory marks: 500
(3) No. of practicals : 05
(4) Total Pract. Marks.: 250
(5) Inplant Training Ms : NIL
(6) Total mks. of sessional, Prog. Assessment, Pract. & Inplant Training. : 600
(60+190+50+50+250 = 600)

Ratio of theory marks 500 :: 600 and (sessional + prog. assess + Practical + Inplant Training i.e. Marks. 1 : 1.2
(60+190+50+50+250 = 600)
Total Marks : 1100
Passing marks for -
Theory - 33%
Practicals - 40%
Sessionals - 60%
Inplant Training - 50%

Note : × common with BASICS OF COMPUTER of IIIrd sem. Manufacturing Engg. + Second semester
+ common with Electrical and Electronics materials of Third semester of Advanced Diploma in Industrial Electronics
□ common with Electrical machines of THIRD semester of Advanced Diploma in Industrial Electronics
△ common with Digital Electronics of Fifth sem. of Advanced Diploma in Electronics

30/72

(71)

ADVANCED DIPLOMA IN MECHATRONICS

THIRD SEMESTER

3.1 BASICS OF COMPUTERS

RATIONALE

Computer is playing an important role in various fields. The major cause of industrial revolution is the invention of computers. Computers can perform complex and repeatative calculations, store large ampunt of data, make decisions and draw and print graphs etc. As a techinician, the basic knowledge of computer is very necessary to use it for elementary purposes. With this view this subject has been designed.

Store emphasis has been laid first on the basic concepts and then their applications.

30/93

(12)

Sub. - 3.1 Basics of Computer

SCHEME OF STUDIES

S.No.	Topic	Contect hours			Remar
		Theory	Practical	Total	
1.	Introduction to computer	06	-	06	
2.	Computer organisation	12	08	20	
3.	Computer software	18	10	28	
4.	Programming in pascal	12	10	22	
5.	MS DOS	16	04	20	
	Total	64	32	96	

30/74

Advanced Diploma in Networkers:

Third Semester

4.1 BASICS OF COMPUTERS:

Theory per week: 4 Hrs. Practical per week: 2 Hrs

COURSE CONTENTS:

1. Introduction to Computers:

Block diagram of computers. Types of computers, features & powers of computers. Application of computers. Concept of Hardware and Software.

2. Computer Organization

Input/output devices, memory, storage devices: floppy, hard disk, tape, peripheral devices, ports: serial & parallel Buses: back plane, process buses, local buses

3. Computer Software

Concept of program, Machine Language, Assembly Language, High level language, compilation, interpretation programming language, problem solving techniques, program development process: flowcharting, Algorithm, program writing, debugging, compiling, executing, program maintenance.

4. Programming in PASCAL

Data types, structure of a pascal program, various programming constructions and loops, functions and procedures, writing simple programs in PASCAL.

5. MS DOS

Aims and functions of operating system, structure of MS DOS basic DOS files and file system, DOS commands: Internal & External, batch files, Auto execute bat file, Configure

30187

(74)

LIST OF PRACTICALS

1. MS DOS

   (a) Practice of various internal & external commands of MS-DOS.

   (b) Learn formatting a disk & making it bootable.

   (c) Study of MS-DOS file system.

2. Learn operations & applications of various input, output, storage & peripheral devices.

3. Pascal programming.

   Draw flow chart & write programs in PASCAL for following problems

   (a) Find out maximum & minimum of 3 numbers.
   (b) Finding out mean, standard deviation of n numbers.
   (c) Finding out roots of an quadratic equation.
   (d) Finding out sum of individual digits of a number.
   (e) Finding out factorial of a number.
   (f) Searching an element in an array of numbers.
   (g) Addition of two matrices.
   (h) Sorting a list of numbers

4. Learning to write programs in Pascal to solve various problems in Mechanical & Manufacturing Engg.

Note:

This is only a suggestive list of problems for programming. The instructor on his part may add more problems which are more Manufacturing Engg. application oriented. He can also take small industrial problem & get it solved by students.

30176

(75)

REFERENCES

1. Introduction to computers by Balaguruswamy; Tata M Hill

2. Computer programming in Pascal by V.Rajaraman

3. Introduction to system software by Dhamdhere; THI

4. Computer fundamentals by B.RAM: Willy Eastern Ltd

5. Introduction to Computer Science by Govind Rajalu; Wi

6. Inside the IBM PC by Peter Norton; Brady Books

7. DOS users guide by Peter Nortan

76/77

(76)

ADVANCED DIPLOMA IN MECHATRONICS

THIRD SEMESTER

SUB. - 3.2 Electrical & Electronics Materials

RATIONALE

The knowledge of electrical & electronics is very essential for a student of Mechatronics materials play an import role in terms of their electrical, chemical, magnetic and thermal properties. The choice of right material for a given engineering requirement, the proper use of these materials, effect on properties of materials when they are in use, all are the direct responsibilities of an engineer.

With this view, the different electrical and electronics materials, components their standered values and their scope of applications have been included in this subject.

30/78

(77)

SUB. - 3.2 Electrical and Electronics Materials

SCHEME OF STUDIES

S.No.	Topic	Contact hours			
		Theory	Practical	Total	Remark
1.	Conducting materials	10	-	10	
2.	Insulating materials	10	-	10	
3.	Semi conductor materials	10	-	10	
4.	Magnetic materials	14	-	14	
5.	Material used in electric and electronics components	20	-	20	
	Total	64	-	64	

30/7/4

ADVANCED DIPLOMA IN MECHATRONICS
THIRD SEMESTER

eory per week: 4 Hrs. Practical per week: NIL

3.2 ~~ENGINEERING MATERIALS~~ Electrical and Electronics materials

OURSE CONTENTS

1. Conducting Materials

* Classification of Materials
- Concept of conductivity
- Requirement of good conducting material
- Factor affecting resistivity of material
- Name of common conducting material
- Comparison of different conducting materials
- Concept of current flowing in conductor
- Mobility
- Energy level of a molecules
- Application of conductors

* Emission of electron From Conductor Surface
- Thermonic Emission
- Photo Electric
- Field Emission
- Secondary Emission

* Concept of Super Conductivity

* Thermoelectric Effect and Application

2. Insulating Materials

* Distinction between Insulator and Conductor

* Insulation Resistance
  - Definition
  - Factor affecting insulation resistance

* Dielectric Strength
  - Definition
  - Factor affecting dielectric strength
  - Dielectric constant

* Breakdown Voltage
  - Definition
  - Effect of dielectric breakdown
  - Concept of air space in insulation

30/80

(79)

* Effect of Frequency and Temperature on Dielectric
  - Dielectric loss
  - Perfect dielectric

* Ferroelectric Properties
  - Curie point
  - Thermal, Mechanical, Physical, Chemical proper

* Classification of Insulating Material
  - Class A,B,C,H,F,Y

* Transformer Oil
  - Characteristics
  - Contamination
  - Purification

3. Semiconductor Materials

* Classifying Material as Semiconductors
  - Concept of conductivity
  - Name of different semiconductor material
  - Concept of forbidden energy gap and compar with insulating and conducting materials
  - Energy band diagram
  - Fermi level

* Intrinsic & Extrinsic Semiconductors
  - Energy bond in extrinsic material
  - Diffusion
  - Mobility

* Einstein Relation
  - Drift & diffusion current

* Hall Effect
  - Definition
  - Application

4. Magnetic Material

* Classification
  - Paramagnetic
  - Ferromagnetic
  - Antiferromagnetic or ferrimagnetic
  - Diamagnetic
  - Comparison

* Different Magnetic Material
  - Siticon steel
  - Soft steel
  - Cast iron
  - Application & properties
  - Comparison

* Curie Temperature
  - Definition
  - Effect on magnetic material

* Impurities in Ferromagnetic Material & their effect

* Magnetostriction
  - Definition
  - Effect
  - Application

* Hystresis Effect
  - B-H curve
  - B-H curve for soft & hard material
  - Losses
  - Steinmet'z constant

* Powdered Core Materials
  - Application

5. Material Used in Electric & Electronic Components

* Resistor
  - Carbon composition resistor
  - Insulated moulded resistor
  - Film type resistor
  - Wire wound resistor
  - Printed circuit resistor

* Capacitor
  - Paper capacitor
  - Ceramic dielectric capacitor
  - Glass dielectric capacitor
  - Plastic dielectric capacitor
  - Electrolyte capacitor

* Inductor
  - Core material
  - Laminated core
  - Powdered iron core
  - Ferrite core material

* Soldering Material
  - Flux material
  - Soft soldering material
  - Hard soldering material

* Fuse
  - Fuse material
  - Properties

* Material Used in Fibre Optics (Optical Fibre)

* Effect of Frequency and Temperature on Dielectric
  - Dielectric loss
  - Perfect dielectric

* Ferroelectric Properties
  - Curie point
  - Thermal, Mechanical, Physical, Chemical proper

* Classification of Insulating Material
  - Class A,B,C,H,F,Y

* Transformer Oil
  - Characteristics
  - Contamination
  - Purification

3. Semiconductor Materials

* Classifying Material as Semiconductors
  - Concept of conductivity
  - Name of different semiconductor material
  - Concept of forbidden energy gap and compar with insulating and conducting materials
  - Energy band diagram
  - Fermi level

* Intrinsic & Extrinsic Semiconductors
  - Energy bond in extrinsic material
  - Diffusion
  - Mobility

* Einstein Relation
  - Drift & diffusion current

* Hall Effect
  - Definition
  - Application

4. Magnetic Material

* Classification
  - Paramagnetic
  - Ferromagnetic
  - Antiferromagnetic or ferrimagnetic
  - Diamagnetic
  - Comparison

* Different Magnetic Material
  - Siticon steel
  - Soft steel
  - Cast iron
  - Application & properties
  - Comparison

30183

* Curie Temperature
  - Definition
  - Effect on magnetic material
* Impurities in Ferromagnetic Material & their effect
* Magnetostriction
  - Definition
  - Effect
  - Application
* Hystresis Effect
  - B-H curve
  - B-H curve for soft & hard material
  - Losses
  - Steinmet'z constant
* Powdered Core Materials
  - Application

5. Material Used in Electric & Electronic Components

* Resistor
  - Carbon composition resistor
  - Insulated moulded resistor
  - Film type resistor
  - Wire wound resistor
  - Printed circuit resistor
* Capacitor
  - Paper capacitor
  - Ceramic dielectric capacitor
  - Glass dielectric capacitor
  - Plastic dielectric capacitor
  - Electrolyte capacitor
* Inductor
  - Core material
  - Laminated core
  - Powdered iron core
  - Ferrite core material
* Soldering Material
  - Flux material
  - Soft soldering material
  - Hard soldering material
* Fuse
  - Fuse material
  - Properties
* Material Used in Fibre Optics (Optical Fibre)

(81) 30/84

REFERENCES

General & Electrical Engineering Materials	-	by M.L. Gupta
Electrical Engineering Material	-	by A.J. Decker
Electrical Engineering Material	-	by C.S. Indulkar
Electrical Engineering Material	-	by K.B. Raina & S.K. Bhattacharya; Ketson Pub. House

30/85

(82)

ADVANCED DIPLOMA IN MECHATRONICS

THIRD SEMESTER

SUB. - 3.3 ELECTRICAL MACHINES

RATIONALE

The subject of electrical machines is of great importance to a student of Mechatronics. It mainly deals in the theory and underlying principles of electrical machines which a student is likely to undertake in his future career by way of operation, control and maintenance.

An attempt has been made to provide all necessary informations of the subject needed at the diploma level.

30/86

83

SUB.- 3.3 Electrical Machines

Scheme of Studies

S.No.	Topic	Contract hours			
		Throry	Practical	Total	Remark
1.	Energy conversion principles.	10	-	10	
2.	Transfarmers	14	08	22	
3.	Polyphase Induction motor	20	12	32	
4.	Synchronous machines	20	12	32	
	Total	64	32	96	

30/87

ADVANCED DIPLOMA IN MECHATRONICS

THIRD SEMESTER

(84)

Electrical Machines

Theory : 4

Practical : 2

Contents

1. Energy conversion principles - Mode of electro mechanical, conversion, energy in magnetic system field energy and mechanical force. Direction of mechanical force Energy conversion via magnetic field, Induced voltage generator and motor action, counter e.m.f. and counter torque.

2. Transformers -

Definition, principle of operation, constructional features, Types: Single phase and three phase, application Regulation, Losses, Efficiency.

Different connections of three phase Transformers e.g. Y/Y, Y/Δ, Δ/Y, Δ/Δ Necessity and conditions of parallel operation. Equal and unequal voltage ratio, various methods of colling e.g. natural, Artificial, air, water mixed. Different types of safety devices used for transformer.

Of rotors squirrel cage and phase V wound. Production of rotating magnetic field by three phase system show that flex is 1.5 lines that of 1 phase acting alone. Principles of operation. Slip and its utility. Doubble cage induction moter, and their advantages, roter current, production of forque. condition of maximum torque (rotor resistance = reactance) Torque/slip charactarstics, relation between rotor resistance and torque. Starting torque and current, speed torque diagram slip ring motor - starter. Speed cont. starter light DOL, Y, Auto transformer and their application. Importance of the speed morten.

4. Synchronous machine - construction features of synchronous revolving armature and revolving field type relationship between speed poles and frequency ($f = \frac{NP}{120}$). Generator and motor action emf equation. equation of single/three phase alternator. Effect of form factor, distribution factor and coil

contd...2

(85)
30/88

span - Factor on emf induced. Synchronous impendence and its importance -
Open circut and short circut test. Alternator charactersitics. regulation of alternator, parallel operation of alternators. conditions of parallel operation. Effect of varying excitation of synchronous motor upon armature current - and power factor when input is constant, synchronous condenser V V curves. Methods of starting synchronous motor. Hunting and its prevention.

Reference Book

1. Electrical Engg. book - H. Cotton
   - Theraja

List of practicals

1. To connect three single phase - transformer to form three phase transformer and measure their voltage on primary/secondery sides
2. To run two single phase transformer in parallel and to find their load sharing.
3. To study the constructional detail of single phase induction motor
4. To determine the slip and calculating percentage slip of a given induction motor.
5. Study direct - on line, star/delta, auto transformer starters and to run the motor with the help of starter.
6. To study a slip ring motor starter and to run the motor with its help.
7. To study a synchronous machine
8. Verify the relationship $f = \frac{NP}{120}$
9. To run the alternators in parallel and study their load sharing.

5p189

ADVANCED DIPLOMA IN MECHATRONICS

THIRD SEMESTER

SUBJECT: DIGITAL ELECTRONICS (-5-4)

(06

CODE:-

Rationale

The digital ICs are present everywhere as the hearts of small devices like electronic watches to biggest enhancements like computers. These are present in the electronic control-devices employed in all modern automatic-plant industries, and almost in every areas like medical, military, agriculture, space-satellites, home appliances entertainment equipments like TV, VCR & film production & processing equipments. But what is inside in IC? what are principles & logics used in these ? IC is a device which uses these principles The subject covers all these principle elements & logics of the field of digital electronics.

The syllabus includes logic gates and logic families, sequential & combinational circuits.

It is assumed that all institutes have training kits. The practicles are aimed to ably these kits successfully. The students will develope the software programmes & test on these kits.

30/90
87

SUB.- 3.4 Digital Electronics

SCHEME OF STUDIES

S.No.	Topic	Contect hours			
		Theory	Practical	Total	Remark
1.	Number system and Binary codes	06	-	06	
2.	Boolean Aljebra	06	-	06	
3.	Logic gates	08	08	16	
4.	Logic families	06	06	12	
5.	Sequential circuits	16	06	22	
6.	Arithmatic logic unit	10	04	14	
7.	Combinational digital circuits	06	04	10	
8.	Convertors	06	04	10	
	Total	64	32	96	

ADVANCED DIPLOMA IN MECHTRONICS

THIRD SEMESTER

SUBJECT-DIGITAL ELECTRONICS (3:4) 30/91

CODE:-

CONTENTS

1. NUMBER SYSTEMS AND BINARY CODES

1.1 Introduction to Decimal,Binary,OCtal,Hexadecimal number system.

1.2 Conversion of number systems.

1.3 Complements of numbers (i.e.) True's complement and radix minus one complement.

1.4 Binary operations (i.e.) addition,subtraction,multiplication and division

1.5 Weighted and unweighted codes;-
Excess-3 code,Gray code,BCD code,Reflected code,Error correcting and Error detecting code,ASCII code.

2. BOOLEAN ALGEBRA

2.1 Basic Boolean functions and Boolean theorems.

2.2 Simplification of Boolean functions.

2.3 K-Map method for simplification of Boolean function.

3. LOGIC GATES

3.1 Basic logic gates(AND,OR,NOT,NOR,NAND,EX-OR,EX NOR)

3.2 Diffrence between "Basic gates" & universal gates.

3.3 Preparation of truth table and symbols of gates.

3.4 Design of Basic gate with universal Gate.

4. LOGIC FAMILIES

4.1 Concept of Resister diode logic,Diode Transister Logic (DTL),Transister Transister Logic(TTL),Emitter Coupled Logic(ECL),Mos & Cmos their circuit and brief discription.

4.2 Compar-rison of above logic family .

30/92

(89)

5. SEQUENCIAL CIRCUIT

5.1 Introduction to Flip Flop.

5.2 R-S,JK,D and T type flip flop their analysis.

5.3 Advantages and Disadvantages of each Flip-Flops.

5.4 Explaination of clocked flip flops.

5.5 Positive and Negative clock function.

5.6 Importance of Edge triggring.

5.7 Counters-Circuit and Brief Discription of-

5.71 Synchronous/Asynchronous.

5.72 Serial/Parallel/

5.73 Shift register.

5.74 Ripple Counter.

5.75 Up-Down Counter.

5.76 Decade Counter.

5.77 BCD Counter.

5.78 Ring Counter.

6. ARITHMATIC LOGIC UNIT (ALU)

6.1 Adder Circuit .

6.2 Half adder.

6.3 Full adder.

6.4 3 Bit binary adder.

6.5 Decimal adder.

6.6 BCD adder.

6.7 3 bit binary subgtractor circuit.

7. COMBINATIONAL DIGITAL CIRCUITS.

7.1 Encoder/Decoder-Circuit and Brief Discription.

7.2 Multiplexer/Demultiplexer circuit and Brief Discript

8. CONVERTORS OF

8.1 A to D Convertor.

8.2 Ramp Convertor.

30/93

(90)

8.3 Dual Slope.

8.4 Successive approximation type.

8.5 D/A Convertor.

//Neelam//
131295.

ADVANCED DIPLOMA IN MECHANI...

THIRD SEMESTER

(11)

SUBJECT: DIGITAL ELECTRONICS (3:4)

30/94

CODE:-

LIST OF EXPERIMENTS:

1. Set up AND/OR/NOT/NOR/NAND gates using digital Trainer/Experimenter and verify truth tables. Study the general specifications & pin configuration of TTL/C-MOS ICs

2. Verification of De-Morgans Theorems using gate circuitry.

3. Setup Exclusive OR/EX-NOR gates using NAND/NOR gates on trainer/experimenter and verify the truth tables.

4. Construct Full Adder using IC 7483 and substractor using IC-7486.

5. Construct a Half adder & Full Adder using Logic gates.

6. Prepare a circuit with 7-segment display & check the operations using logic input switches, BCD code truth table using 7446.

7. Realize the minimized networks of a given function and verify the truth tables .

8. Test the function of TTL (74 series) / C-MOS (40 series ICs).

9. Prepare clocked and unclocked JK Flip-flop circuit using NAND/NOR gates.

10. Make a Master-Slave JK F/F and verify the output with its truth table.

11. Make a T-F/F and DF/F using J-K f/f and verify its output with its truth table.

30/95

12. Prepare a 3-bit Ripple, , , ,up/down,decade counter using J-K F/F/D-F/F with -ve and +Ve clock input and analyse its output.

13. Prepare BCD to Decimal decoder using IC 74141 and verify its output using 7-segments, display circu

14. Suggest Decimal to BCD decoder using logic gates.

15. Study operation of 4 line to 1 line multiplexer.

30/96

ADVANCED DIPLOMA IN MECHTRONICS

THIRD SEMESTER

SUBJECT : DIGITAL ELECTRONICS (3.4)

CODE:-

LIST OF REFRENCE BOOKS:

1. Digital principles and applications
   By Malvino and Leach
2. Digital Computer fundamentals
   By Thomas G. Barlea:
3. Digital logic and computer design
   By Morris mano
4. Intagated Electronics
   By Jacob Millman and Cheistos Halkias

30/97

ADVANCED DIPLOMA IN MECHATRONICS

THIRD SEMESTER

SUB. - 3.5 Machine drawing and Electrical drawing

RATIONALE

Engineering drawing is the language of engineers, The knowledge of this subject is very important to the students of Mechatronics, The course in machine drawing is prepared to develop average skill of machine drawing i the students. More emphasis is laid on the use of I.S. co of practice and reading and interpretation of drawings. T topics of multi view representation,diamensioning,toleran and sectioning of machine components etc.are included to foundation for production drawing.

The course in electrical drawing deals with the symboles and notations of various electrical and electro quantities, the various circuits of electrical and elect equipments used in different fields of engineering. This knowledge is very useful to the students in understandi drawings of various circuits and equipments, conveying i tions and solving problems on sites and shop floors etc.

30/98

(95)

SUB : 3.5 MACHINE DRAWING & ELECTRICAL DRAWING

SCHEME OF STUDIES

S.No.	Topic	Contact hours			
		Theory	Practical	Total	Remark
1.	Projection	-	12	12	
2.	Diamensioning/Toleranling and Indication of surfaces	-	12	12	
3.	Sectioning	-	16	16	
4.	Assembly drawing	-	24	24	
5.	Symboles and notations	-	08	08	
6.	Wiring circuits	-	12	12	
7.	Instrument circuits	-	12	12	
8.	Power wiring diagrams	-	20	20	
9.	Electronic circuits	-	12	12	
			128	128	

30/99
(96)

ADVANCED DIPLOMA IN MECHATRONICS

THIRD SEMESTER

3.5 Machine Drawing and Electrical Drawing

Projection 2+9=11 (2 plates)

Projection, multiview representation and conversion of simple machine part :

1. Super fluious views 2. choice of views 3 Auxiliary views of simple machine components. 4. convertional practice from pictorial views into or graphic & Vice versa. 5. conventional representation of simple machine components like, internal and external threads, shafts i.e. splined & serrated shafts, springs gears, knurling (straight & Diamond) crain wheels, slotted heads.

Dimensioning/Tolerancing and Indication of surface roughness on drawing and welded symbols shop process terms.

1. System of dimensioning as aligned system and unidirectional system.
2. Size dimensioning and location dimentioning Geomatric tolerances.

Sectioning :

Definition. Types: full section, Half section, removed and revolved section, offset section, Local/Broken/ partial section. Sectioning of adjacent part, List of component which are not shown in section.

Assembly Drawing

Detailed drawing, Assembled drawing, working drawing, preparation of assembly drawing from detailed drawing and vice versa.

a) Assembly drawing of : Foot step bearing, plummer block or pedestal bearing, universal coupling, speed cone pulley,

b) Detailed drawings of : Knuckle joint, Tool holder Flange coupling

(97)

30/100

Symbols and Notations related to Electrical Engg.

Symbols and Notation as per I.S.S., commonly used in Electrical Engineering e.g. Indicating instruments recording instrument, control gears, disbribution board out lets, bells and buzzers, aerials, earthing switch gears arrestors and motor starters.

Wiring circuits

Fluorescent tube connection diagram (gingle and twine tubes), M.V. lamp and sodium vapour lamp connection diagram.

Instruments circuits

Connection diagrams of - ammeter, voltmeter, wattmeter and energy meter (single phase & three phase and three elements), Connection diagram using C.T. and P.T. for measurement of power and energy.

Power wiring diagrams

Power wiring diagrams of: shaded pole and split phase single phase induction motors, series, shunt and compound (long and short shunt) motors, capacitor start and capacitor start and run motors, slipring motor. D.C. motor starters (3 points and 4 points). DOL, star delta, Auto-transformer to starters, slipring motor starter.

Electronic circuit

Circuit diagrams of: Battery charger,
Full wave rectifier: centre tapped and bridge types,
R.C. coupled. Amplifier, voltage regulator.

30/101

ADVANCED DIPLOMA IN MECHATRONICS

THIRD SEMESTER

SUB.- 3.5 Macnine drawing and Electrical drawing

LIST OF BOOKS

1. Machine Drawing by N.D.Bhatt.
2. Machine Drawing by Nagpal.
3. Machine Drawing by Laxminarayan.
4. Machine Drawing by T.Jones.
5. I.S. 696 Latest version
6. Electrical Engg.Drawing by Bhattachariya
7. Electrical Engg.Drawing by Nagpal
8. Electrical Engg.Drawing by Dorgan
9. Electronics Principles - by Malvino.

ADVANCED DIPLOMA IN MECHATRONICS

30/102

(99)

THIRD SEMESTER

SUB.- 3.6 Electrical and Electronics workshop

RATIONALE

Workshop practice introduces a sense of self confidence in the students, which is very useful in supervision work. This course has been designed to provide knowledge of tools, components, contactor and switches. Cables and wires, differenc types of wiring and to provide practice of wiring, soldering P.C.B. making coil winding and testing of various electrical and electronics equipments used in various fields of engineering. This would be useful in make the students fit for shop floor working and supervision.

30/103

SUB.- 3.6 Electrical and Electronics workshop

SCHEME OF STUDIES

S.No.	Topic	Contact hours			
		Theory	Practical	Total	Rem
1.	Symboles	-	08	08	
2.	Data book and informatiom documents	-	04	04	
3.	Tools	-	04	04	
4.	Components identification & testing	-	08	08	
5.	Contactor & switches	-	08	08	
6.	Cables and wires	-	12	12	
7.	Soldering technique	-	04	04	
8.	P.C.B.development	-	16	16	
9.	Assembly & testing	-	16	16	
10.	Coil winding	-	12	12	
11.	Safty and storage	-	04	04	
	Total	-	96	96	

(14)

ADVANCED DIPLOMA IN MECHATRONICS

THIRD SEMESTER

30/10/4

3.6: ELECTRICAL & ELECTRONICS WORKSHOP

THEORY PERWEEK : NIL. PRACTICAL PER WEEK : 6 HRS.

COURSE CONTENTS

1. Symbols

* Electrical Symbols
  - Component
  - Electrical Instruments and Machines
  - Wiring

* Electronics Symbols
  - Components
  - Circuit

2. Data Book and Information Documents

- Necessity of Data-Books and Mannuals
- Data/Information reading

3. Tools

- Tools used in Electrical & Electronic Workshop
- Specification of tools
- Selection of tools

4. Component Identification and Testing

- Resistor
- Inductor
- Capacitor
- Semiconductor diodes
- Transistors
- Silicon controlled rectifier
- Integrated circuits

5. Contactor and Switches

* Connectors
  - Various types of connectors (function and uses)

* Switches
  - Various types of switches (function and uses)
  - Limit switches
  - Micro switches

30/105

* Contactors and Relays.
  - Various types of contactors (function and use
  - Setting and repairing of contactors
  - Various types of relays
  - Setting and repair of relays

6. Cables and Wires

* Cables
  - Various types of cables and wires
  - Selection of wires and cables

* Wiring
  - Interpretation of wiring diagram (House, Industrial and control panel)
  - Identification of wires/cables
  - Wiring of control panel
  - Cable laying (for control panel)
  - Cable joints

7. Soldering Techniques

- Soldering materials, flux materials
- Various types of soldering irons and its selection
- Desoldering pumps
- Precautions while soldering
- Soldering and de-soldering practice

8. P.C.B. Development

- Various types of P.C.B.
- P.C.B. layout drafting (of any circuits)
- Printing of layout on copper clad board
- Etching
- Washing
- Inspection of prepared P.C.B. and correction
- Drilling holes on P.C.B.
- Cutting of P.C.B.
- Testing of P.C.B.
- Timing of P.C.B.

9. Assembly and Testing

* List of Assembly
  - Battery eliminator for 3,6,9,12 volt
  - I.C. Voltage regulators for 5V, 12V, 1 AMP
  - Waveform generators using 555 IC
  - Audio Amplifier
  - Electronic sound generator
  - Light dimmer/fan speed regulator using di triac
  - Select static relay for 10A, 400V
  - Electronic Display using LEDs/Seven seg display

(103)

- Variable power supply
- Signal generators

10 Coil Winding

- Winding and rewinding of coils, using coil winding machine

11. Safety and Storage

- Safety precautions in workshop
- High voltage precaution and safety measures
- Storage of equipments/tools/components

30/107

(104)

ADVANCED DIPLOMA IN MECHATRONICS

THIRD Semester

ELECTRICAL AND ELECTRONICS WORKSHOP

REFERENCE BOOKS

1.	Linear IC Equivalent	-	by A.M. Hoebeek BPB Pub.
2.	Fundamentals of Cable Engineering	-	by V. Privezentsev I. Grodnev S. Kholodny I. Ryazanov Mir Pub./Moscaw
3.	The Master Handbook of IC Circuits	-	by Delton T. Horn TAB Book Inc. Blue Ridge Summit, PA
4.	Handbook of IC Circuit Projects	-	by Jim Ashe TAB Book Inc. Blue Ridge Summit, PA
5.	International Diodes Equivalents	-	by A.M. Hoebeek BPB Pub.
6.	Design of Electronics Circuits and Computer Aided Design	-	by M.M. Shah Willey Eastern Pub.

30/108

(105)

ADVANCED DIPLOMA IN MECHATRONICS

(FOURTH SEMESTER)

STATE CURRICULUM DEVELOPMENT CENTRE

M.P. BOARD OF TECHNICAL EDUCATION

A/4, OFFICE COMPLEX, GAUTAM NAGAR, BHOPAL - 462023

TEL : 583656, 583673, 533627

MADHYA PRADESH BOARD OF TECHNICAL EDUCATION, BHOPAL.

DIPLOMA PROGRAMME IN MECHATRONICS IV SEMESTER

(To be introduced from January 1997)

30/109

S.No.	NAME OF SUBJECT	SCHEME OF STUDY. CONTENT HRS PER WEEK(YEAR)			SCHEME OF EXAMINATION: SESSIONAL MARKS		PROGRASSIVE ASSESMENT		BOARD EXAMINATION						
		THEORY	LAB.	TOTAL	TERM WORK	LAB. WORK	I	II	THEO. PAPER	DURATION HRS.	MKS.	PRACTICAL	DURATION HRS.	MKS.	REMARKS
4.1	Production Technology-II	4 (64)	4(64)	8(128)	15	25	10	10	1	3	100	1	3	50	
4.2	Mechanics of Machines	4 (64)	2(32)	6(96)	15	25	10	10	1	3	100	1	3	50	
4.3	Microprocessor & Interfacing	4 (64)	3(48)	7(112)	20	20	10	10	1	3	100	1	3	50	Common To CSE 401 (Theory Paper)
4.4	Industrial controls	4(64)	2(32)	6(96)	15	25	10	10	1	3	100	1	3	50	
4.5 **	Computer Applications	4(64)	5(80)	9(144)	20	20	10	10	1	3	100	1	3	50	Common To CSE 404 (Theory PAPER)
6-															
7-															
8-															
9-															
10-		20	16	36	85	115	50	50	05		500			250	

NOTE:- (1) No. of Theory paper: 05

(2) Total theory marks: 500

(3) No. of Practicals : 05

(4) Total Pract.Marks : 250

(5) Inplant Training Mks: - NIL

(6) Total Mks.of Sessional+ Prog.Assessment,+Pract. &Inplant Training :550

(7) Ratio of theory marks : 1:1.1 and(Sessional+prog.Assess +Practical +Inplant Traingin Marks)i.e.

(8) Total Marks: 1050

(9) Passing marks for :
(a) Theory-33%
(b) Practicals-40%
(c) sessionals-60%
(d) Inplant Trg-50%

* Theory paper of subject 4.3 Microprocessor and Interfacing is common with CSE 401 (as per MPECS)

** Theory paper of subject 4.5 computer application is common with CSE 404 (as per MPECS) ly PC softwares.

(196)

30/110

ADVANCED DIPLOMA IN MECHATRONICS

IV SEMESTER MECHATRONICS

Subject:- Production Technology-I

CONTENTS

S.No.	Topic	THEORY HOURS	PRACTICAL HOURS	TOTAL HOURS
1-	Metal Casting	13	16	29
2-	Mechanical Working	16	16	32
3-	Metal Joining	12	16	28
4-	Metal Machining	09	12	21
5-	Production Processes	14	04	18
	TOTAL	64	64	128

FOURTH SEMESTER MECHATRONICS (108) 30/111

Subject:- Production Technology-I T+P=TOTAL

Topic No 1: METAL CASTING 13+16=29

Pattern Making : Introduction to metal casting Advantages and limitations of castings as a production process.,Type of patterns and materials desirable properties Types and area of applications spec-ial features of solid, split match-plate and sweep pattern pattern Allowances-shrinkage Phenomena Shrinkage,Allowances and shrinkage rule, Effect of shrinkage on castings.Machining and draft allo-wances. Use of fillets,Technique of preparation of patterns. Colour code for patterns.Use of cores in moulding.Determination of shape and size of Cores-Preparations of cores and core-boxes.

Moulding : Sand properties,Moisture content and its effects.Sand compositions for different applications -Sand condition-ing Moulding materials and machines ~~mould~~ Moulding materials and machines moulder tools and functions. Different parts of mou-ld Preparation of sandmoulds.open, two mould boz,three mould box process and application. Characterstics and defects of moulds.,Casting Metals :- Casting metals-Typical application of cast iron,brass,steel Alluminium,gun-metal Furnaces: Pit Furnaces,cupola and crucible furnaces,their saliant features,advantages and limitations.Preparing furnace for melting,safety aspects. Casting Process:- Dangers of pouring the metals directly on moulds. Use of runners ,risors,gate etc. Factors affecting shape and size cleaning and testing of castings'-flows. Need for special casting,Methods like,contrifugal,and die casting-Area of applications casting defects-causes and analysis salvaging of faulty castings quality control techniques at different stages in the foundry

Topic No :2 MECHANICAL WORKING 16+16=32

Hot working: Importance and principle of mechenical working structural chages in the process.Advantages and disadvantages of hot working equipments required and different hot working methods.,Cold working: Basic Principles, grain structure,strength hardness cold processes.Forging press work,cold rolling drawing,spinning.Residual stresses and the remedies.,Comparison of hot and cold working,advantages and disadvantages of cold working., Preheating principles equilibrium diagram,its use for determining preheating temperature.,Metal Rolling : Principles of metal rolling basic componets.Simple rolling process equipment.Types of deformations ingot rolling materials,Principle of thread rolling Manufacture of seam less tubes.Flow diagram of a mo-dern rolling mill., Types of rolling mills,salient features Methods of Metal Drawing: Basic concept of plasticity ductility., malliability, Different drawing practices,Wire drawing equipment die details,

Metal Spinning:- Process of metal spinning principles.

Extrusion: Extrusion-Direct and indirect methods, Advantage and limitation.

Forging: Press forging,up set forging, die material Forging:Die forgings defects,calculations Advantages and limitations.

Press work: Double action,press,Die punch,types of die,specification of press,safety

Topic No :3 METAL JOINING 12+16= 28 30/113 (110)

Arc welding : Principle of Arc welding 1, A C and D C,2. Metal Arc,Carbon Arc,Atomic Hydrogen, 3. Shielded and unshielded Arc.,Applications of Arc welding machines Bare and coated electrodes materials of electrodes cast iron steel,nonferrous and alloys,Sequence of operations involved in Arc welding,Precautions.Fundamental types of joints edge,butt,Corner,lap and tee and welding of the joints(above),plug joint,pipe and flat joint.,Resistance welding Processes from basic Principles for given job,selection of process of resistance welding equipments and tools. Differenciate between squeeze time weld time and hold time.,Gas welding: Basic principle of gas welding gas combinations and necessity,Different flames and their tempratures and proper adjust-ments. equipments and tool and their functions.,Low and high pressure gas welding torch . Differenciate between these on the basis of construction and application. Fluxes types and selection. Filler metals necess-ity classification and selection., Gas cutting:Gas cutting,lance cutting,corbon and metal Ac cutting torch and comparis-on with welding torch gas cutting operation, condition affecting the quality of cut safety precautions.,Weldability: Weldability characteristics of weldable material,Influ-ence of welding conditions.Weldability tests-component,Simul-ation,critical,Description and application Comparison of weldability of different metals welding defects and causes. Testing of weld-Visual-destructive-selection of suitable method of testing as per quality .

Topic No : 4 METAL MACHINING 09+12 =21

Introduction scope and limitations of machining machining methods,Principle elements of metal cutting, Lathe functioning,constructional details of bed,head stock tail stock saddle cross slids,compound slide,lead screw, feed shaft and tumbler gear.,Turning-Drilling.,Work holding methods for lathes,Drilling mechine,type of drill machings construction of drilling machine,drill chuck,drill shank and types of drills.,Machining: Shaping slotting and planing machings constructions,functions of main parts.Work Holding devices-Quick return machanism for shaper,planer and slotter

30/114

(III) (

-- --

Topic No 5: Production Processes 14+04=18

Hot and cold working of metal,principles,operations and examples,Forging processes coldand hot working of metals,principles and operations in forging,presses and hammers,forging dies,hammer and drop forging techniques, examples of forging of crank-shaft,connecting rod,gear-blanks etc.,Defects in forged parts and their remedies., Rolling-hot rolling characteristics classification of rolled products rolling methods.,Rolling mill trains-single line,multiline,cross country,staggered,continuous,production-methods Rolling of tubes seamless and welded. Defects in rolled producta and remedies.,Wire drawing basic principles and operation,Power spinning basic principles and advant age production of cone, cylinder and parabolic shapes., Threed Rolling advantages and limitations,thread rolling techniques-radial infeed tangential infeed,flat die rolling calculation of blank diameter for various types of threads to be rolled. Numerical problems.Galvanizing process-applications defects and remedies.

--

ADVANCED DIPLOMA IN MECHATRONICS 30/115

LIST OF PRACTICALS

SUBJECT :- PRODUCTION TECHNOLOGY -I

S.No.	Practical details
1	2
1-	Carpentry practice on Sawing planning chiselling and simple Joiner work
2-	Making a spit/solid pattern from wood
3-	Making a core-box
4-	Tempering of sandprctice of green and dry sand making
5-	Practice of core making and baking
6-	Practice of open mould in a two box,using spit pattern and solid pattern.
7-	Demostration of casting of metal in pit furnace
8-	Simple forging practics(Making a squre bar bar Making of a chisel) and bolt.
9-	Practice of upsetting of a round on power hammer
10-	Practice of sheet cutting with the help of straight and bent snips. Making small rectangular prism and cyliner.
11-	Practice of making of washer of any size on a flypress
12-	Practice of piercing,notching and circle cutting with the help of a Metal master machine
13-	Practice of sawing,filling and fitting of small rachangler pieces prepration of edges for welding.
14-	Linear measurement of Jobs with the help of calliper micrometer and simple measuring tools
15- welding)	Demonstration and practice of bead laying(on a falt piece
16-	Practice of welding of corner edge and tee joint
17-	Welding'V' butt joint.
18-	Practice of joining wires and rods of differant size on spot welding machine

19- Practice of marking gas flames with nozzles and making simple joints.

20- Demostration and practice of plain turning & step turning on any give piece of bar

21- Practice of Knurling grooving and boring on a lathe turning between centre nd using chuck.

22- Simple drilling practice on flat pieces.

23- Shaping of a ractangulary job

24- Study the construction and Working of forging hammer and forging a shaft.

25- Study of forging presses and dies and hot stamping of a gear-blank

26- To prepare a processsheet factors to be considered in selection of tools .,xe

27- selection of tools accessories and dies for drop forging of connecting rod and other products.

28- Study of defects in forged parts,testing and common remedial measures.

29- To study common wire drawing operation manually
To study wire drawing dies and wire drawing equipment

26- Study of the spinningthe and production of conical and cylindrical parts by power spinning.,Study of production of parabolic shape by powe spinning.

27- Study of various thread,rolling mechines available
Rolling of threads by radial infeed tangential infeed and flat die-rolling methods and to study the defects.

28- Study th

ADVANCED DIPLOMA IN MECHATRONICS

30/117

1. SUBJECT:- PRODUCTION TECHNOLOGY-I

(114)

REFERENES (BOOKS)

S.No.	Title	Author/Publisher
1-	Foundry Practice	Asian Publication
2-	Welding Technology Vol-I	Hazra Choudhary
3-	Mechanical Technology	Charnok
4-	Forging and Forming	Russi-hoff
5-	Manufacturing Processes	Young.
6-	Manufacturing science and Technology Vol. I & II	Suresh Dalela.
7-	Workshop Technology Vol.-I&II	Hazra Choudhary
8.	Workshop Technology Vol I & II	Raghuvanshi.

30/118

ADVANCED DIPLOMA IN MECHATRONICS

IV SEMESTER MECHATRONICS

Scheme of studies For (MECHANICS OF MACHINES)

S.No.	TOPIC	THEORY HRS	TUT./LAB HRS	TOTAL HRS
1-	Simple Mechanism	4	0	4
2-	Velocity & acceleration of points & Links	8	6	14
3-	Crank, Effort diagrams & Flywheels	6	4	10
4-	Power Transmission Belt, Ropes, chain-drive Gears&geartrains	10	4	14
5-	Balancing of machine & Vibration	6	3	09
6-	Governors	2	3	5
7-	Simple stresses &strains	8	4	12
8-	Shearforce & Bending Moment, Bending Stresses	12	6	18
9-	Torsion of Circular shafts	5	2	7
10-	Springs	3	-	3
		64	32	96

ADVANCED DIPLOMA IN MECHATRONICS (116) 30/119

MECHANICS OF MACHINES

CONTENT OUTLINE

TOPIC 1:- SIMPLE MECHANISMS:- 4+00=4

Introduction to theory of machines, Definitions, Kinematics, Dynamics, Statics and kinetics, link, kinematic pair, Kinematic chain, Mechanism, Machine, Inversions, relation between number of links, number of joints, no. of pairs, chain its inversions, slider crank chain and its inversions.

TOPIC 2:- VELOCITY AND ACCELERATION OF POINTS AND LINKS:- 8+6=14

Velocity in links, angular and linear velocity, ~~locating~~ relative and absolute velocities, Instantaneous centre, locating instantaneous centre of rotation, four bar and single slider crank mechanism, velocities by realtive velocity method. Acceleration of link centripetal and tangencial. Total relative and absolute acceleration. Acceleration diagram for four bar and single slider crank mechanism. Klein's construction for single slider crank mechanism. Analytical method of calculating the velocity and acceleration of piston in a reciprocating engine mechanism. (use of formula only)

TOPIC 3:- CRANK EFFORT DIAGRAMS AND FLYWHEELS:- 6+4=10

Dynamics of reciprocating engine mechanism. Inertia force due to reciprocating mass, piston effort, crank effort, turning moment on crank shaft, Analytical and graphical method of construction of turning moment ~~xxxxxxxxxxx~~ diagrams for machines, I.C. engines.

Fluctuation of energy, comfficient of fluctuation of energy and speed. Flywheel and its functions. Calculation of moment of inertia and weight of flywheel for I.C. Engines.

TOPICS-4 POWER TRANSMISSION:- 10+4=14

Classification of drives, belt drive, flat and 'V' belt, rope drive Ratio of tensions, slip, H.P. Transmitted, effect of centrifugal force on power transmission, Centrifugal tension total tension, maximum stress in belt, condition & velocity for maximum H.P. transmitted, Gear trains, classification function of idler, calculation of velocity ratio, Motor car gear box, chain drives. (Study only)

TOPICS-5 BALANCING OF MACHINE & VIBRATION 6+3=9

Need of balancing rotating masses, Balancing of a single rotating mass by a single mass rotating in the same plane, Balancing of several masses rotating in the same plane Introduction to the vibrations, Period of vibration, cycle, amplitude of vibration, frequency free or natural vibration, forced vibration, Damped vibration.

TOPIC 6:- GOVERNORS :- 2+3=5

Function of governor,difference between flywheel and governor,only description of following governors watt, porter,proell and hartnell, Height & speed relation for watt and porter governors. Definitions of sensitivity,stability, power and effort

TOPIC 7:- SIMPLE STRESSES AND STRAINS:- 8+4=12

Introduction, Types of ,loads and deformations,Types of stresses and strains,Hooke's law,Elastic limit,Poisson's ratio Modulus of Elasticity,Modulus of Rigidity,Bulk Modulus,Modular ratio,Temperature Stresses,Hoop stress,state of simple shear,Relation between the Elastic constants,volumetric strain,Rectangular block subjected to normal stresses.

Strain energy or Resilience,Proof Resilience Modulus of Resilience,Types of Loading Strain Energy stored due to gradual,sudden and Impact applied load.

TOPIC 8:- SHEAR FORCE AND BENDING MOMENT & BENDING STRESSES. 12+6=18

Types of beams,Types of loading,Shear force, Bending Moment,Relation between shear force and bending moment at a section.Sign convention,shear force and bending moment diagrams for cantilever,Simply supported beams

Assumptions,Bending stress,Neutral layer,Neutral axis,Moment of resistance,moment of inertia of symmetrical and unsymmetrical section. Distrubution of Bending stresses across the section,Bending stresses in symmetrical section, section modulus.

TOPIC 9:- TORSION OF CIRCULAR SHAFT:- 5+2=7

Torsion,Assumptions,Torsional stresses and strains strength of a solid shaft,Polar mom ent of inertia power transmitted by a shaft,torsional rigidigy,strength of a hollow shaft, replacing a shaft,

TOPIC 10:- TORSION OF CIRCULAR SHAFT SPRINGS:- 3+0=3

Stiffness of a spring,Types of springs Carriage or Leaf springs(semi-eliptical type) Helical springs,Closely coiled helical springs,Closely coiled helical springs subjected to an Axial load. Simple problems.

30/121

ADVANCED DIPLOMA IN MECHATRONICS
FOURTH SEMESTER

SUBJECT:- MECHANICS OF MACHINES

List of Practical:-

1- To study the four bar mechanism and slider crank mechanism.

2- To study various types of springs and their use.

3- To study the various shapes for ends of compression springs and meaning of terms used.

4- To Study universal testing machine.

5- Tensile test of M.S.Specimen (Prepared as per I.S.) on universal testing machine.

6- Compression test of wood/C.I.(As per I.S.) on universal testing machine.

7- Lzod test on impact testing machine.

8- Hardness test of steel speciman by Brinell Rookwell and Vickers hardness testing machine.

9- Charpy test on impact testing machine.

REFERENCE BOOKS:

1-	Strength of materials	by	Dr. B.C.Punmia, Vol. I&II R.S.Khurmi K.D.Saxena S.Ramanurthan I.B.Prasad Gurbaksh Singh Vol I&II
2-	Laboratory Experiments in strength of materials	by	R.D.Sharma
3-	Theory of Machines	by	Malhotra & Gupta, Jafdish lall, Ratan
4-	Mechanics of machines	by	J.K.Kale
5-	Mechanics of Materials	by	Kripal Singh(SI)
6-	Testing of Material	by	Surya Narayan
7-	Padarth Samarthya Tatha Nirman Vigyan Ke Sidhanta (Hindi Medium)	-(i) -(ii)	Gurcharan Singh Jain, Gupta, Vijay Gupta
8-	Mechanics of Materials	by	Kripal Singh
9-	Machino Ke Sidhanta (Hindi Medium)	by(i) (ii)	D.C.Meetal, Prasant Chakroborty Kapur, Kumar
10-	Padartha Ki Samartha	by	R.A.Agrawal
11-	Padartha Aur Padarths Vigyan	by	Bhatnagar
12-	BIS hand books 1995	-	-

30/122

(119)

ADVANCED DIPLOMA IN MECHATRONICS

IV SEMESTER

SUBJECT : MICROPROCESSOR & INTERFACING

SCHEME OF STUDIES

S.No.	NAME OF TOPIC	TH. HRS.	LAB/ TUT.HRS.	TOTAL
1.	Introduction	2	–	2
2.	Microprocessor Architecture	5	4	9
3.	8085/8080 A-MICROPROCESSORS	20	16	36
4.	INTERFACING PERIPHERALS (I/os)	20	16	36
5.	MICROPROCESSOR APPLICATIONS	8	6	14
6.	OVERVIEW OF TRENDS IN MICROPROCESSOR TECHNOLOGY	9	6	15
	TOTAL	64	48	112

30/123

ADVANCED DIPLOMA IN MECHATRONICS (120)
IV SEMESTER

SUBJECT: MICROPROCESSOR AND INTERFACING

1.Introduction: General concept, Funcion, importance and structure of microprocessor, microcomputer - digital, analog and hybrid computers. Importance of machine language and assembly language. IC's (SSI, MSI, LSI, LSI, VLSI'S)

2.Microprocessor architecture: Microprocessors and its architecture, operations and bus organisation. 8080A/8085 Microprocessor. 8085MPU and 8080A MPU Logic schematic, block diagrams their functions and architectures.

Instruction - Classification data transfer (copy) operations, arithematic, Logical branching and control operations. Instruction Format - word size, one byte two byte and three byte instruction opcode format, programming techniques, simple programs to generate instruction sets for addition, subtraction, division between 8080A and 8085 instruction of two hexa-decimal numbers. Illustrative assembly language programs with 8080A/8085 Mnemonics for data transfer, arithmatic and logic operations, branching, looping, counting and indexing techniques. Debugging Techniques.

Stack and Subroutiones - Stack information locations, resetting and displaying flags. Subroutins instructions, call and return instructions.

Illustrative Programs - Traffic signal generator, BCD to Binary conversion, BCD to LED code conversion, BCD addition and substration. 16-Bit Data transfer (copy) and Data Exchange Programs, Multiplication, subtraction with carry programms. Tools for developing assembly language programs.

3. Microprocessor memory: Memory and its organisation, memory chips 2114, 2716. Direct memory access.

4. Interfacing peripherals (I/Os): Functions of input/output and interfacing devices like keyboard, monitor, disk and printers. MPU communication methods peripharal input/output and memory mapped input/output. Tristate devices, buffers, decoders, encoders. latches their types and block diagrams. Define Peripherals and interfacing terms. MPU Communication with peripherals modes as parallel or serial.

Parallel I/O - Device selection and data transfer, Basic interfacing concept, input/output with decoders. LED display seven segment display, data input with DIP switch & keyboard.

Interupts - 8085 Interupts, 8086 Interupts, Restart instructions, multiple interupts Trap, RST-5.5, 6.5 and 7.5 programable interupt.

30/124

(121)

Data Converters - Basic concept of A to D converter and D to A converters and interfacing with microprosser.

Serial I/O - Basic concept of I/O requirements, Alphanumeric codes, Transmission format, Parity checks, Baud rates, Modem Serial I/O data communication standards- RS232, RS232C, TTY, SID SOD and USART, RS422, RS423 and GPIB488.

5. Microprocessor Applications : A microcomputer system, its design requirments 8085 MPU with its Bus organisation.

6. Overview of trends in microprocessor Technology: (Main Features and comparision)

8-bit Microprocessor - In addition to intel 8085/8080A others (like Z-80, MC6800, Single chip microprocessor intel 8048 and 8051)

Advance Technology 16 bit and 32 bit microprocessor - Intel 8086/8088 and 8087 parallel processor (Co-processor/Numeric Processor), Motorola MC 68000 and Z8001/8002. Intel 80286, 80386, 80486 and pentium chips. Concept and features of Super Micros/ Micro Mainframes. Single chip and multiple chip microprocessor.

* * *

19.3.97

19.3.97

30/125

(122)

ADVANCED DIPLOMA IN MECHATRONICS

IV SEMESTER

SUBJECT:-MICROPROCESSOR & INTERFACING

List of Experiments:

1- Study various parts and incorporated ICs to 8086/8088 Microprocessor system.

2- Write a programme to multiply two 16-bit binary numbers to give a 32-bit result for 8086/8088 and execute.

3- write a programme to store data in a memory segment 8086/8088 and execute.

4- Write a programme to define keys, display the keys and execute the key, "ends the programme" for 8086/8088 (for Key Assignment).

5- Write a programme to transfer a group of data to memory location using PUSH and POP instructions and execute.

6- Write a programme to add 8-Digit BCD number in AX and BX to 8- Digit BCD number in CX and DX, result should be stored in CX and DX. Execute the programme.

7- Prepare Hardware intreface for Numeric keyboard/ Display for 8085/8086/8088 write a programme and execute.

8- Configure a Microprocessor for 7-segment LED Display, Write the programmes, prepare functional table for decimal number0-9 and execute.(Comm.Elc+ Inds Elx.).,

9- Prepare a modelof "Traffice Signalling System" using Microprocessorand 8225(Comm.+Ind.Elx.)

10- prepare a hardware interface for speech synthesising for Microprocessor to record and play-back through a speaker using ADC 080x and DAC 08XY (Comm.Elx.).

11- Interface a Temp.Controller to Microprocessor using ADC 0804 and 8255 and display temp.(Ind.Elx)

12- Measure a given frequency using Microprocessor interfacing with 8255 and verify the frequency (comm.Elx.).

13- Study the internals hardware circuit of 80286/ 80386/80486 based Microprocessor with co-processor and without co-processor justify the use of Math co-processor.

14- Programme a PLC for stepper motor controlling (if possible)

15- Write programmes for 6800/68000.(if possible).

30/126

(123)

ADVANCED DIPLOMA IN MECHATRONICS

IV SEMESTER

SUBJECT :- MICRO PROCESSOR & INTERFACING

REFERENCE BOOKS:-

1- Microprocessor Architecture Programming & Application
-Ramesh S.Gaonkar,Willey Eastern Pub.

2- Introduction to Microprocessor.
-Aditya P. Mathur,Tata-Mc Graw Hills

3. Introduction to Microprocessor: Software,Hardware Programming. -Lance A.Laventhall,Prentice-Hall Pub.

4. Microprocessor and Digital Systems.
-Douglus V.Hall,Mc-Graw Hill Pub

5. Microprocessor & Interfacing.
Dougus V.Hall,Mc.Graw Hill Pub.

6. Microprocessors & fundamentals.
-B.Ram,Dhanpat Rai & Sons Pub.

==+==

DIPLOMA IN MECHATRONICS

IV SEMESTER

30/127

SUBJECT: INDUSTRIAL CONTROLS

SCHEME OF STUDIES

(124)

		Theory hours	PR. HRS.	TOTAL HRS.
1.	Control and regulation	4	TOTAL 32 HRS.	
2.-	Hydraulic control system	4	FOR LAB. WORK	
3.	Hydraulic power units, measuring & controlling.	4		
4.	Hydraulic cylinders, motors and accessories.	2		
5.	Symbols used in hydraulic circuits.	2		
6.	Hydraulic control circuits	4		
7.	Introduction to pneumatic controls	2		
8.	Production of compressed air and its treatment.	2		
9.	Distribution of compressed air	2		
10.	Symbols used in pneumatic circuits.	2		
11.	Pneumatic Control Systems.	3		
12.	Combination Systems.	3		
13.	Process Control	10		
14.	Electro-Pneumatic Controllers	8		
15.	Speed Control of Motors	12		
	TOTAL	64	32	96

30/12B

IV SEMESTER: ADVANCED DIPLOMA IN MECHATRONICS

SUBJECT : INDUSTRIAL CONTROLS

CONTROL AND REGULATION

1 Meaning and scope of control technology

2 Control - its meaning and main elements (Signal, control, correcting and drive) and their functions.

3 Basic control Principles used in control of elements i.e. mechanical, pneumatic, hydraulic, electrical, electronic (CNC), etc. or their combination

4 Name the principal types of controls i.e. guidance control and programme control (including time pattern path pattern, operational cycle control, etc.) their meaning, need and some illustrative examples.

5 Introduction to general working mechanism of each type of basic control Principles.

6 Block or overall system diagram of a control system and identify its sub-system (e.g. sensorics, actorics, processories, software, network)

HYDRAULIC CONTROL SYSTEM

1 Hydraulic transmission of force flow rate law, continuity equation, three forms of hydraulic energy, Bernaulli's theorem, loss of head due to friction, bend, enlargement of pipe etc.

2 Requisite preparations of fluids used in control systems, commonly used fluids, their characteristics, functioning and limitations.

HYDRAULIC POWER UNITS, MESURING AND CONTROLLING

1 General circuit diagram for a hydraulic control system and its main elements.

2 Electric motor and (appraisal of) its characteristics.

3 Different types of pumps used, their construction, working characteristics, applications and limitations.

4 Different types of pressuresand flow measuring devices , their construction, working and applications.

5 Different types of pressure and flow controlling devices (valves), their construction, working and applications.

30/129

IV SEMESTER: ADVANCED DIPLOMA IN MECATRONICS

SUBJECT : INDUSTRIAL CONTROLS

126

HYDRAULIC CYLINDERS, MOTORS AND ACCESSORIES

1. Types of hydraulic motors their Difference from hydraulic pumps.

2. Purpose, construction and working of hydraulic motors (emphasis on axial-piston motor) their applications and limitations.

3. Accessories used in hydraulic control systems viz. pipes, joints, etc. their requirements, purpose and assembly.

SYMBOLS USED IN HYDRAULIC CIRCUITS

1. Various symbols used in hydraulic control systems as per Is.

2. Representation of some given actual hydraulic circuits through the symbols.

HYDRAULIC CONTROL CIRCUITS

1. Principal hydraulic circuits for different uses e.g. volume-speed control, parallel control of number of equipment, speed stabilizer, etc.

2. Develop hydraulic circuit for some simple applications and draw it using suitable symbols.

3. Fields of application of hydraulic control system e.g. hydraulic shaper, assembling press, etc.

4. Common sources of faults and their remedy.

INTRODUCTION TO PNEUMATIC CONTROLS.

1. Meaning and scope of pneumatic control system and limitation.

2. Comparsion of principle of hydraulic control system with pneumatic control system.

3. Fluid used and its properties.

PRODUCTION OF COMPRESSED AIR AND ITS TREATMENT

1. Need and characteristics of compressed air.

2. Characteristics of compressors, their types, construction, working and installation of different type of compressors. Peculiarities of non-lubricated compressors.

3. Treatments to compressed air to make it moisture-free and oil free.

30/130

(127)

DISTRIBUTION OF COMPRESSED AIR

1. Purpose, construction working and installation of air receivers, accumulators, pipings and fitting.

2. Purpose, construction and working of different types of pneumatic cylinders and valves (valve actuation, non-return valves, pressure control valves, flow control valves, etc.)

3. Purpose, construction and working of different types of air-motors.

SYMBOLS USED IN PNEUMATIC CIRCUITS

1. Various symbols used in pneumatic control system.

PNEUMATIC CONTROL SYSTEMS

1. General features of pneumatic control systems and design.

2. General logic control circuits.

3. Scope of application and examples of pneumatic control systems e.g. clamping, feeding, assembly, cutting forming, measurement and inspection, material handing, etc.

4. Special application of pneumatic systems such as in mining.

5. Common maintenence problems with air compressors & accessories, air mains, cylinders, valves, appliances & systems, etc. and their remedy.

COMBINATION SYSTEMS

1. Limiations of pneumatic system and hydraulic systems.

2. Some example and circuit diagrams of combination systems and the advantages obtained.

PROCESS CONTROL

Importance and definitions of variables. Open loop and closed loop control system - block diagram Servomechanism Characteristics of control, gain stability and accura-cy. Ineffects of instability, time lag and its effect on control. Mode of control ON-OFF, proportional integral and derivative, Electrical application of cont

1

ELECTRO-PNEUMATIC CONTROLLERS

(128)

Introduction to pneumatics, advantages different stages involved in the pneumatic systems electro-pneumatic controls.

SPEED CONTROL OF MOTORS

Advantages of Electronic speed control of Electrical Motors, Speed control of DC. shuntmotors by single phase and three phase controlled Rectifiers, Chopper drive system, Speed Regulation by Armature current and voltage control, Reversible drive - Armature current Reversal, field current Reversal Speed control of DC. series motor.

Speed control of AC. Drives Speed control of Induction motor using TRIAC, sped control of slipring Induction motor by SCR in rotor circuit.

30/132

(129)

ADVANCED DIPLOMA IN MECHATRONICS

IV Semester

Subject - Industrial Controls

List of Experiments/Tutorials

1. Verification of Bernaulli's Theorem
2. Demonstration of loss of Head due to friction, bend etc.
3. Study of constructional details & working of hydraulic Pumps.
4. Plot characteristic curves for hydraulic pump for different valve positions in the hydraulic circuit
5. Assemble a simple hydraulic circuit from a given drawing and measure the effects of alternative positions of controls on performance.
6. Study the construction & working of hydraulic cylinders (single & double acting)
7. Study of construction & working of axial piston hydraulic motor & its discharge characteristics against pressure (or restrictions) in the circuit.
8. Develop a simple hydraulic circuit for a given application represent it on drawing using symbol & verify/or modify to have desired performance.
9. To study the construction of air-filters
10. Study of the construction & working of pneumatic cylinders
11. Study of the construction & working of air motors
12. Assemble a simple pneumatic control circuit from a given drawing using symbols & find out the performance characteristics of the circuit.

30/133

ADVANCED DIPLOMA IN MECHATRONICS

IV SEMESTER

SUBJECT :- INDUSTRIAL CONTROLS

(130)

REFERENCES

(1) Control of fluid power (Analysis & Design) 2nd edition (revisied) : by D McCloy & H.R. Martin Ellis Harwood Ltd. John Wiley & Sons.

2. Pneumatic control (An introduction to Principles) : By Werner Deppert & Kurt Stoll Vogel-Buchvering Worzubnrgg.

(3) Technology of the metal trade Hans Appold et.al. : Willey Enstern Ltd.

(4) Process Control : Peter Heriott Pub. TMGH

(5) Control System Engineering : Nagrath & Gopal Pub. Willey Eastern Ltd.

30/134

(131)

ADVANCED DIPLOMA IN MECHATRONICS

IV SEMESTER

SUBJECT - COMPUTER APPLICATION

S C H E M E O F S T U D I E S

Topic S.no.	Name of Topic	Th. Hrs.	Tut./Lab. Hrs.	Total Hrs.
A.	WORD PROCESSING	08	12	20
1.	Introduction	01	-	01
2.	Editing	01	02	03
3.	Formating & Printing Features.	03	04	07
4.	Special W.S.Features	02	04	06
5.	W.S.Version	01	02	03
B.	D BASE III +	30	30	60
1.	Introduction	01	-	01
2.	Building Database	03	04	07
3.	Organise Database	03	02	05
4.	D Base Program and procedure	21	22	43
5.	Compiling Techniques	02	02	04
C.	LOTUS 1-2-3	14	26	40
1.	Introduction	01	-	01
2.	Building Spread Sheet	01	02	03
3.	Using @ Functions	02	04	06
4.	Working with Spread Sheet	02	04	06
5.	Graphics	02	04	06
6.	Building A Database	02	04	06
7.	Data Share Techniques	02	04	06
8.	Introduction to Mayco	02	04	06
D.	INTRODUCTION TO DESK TOP PUBLISHING SOFTWARE & APPLICATION.	12	12	24

ADVANCED DIPLOMA IN MECHATRONICS II SEMESTER

SUBJECT : COMPUTER APPLICATION

(A) WORD PROCESSING

1. INTRODUCTION : Word Processing. Word Processor. Word star software. Common support files. Installation. configuration and starting procedure. Opening menu. Document and non document mode. Use help facility and function key.

2. EDITING : Block operation making. Move Copy. Hide, Delete. Write, Read. Search and replace of text. Dot command. Quick commands.

3. FORMATTING AND PRINTING FEATURES : Page formating. Margins. Ruler. line and tab setting. Paragraph. Page break. header footer. line space. Line height. Printing features. Document printing and mail merge printing procedure.

4. SPECIAL W.S. FEATURES : Documents Vs Nondocument and their conversion. Indexing. Projecting. Merging of files. Math operations shorthand and spell star.

5. W.S. VERSION : The latest release of W/S and its new applications and features.

(B) DBASE III +

1. INTRODUCTION : Technical specifications. File types. Record size. Fields. Field types. Files operation. Numeric accuracy and memory variables. command keywords and function keys. Environment setup commands. Command history. Dot command and their syntax.

2. BUILDING DATABASE : Create / Open / append / edit / close modify DBF. Building search conditions and retrive records. Work areas handing multiple database files.

3. ORGANISE DATABASES : Sorting / Indexing of DBF. Design custom screen. Create / modify lables and reports. Create catalog. View. Query. Memory variables and text files. Managing numeric and data fields with appropriate function and replace commands.

4. DBASE PROGRAM AND PROCEDURE : Create command/ Procedure files. programming techniques. Do-while-enddo loops. decision making-if-end-if and do case-endcase and macro substitution. Design and development of Programme. Debugging techniques and error messages.

5. COMPILING TECHNIQUES : Limitation of Dbase III+. Introduction to compliers (cliqper). Linking and compling dbase III+ programmes. Execution of the complies programme. Runtime errors.

30/136

131

133

(C) LOTUS 1-2-3

1. INTRODUCTION : Spreadsheet defination, Lotus 1-2-3 soft. ware as spread sheet. Database and graphics, 1-2-3 common support files and its installation procedure, Hardware requirments for memory for fast computation .

2. BUILDING SPREADSHEET : Basic structure of a spreadsheet, Use of menu command function keys, Meaning of row, Coloumn, Cell, Cell width, Cell address, Range & range address. Enter/ Edit lables and values in cells, Saving and calling of spreadsheet.

3. USING @ FUNCTIONS : Defination, Argument and syntax of @ functions used for statistical, Date, Logical mathematical and financial computation. Some special @ functions used for engineering financial and graphics display. @ If functions for testing against condition and selecting certain desired information from a spreadsheet.

4. WORKING WITH SPREADSHEET : Formating and computing values entered in cells or in range. Copying, Moving, Hidding, and erasing of cells/ range. Faster way to move around screen and spreadsheet. For longer spreadsheet larger then screen, Creating windows and moving between windows. Printing whole or part of spreadsheet with cretain printing features.

5. GRAPHICS : Create a bar, line , XY, or pie graphs, View Redraw and Printing Graphs.

6. BUILDING A DATABASE : Create a database, compute fields. Organise & sort a database. Print data-bases, perform statistical analysis. Build a query and data tables.

7. DATA SHARE TECHNIQUES : Link two or more databases, Tansfer 1-2-3 data file to dbase III and vise versa.

8. INTRODUCTION TO MARCO : Defination, Create simple marco and make a marco automatic.

(D) INTRODUCTION TO DESK TOP PUBLISHING, SOFTWARE AND APPLIC. ATION.

ADVANCED DIPLOMA IN MECHATRONICS, IV SEMESTER.
SUBJECT:-COMPUTER APPLICATION.

(134)

List of Practicals.

(1) Word Processing(Wordstar Professional)

STUDENT SHOULD PERFORM FOLLOWING OPERATIONS.

1-Moving the Cursor
2-Scrolling
3-Inserting and Deleting Text
4-Saving a File
5-Block Operations-Move@Copy/Hide/Delete/Read/ Write.
6-Searching & Replacing
7-Margins & Tabs
8-Special Printing Features
9-Dot Commands
10-Headers,Footers,Page Numbering etc.
11-Shorthand
12-Indexing &Table of Contents.
13-Merging Files with mailmerge &Printing Merged Documents.
14-Checking spellings with correctstar/Spellstar

(2) Database Management Systems-d BASE III PLUS

STUDENTS SHOULD PERFORM FOLLOWING OPERATIONS.

1-Using Files,Fields and Memory Vari-ables
2-Using d BASE-III plus commands.
3-Creation of Database.
4-Modifying &Editing Databases.
5-Oraganisation of a Database(Sorting & Indexing)
6-Creating & Modifying Screens.
7.Creating & Modifying Reports/Lables.
8.Programme Files & Command Language.
9-Con-trol Commands.
10-Data Input Commands.
11-Work Areas &Linking of Files.
12-Environmentals & Parameter Control.
13-Memory Variables.
14-d BASE III Plus Functions.
15-Data Arithmatic.
16-Designing & Developing Programs in dBASE III Plus.
17-dBASE III Pluse Error & Other Messa-ges.
18-Importing & Exporting Data between different programs.

30/138

19-Introduction to d BASE III plus Compilers (Clipper)

20-Similarities and difference in dBASE III pl

21-Compiling d BASE III Plus Programs with Clipper.

22-Linking complied programs with PLINK 86 Object Linker.

23-Executing compiled Programs.

24-Run time Errors.

(3) Spreadsheets-Lotus-1-2-3

STUDENTS SHOULD PERFORM FOLLOWING OPERATIONS.

1-Cursor movement keys.

2-Labels & Numbers

3-Formulas,Functions & Logical Operators.

4-Relative,Absolute & Mixed Addresses.

5-Ranges.

6-Lotus 1-2-3 Commands.

7-Copy/Data/File Graph /Move/Print/Range Worksheet/System/Quit.

8-Lotus 1-2-3-Functions.
Date,Database,Database Statistical.

9-Mathematical,Financial,Logical,Special, String.

10-Improting & Exporting Data between different programs.

11-Lotus 1-2-3 Programming-Macro Command Language.

12-Lotus 1-2-3- Error & Other Messages.

13-Printing Graphs with Lotus Printgraph.

30/139

ANNEXURE-A

Advanced Diploma in Mechatronics

FIFTH SEMESTER

Inplant Training(Duration 16 weeks)

	Component of Assessment	Marks Alloted
A.	In Industry	
	I Attendance and General discipline	25
	II Daily diary Maintenance	25
	III Initiative & Participative attitude	50
	IV. Assessment of Training by Industrial Supervisor	100
B.	In Institution	
	V. Training report	100
	VI Seminar	50
	VII Viva-Voce	50
	Total	400

Sd/-
(B.K.Rawat)

Sd/-
(K.C.Mahajan)

Sd/-
(N.K.Joshi)

30/140

ADVANCED DIPLOMA
IN
MECHATRONICS

(SIXTH SEMESTER)

STATE CURRICULUM DEVELOPMENT CENTRE

M.P. BOARD OF TECHNICAL EDUCATION

A/4, OFFICE COMPLEX, GAUTAM NAGAR, BHOPAL - 462023

TEL : (0755) 583656, 583673, 583627

REPORT

30/141

A workshop on curriculum development in Mechatronics VI Semester was organised by M.P.Board of Technical education Bhopal for 4 year Advanced Diploma course in Mechatronics as per the following schedule;

Venue	:	**Production Engineering Department, S.V.Govt.Polytechnic Bhopal.**
Dates	:	**19-21 January 1998.**
Timings	:	9 AM to 5 PM.

The followinmg Experts/Faculty from Engineering College, Polytechnic and PDU have attended the above workshop.

1. Prof. Dr. C. M. Sadiwala, M.A.C.T. Bhopal.
2. Mr.K.K.Jain, Secretary M.P. B.T.E. Bhopal.
3. Mr.K.C.Mahajan, Expert Teacher PDU Bhopal.
4. Mr.S.R.Madan, HOD Mechanical S.V.Govt.Polytechnic, Bhopal.
5. Mr.R.M.khan,Lecturer in Mechanical, S.V.Govt.Polytechnic, Bhopal
6. Mr.H.K.Parekh, Sr.Lecturer, S.V.Govt.Polytechnic, Bhopal.
7. Mr.Sharad Saxena,Lecturer in Production Engg., S.V.Govt.Polytechnic, Bhopal.
8. Mr.Rajeev Gupt, Lecturer in Mechanical, S.V.Govt.Polytechnic, Bhopal
9. Mr.A.K.Tuli,Lecturer in Production Engg.,S.V.Govt.Polytechnic, Bhopal.
10. Mr.Mukesh Katariya, Lect.in Mechanical, Govt.Polytechnic, Dhar.
11. Mr.Moiz Contractor,Lect.Mechanical Govt.Polytechnic Pachore.

Contd...2

30/142

The following deliberations were made;

1. The course structure proposed earlier by TTTI Bhopal for VI and VII Semesters was restructured and accordingly the scheme of studies/examinations (in prescribed format of BTE) is finalised and prepared for the Advance diploma in Mechatronics as per annexure 1&2 (Scheme of studies/ Examinations for VI Sem & VII Sem respectively)

2. The course details are prepared by individual groups of experts and faculty as per the scheme of studies following all possible norms of AICTE.

3. The group has recommended to split the subject of CNC in to two parts that is CNC-I in VI semester and CNC-II in VII semester of Advance Diploma in Mechatronics to maintain the course uniformity.

4. The syllabus of subject CNC-I of VI semester, Mechatronics prepared in this Workshop is recommended to be followed, as it is, for the subject CNC of VII semester of Advanced Diploma in Manufacturing Engineering.

5. A subject on Maintenance Engineering is considered for VII semester by merging Maintenance engg. I and II (earlier proposed in VI and VII semester respectively) to provide thorough knowledge and to develop skill for maintenance and repair of CNC,CAD,Robots etc.

6. The curriculum for Business Communication of VII semester was already prepared by M.P.B.T.E. for Advanced Diploma in Manufacturing Engineering . The same syllabus is recommended for this course of Mechatronics in VI semester.

7. The contents of the subjects were developed by separates groups after discussing various aspects related to the curriculum development, with the members and experts for reaching to common final decision. The group has tried to incorporate all possible aspects proposed by AICTE in this context .

Course Coordinator

K.K.JAIN

मैकाट्रानिक्स पाठ्यक्रम समिति का कार्यवाही विवरण

आज दिनांक 11.3.98 को एडवांस डिप्लोमा इन मेकाट्रानिक्स की पाठ्यक्रम समिति की बैठक संस्था कार्यालय में प्राचार्य, शासकीय पोलीटेकनिक, धार की अध्यक्षता में सम्पन्न हुई। समिति में निम्न सदस्यों ने भाग लिया -

1. प्राचार्य, शासकीय पोलीटेकनिक, धार
2. श्री एम.जी. राव, व्याख्याता, शास. कलानिकेतन, जबलपुर
3. श्री एस.यू. किदवई, वरिष्ठ उपमहाप्रबंधक, बीएचईएल, भोपाल
4. श्री के.सी. महाजन, विशेषज्ञ शिक्षक, पीडीपू भोपाल
5. श्री एस.एन. डागा, अपर महाप्रबंधक, बीएचईएल, भोपाल

समिति ने निम्न प्रमुख निर्णय लिए -

1. समिति ने उक्त पाठ्यक्रम के छठवे सेमे. की प्रस्तावित पढ़ाई एवं परीक्षा योजना एवं प्रस्तावित पाठ्यचर्या को यथावत अनुमोदित कर तुरंत प्रभाव से लागू करने की अनुशंसा की।
2. समिति ने उक्त पाठ्यक्रम के सातवे सेमे. की प्रस्तावित पढ़ाई व परीक्षा योजना को यथावत अनुमोदित किया, परंतु पाठ्यचर्या को आवश्यक संशोधनोपरांत अनुमोदित किया एवं इसे वर्ष 1998 से लागू करने की अनुशंसा की। संशोधन संलग्नक क्र.1 पर अंकित है।

(एम.एस. झामड़) (एम.जी. राव)

MADHYA PRADESH BOARD OF TECHNICAL EDUACATION, BHOPAL

ADVANCED DIPLOMA PROGRAMME IN MECHATRONICS

(To be introduced from 1998-99)

30/144

AS PER AIBTE NO

TOTAL TIME FOR SEMESTER = 16 WEEKS @ 36 PERIOD PER W

TOTAL HOURS =

SCHEME OF STUDIES AND EXAMINATION
VI SEMESTER

S. NO.	NAME OF SUBJECT	SCHEME OF STUDY			SCHEME OF EXAMINATION										
		CONTENT HRS. PER WEEK (SEMESTER)			SESSIONAL MARKS		PROGRESSIVE ASSIGNMENT		BOARD EXAMINATION						
		THEORY	LAB.	TOTAL	TERM WORK	LAB. WORK	I	II	THEORY PAPER	DURA - HRS	MKS	PRACTICAL	DURA -HRS.	MKS	REMAR
1.	PRODUCTION TECHNOLOGY - II	80	48	128	20	25	10	10	1	3 Hrs.	100	1	3 Hrs.	50	
2.	INSTRUMENTATION	80	48	128	20	25	10	10	1	3 Hrs.	100	1	3 Hrs.	50	
3.	C A D	48	80	128	20	25	10	10	1	3 Hrs.	100	1	3 Hrs	50	
4.	BUSINESS COMMUNICATION	64	-	64	20	-	10	10	1	3 Hrs.	100	-	-	-	
5.	C. N. C. - I	80	48	128	20	25	10	10	1	3 Hrs	100	1	3 Hrs	50	
	TOTAL	352	224	576	100	100	50	50	5	-	500	4	-	200	

1.	No. of Theory Paper	: 05	7.	Ratio of Theory Marks	: 500 / 500	9.	PASSING MARKS FOR
2.	Total Theory Marks	: 500		and (Sessional+Prog.Assess+	: 1 / 1		(a) Theory - 33%
3.	No. of Practicals	: 04		Practical+Inplant Training Marks) i.e			(b) Practicals - 40%
4.	Total Practical Marks	: 200					(c) Sessionals - 60%
5.	Inplant Training Marks	: -	8.	Total Marks	: 1000		(d) Inplant Trg - 50%
6.	Total Marks of Sessional + Prog. Assessment + Pract & Inplant Training	: 300					

30/1415

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

NAME OF SUBJECT : **PRODUCTION TECHNOLOGY - II**

RATIONALE

In the increasingly competitive environment, Production Technology is key to Industrial prosperity. The recent developments in the field of metal working are responsible not only for new machining techniques, but also for refining many basic processes and equipments.

This subject of Production Technology-II includes the topics pertaining to unconventional machining processes, finishing processes, Automates, Production Design, Process Engineering, Tool Design, Quality Control in manufacturing etc.

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

With the development of technology, many new materials such as Ceramics, Carbides 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.

Modern developments of high speed machines and properties of wear , friction, fatigue, and corrosion resistance form the basis of giving higher emphasis to finishing processes.

Keeping in view of the requirement of heavy engineering manufacturing and mass production units, the chapter automates is also included.

Introductory knowledge about Product Design, Tool Design, Process Engineering and Quality Control in manufacturing is also essential for giving an overall view of Production Technology.

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

30/146

VI - SEMESTER

NAME OF SUBJECT : PRODUCTION TECHNOLOGY - II

SCHEME OF STUDIES AND SPECIFICATION TABLE

S. No.	Topic	Hrs. of Study			K	C	A	Total
		Th.	Pr.	Total				
1.	Finishing Processes	08	04	12	06	04	06	16
2.	Unconventional Machining processes	12	08	20	08	06	04	18
3.	Automates	12	10	22	06	04	02	12
4.	Product Design	08	00	08	04	04	05	13
5.	Process Engg.	14	04	18	04	04	05	13
6.	Tool Design	12	10	22	06	04	04	14
7.	Quality Control in Manufacturing	14	12	26	06	04	04	14
	TOTAL	80	48	128	40	30	30	100

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

NAME OF SUBJECT : PRODUCTION TECHNOLOGY - II

Theory per week : 5 Practical Per week : 3

Topic No	Topic Details	Hours of Study T+P=Total
1.	**Finishing Processes :** - Purpose, Necessity, Different finishing processes e.g. Honing, Lapping, Buffing, Super finishing, Burnishing and application of above processes.	08+04=12
2.	**Un Conventional Machining processes :** - Purpose, Necessity, Different types of un-conventional machining processes e.g. ECM, EBM, AJM, USM, LBM. Application of above processes.	12+08=20
3.	**Automates :** - Need, Uses, Transfer machines, Capstan lathe, Turret Lathe, Introduction to automatic screw machines, Introduction to copying lathe.	12+10=22
4.	**Product Design :** - Product design, Inspection, assembly, functions of research and development.	08+00=08
5.	**Process Engineering :** Process planning, operations planning, machine capacity and selection, production planning and control, types of production systems, Types of manufacturing : Job, Batch and continuous Production, Raw materials, finished parts, loading, economic order quantity, scheduling and loading.	14+04=18
6.	**Tool Designing :** General Consideration in tool design, Principles of Jigs and Fixtures, Design of simple types of Jigs and Fix-	12+10=22

M. P. BOARD OF TECHNICAL EDUCATION 30/148

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

NAME OF SUBJECT : **PRODUCTION TECHNOLOGY - II**

Theory per week : 4 **Practical Per week : 3**

Topic No	Topic Details	Hours of Study T+P=Total
	tures, Types of locations, clampings, supports, positioning and guiding for tools.	
7.	**Quality Control in manufacturing :** Organising of quality control, Design of Inspection procedure, Quality assurance, Control charts for attributes, Acceptance sampling, Sampling Plan. Introduction to ISO 9000 standards.	14+12=26

30/149

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

NAME OF SUBJECT : **PRODUCTION TECHNOLOGY - II**

Theory per week : 5 **Practical Per week : 3**

Topic No	Topic Details	Hours of Study T+P=Total
	LIST OF PRACTICALS	
1.	Cleaning, Electroplating & Buffing minimum two jobs.	
2.	Superfinishing one job.	
3.	Planning of Tool layout and job making on Capstan or Turret lathe - Minimum two jobs.	
4.	Exercises on Acceptance sampling. (i) Attributes (ii) Variables	
5.	Exercises on Control Charts for attributes. Variables P-Charts, C-Charts	
6.	Exercises on design of Inspection procedure for large number of components and small number of components.	
	TOTAL HRS. =	**48**

30/150

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

NAME OF SUBJECT : **PRODUCTION TECHNOLOGY - II**

REFERENCES

S.No.	TITLE	AUTHOR / PUBLICATION
1.	Elements of Work-shop Technology (Vol. I & II)	Hazra Choudhary SK Media Promoters Pvt. Ltd.
2.	HMT, Production Technology	Tata Mc Graw Hill, New Delhi
3.	Process and Materials of Manufacture	Linderberg Roy Allyn and Bacon Inc.
4.	Production Technology (Vol. III)	Patel R. C. & Gupta C. G. C. Jamndas
5.	Production Technology	R. K. Jain
6.	S. Q. C.	L. G. Rant
7.	Inspection and Quality Control	M. V. Raman
8.	Industrial Engineering	Prof. S. C. Saxena & P. N. Sethi M.P. Hindi Granth Academy, Bhopal.
9.	Production Technology	O. P. Khanna & M. Lal Dhanpatrai & Sons
10.	Workshop Technology (Part III)	Chapman WAJ CBS Publishrs & Distributors - Pvt. Ltd., New Delhi.

30/151

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

NAME OF SUBJECT : **INSTRUMENTATION**

RATIONALE

Experimental development approach reduces the responsibilities of attending the preliminary design phase at a new device or process. In fact knowledge gained through experimental programs continually strengthens and supports the theoretical phases.

Measurements and the correct interpretations are necessary part of any engineering research and development program. Naturally, the measurements must supply reliable information and their meanings correctly comprehended. It is a primary purpose of this curriculum to supply the basis for such measurements.

The subject of instrumentation applies to a widely diverse list of physical quantities, many of which are not necessarily limited to the field of Mechanical Engineering. Such items include linear and angular displacement, time intervals, stress and strain, linear and angular acceleration, precise dimensional measurements, vibrational frequency and amplitude, pressure, temperature and flow measurements etc. Greatest advances during the past ten years have undoubtedly occurred in general area of dynamic, static measurements.

30/152

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

NAME OF SUBJECT : **INSTRUMENTATION**

SCHEME OF STUDIES AND SPECIFICATION TABLE

S. No.	Topic	Hrs. of Study			K	C	A	Total
		Th.	Pr.	Total				
1.	C R O	05	04	09	03	05	04	12
2.	Recorders	10	04	14	02	05	02	09
3.	Transducers	35	15	50	20	08	06	34
4.	Sensors	20	15	35	15	06	06	27
5	PLCs	10	10	20	10	06	02	18
	Total	80	48	128	50	30	20	100

30/853

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

NAME OF SUBJECT : **INSTRUMENTATION**

Topic No.	Topic Details	Hours of Study T+P=Total
1.	**CRO:** Blockdiagram,functions, use of CRO for measurment of Voltage, Current, Frequency, Component Testing & Circuits Testing.	5 + 4 = 9
2.	**Recorders:** Necessity of recorders,types of recorders (strip chart, X-recorder, plotters, recording methods) their functions and applications.	10+ 4=14
3.	**Transducers:** Need, classifications, selection criterion,features, construction details and application of physical quantities.e.g. Displacement, Force, Torque, Temperature, Pressure, Flow, Level and Vibrations.	35+15=50
4.	**Sensors :** Need, selection criterion, construction details of primary and secondary sensors. Types of sensors, Principle of inductive proximity sensors, Capacity proximity sensors and Optical sensors.	20+15=35
5.	**PLCs :** History of automation, Objective of use of PLC for automation, PLC components and their functions, advantages of PLCs over other conventional automation techniques. Addressing of digital and analog input/ output programming methods (Ledder, CSF, Statement list method)	10+10=20

30/154

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

NAME OF SUBJECT : **INSTRUMENTATION**

TOTAL 48 HRS.

LIST OF PRACTICALS

1. Measurement of AC & DC voltage with CRO.
2. Measurement of frequency & phase displacement using CRO.
3. Testing of electronic component using CRO.
4. Study of X-Y and strip chart recorders.
5. Measurement of displacement using LDR and LVDT.
6. Study of various transducers/sensors.
7. Measurement of temerature, flow, velocity and pressure.
8. Determination of characteristic curve of an analog inductive sensor.
9. Measuring material thickness using analog diffuse optical sensor.
10. Sensing of different metals with inductive proximity sensors.
11. Study of fixed type & modular type PLCs.
12. Addressing of digital/ analog inputs & outputs.
13. Developing & running programme for simple task (task on various process may be given by teachers.)
14. Study of special features of PLC (timer, counter, RTC etc.)

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

30/155

NAME OF SUBJECT : **INSTRUMENTATION**

REFERENCES

S.No.	TITLES	AUTHOR / PUBLISHER
1.	Instrumentation devices and systems	C. S. Ranjan. R.Sharma TMH Publication.
2.	A course in Electrical and electronics measurement and instrumentation.	A. K. Sawhney Dhanpat Rai & Sons
3.	Instrumentation measurement and analysis	B. C. Nalera and A.K.Chaudhary TMH Publication.
4.	Mechanical and Industrial measurements	R.K Jain, Khanna Publications.
5.	Electronic Instrumentation and measurements Technique	W.D. Cooper and L.D. Helfric Prentice Hall of India New Delhi.
6.	Industrial Instrumentation and control	S.K. Singh TMH Publications.
7.	Instrumentation for Engineering Measurements	Cerni and Foster John Wiley and sons
8.	Metrology and Instrumentation	H. K. Parekh. M.P. Hindi Academy Bhopal.
9.	Reference for PLC contents.	Manuals supplied by manufacturer.
10.	PLC Basic level Text book	TP 301 by Feste Didactic Publ.
11.	Industrial Automation Circuit Design & Components	David. W. Pessen, John Willey & sons

30/156

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VI- SEMESTER

NAME OF SUBJECT : **CAD**

RATIONALE

In the 21st Century, for increasing of production with higher degree of accuracy with the minimum efforts, there is need of change in conventional manufacturing systems. Now a days modern manufacturing methods are totaly tending towards Automation and Flexibility of manufacturing. This can be implemented in industries by new techniques of Computer Aided Design of machine parts. This method is used to design the parts quickly before manufacturing & provide very high accuracy in product with the involvement of less manual labour. Therefore it is very essential to introduce this course of CAD for study in Mechatronics.

30/157

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

NAME OF SUBJECT : **COMPUTER AIDED DESIGN**

SCHEME OF STUDIES AND SPECIFICATION TABLE

S. No.	Topic	Hrs. of Study			K	C	A	Total
		Th.	Pr.	Total				
1.	Introduction to CAD	04	-	04	03	04	04	11
2.	CAD Hardware	10	10	20	04	06	10	20
3.	CAD Software	10	10	20	04	06	14	24
4.	CAD Drawing	10	15	25	03	03	10	16
5.	AUTOCAD	10	25	35	03	05	06	14
6.	CAD packages	04	20	24	03	06	06	15
	Total	48	80	128	20	30	50	100

M. P. BOARD OF TECHNICAL EDUCATION

30/138

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

NAME OF SUBJECT : **CAD**

Theory/ week : 3 Hrs.

Practical/ week : 5 Hrs.

Topic No	Topic Details Course Content	Hours of Study T+P=Total
1.	**Introduction to CAD** CAD, Working of a typical CAD system. Advantages of CAD over conventional methods of drafting/design.	4 + 0 = 4
2.	**CAD Hardware** Hardware requirement of a typical CAD system. Need of having a computer with high resolution monitor, large main memory, faster processor and a coprocessor. A typical CAD workstation. Peripheral devices used in a typical CAD system - mouse, plotter, digitizer, light pen, graphic tablet, joy stick, raster display terminals & vector storage & refresh display, concept of resolution and pixel.	10 + 10 = 20
3.	**CAD Software** Introduction, software configuration of a graphic system, functions of a graphic package, construction of geometry, editing the geometry. Transformations, wireframe and solid modelling. Features of a typical CAD package.	10 + 10 = 20
4.	**CAD Drawing** Drafting fundamentals: screen grids, coordinates, Drawing lines, circles, Arcs with CAD. Automatic fullering & chamfering using CAD. Drawing irregular curves sectional views using CAD, placing labels & dimension on Drawing, copying details in a defined area. Stretching a	10 + 15 = 25

30/159

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

NAME OF SUBJECT : **CAD**

Theory/ week : Hrs. Practical/ week : Hrs.

Topic No	Topic Details	Hours of Study T+P=Total
	Drawing, Measuring Entities with CAD & Calculating areas using CAD.	
5.	**Auto CAD** Introduction to Auto CAD. Study of various commands of auto CAD; generation of different geometrical design with the help of commands. Applying Auto CAD to Mechanical Drawing, Electrical and Electronic circuits.	10 + 25 = 35
6.	**Study of CAD packages** Packages such as CAD plus-3D (Research Engineers Inc.-USA), IDEAS (SDRC pm), STARDYNE (Research Engineers).	4 + 20 = 24

M. P. BOARD OF TECHNICAL EDUCATION

30/160

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

NAME OF SUBJECT : **CAD**

	LIST OF EXPERIMENTS	
1.	Operate various input, output devices used in a typical CAD system.	
2.	Practice of executing Auto CAD, main menu.	
3.	Practice the working and applications of following AUTO CAD Commands. LIMITS, UNITS, GRID, SNAP, ZOOM, PAN, ISOPLANE, LINE, TRACE, ORTHO, CIRCLE, SOLID, REDRAW, REGEN, POINT, ARC, AXIS, ERASE, COPY, MOVE, MIRROR, BREAK, HIDE, VPOINT, DIST, ID, HATCH, TEXT, STYLE, ARRAM, PLINE, FILL, PEDIT, FILLET, CHAMFER, TRIM, STRETCH, POLYGON, AREA, SCALE, ROTATE, OFFSET, LANER, MEASURE, BLOCK, INSERT, EXPLODE, BASE, FILES, SHELL, COLOR, VIEW, PLAN, SHADE, SOLWIRE & other SOL commands, ZOOM.	
Note:	This is only a short list of recommended AUTOCAD commands and functions. The student is adviced to learn as many as commands & functions available in the latest version of AUTOCAD.	
4.	Practice of command to plot a given drawing, plot samedrawing with 1/2 scaleand doublescale. todraw a particular part of drawing.	
5.	Practice of command to make 3D drawing of wire frame, shade 3D image.	
6.	Practice to set up CAD package on the computer.	

M. P. BOARD OF TECHNICAL EDUCATION

30/1881

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

NAME OF SUBJECT : **CAD**

REFERENCES

Sl. No.	Name of book	Author/ Publisher
1.	Fundamental of CAD	by Bertoline; Galgotia.
2.	Introduction to CAD	by voisinet; McGraw hill.
3.	Understanding CAD/CAM	by Bowman & Bowman.
4.	Illustrated Auto CAD rel 11	BPB
5.	Inside Auto CAD	BPB

M. P. BOARD OF TECHNICAL EDUCATION

30/162

ADVANCED DIPLOMA IN INDUSTRIAL ELECTRONICS

VI - SEMESTER

SUBJECT :- BUSINESS COMMUNICATION

SCHEME OF STUDIES

S.No.	Topics	Theory Hours	Total Hours
1.	Communication	14	14
2.	External Barriers	12	12
3.	Oral Communication	08	08
4.	Professional Interviews	10	10
5.	Written Communication	20	20

M. P. BOARD OF TECHNICAL EDUCATION 30/163

ADVANCED DIPLOMA IN INDUSTRIAL ELECTRONICS

VI - SEMESTER

BUSINESS COMMUNICATION

TOPIC 1:- COMMUNICATION

Definition,nature,importance to Managers communication theories and process,symbolic interactionalism,Information theory,Interaction theory,transaction theory,elements of communication process Importance, feedback.

TOPIC 2:- EXTERNAL BARRIERS

Psychological barriers,linguistic barriers,Mechanical barriers,making communication effective.

Communication methods, oral media, written media, non verbal communication.

TOPIC 3:- ORAL COMMUNICATION

Speeches for different occasions, guidelines, listening value problem and guidelines, Interview, types of information.

TOPIC 4:- PROFESSIONAL INTERVIEWS

Interview process, problems, guidelines,group discussions, purpose and problem guideline. Conference responsibility of chairman and participant, effective use of non verbal communication.

TOPIC 5:- WRITTEN COMMUNICATION

Writing techniques and guidelines, letter writting ,basic principles , purpose, types of business letter, handling negative ideas effectively , report writing, types of reports , structure of report , drafting report.

M. P. BOARD OF TECHNICAL EDUCATION 30/164

ADVANCED DIPLOMA IN INDUSTRIAL ELECTRONICS

VI - SEMESTER

SUBJECT :- BUSINESS COMMUNICATION

BOOKS RECOMMENDED :

1. Jerry C. Voffered, A Gerloff & Rebert C. Cumins: Organisational communication, Mcgraw Hills, New York.

2. Haston, Sandberg & Mills :
Effective speaking in Business Prentice Hall, New York.

3. George L. Mornisey :
Effective business and technical presentations, Addission Wesley Publication Co., London.

4. Raymond Lesikar :- Business Communication, Theory & Practice.

5. Essentials of Business Communication by Rajendra Pal,& J.S. Korlahalli.

6. Business Communication - U.S. Rai & S.N. Rai.

7. Business Communication - Nomai Pradhen, D.S. Bhende, Vijay Thakur.

M. P. BOARD OF TECHNICAL EDUCATION

30/165

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

NAME OF SUBJECT : **CNC-1**

RATIONALE

In the 21st Century, for increasing of production with higher degree of accuracy with the manual efforts, there is need of change in conventional manufacturing systems. So now a days modern manufacturing methods is totaly tending towards Automation and Feasibility of manufacturing. This can be implemented in industries by new techniques of Computer Aided Manufacturing machines. These machines which are operated and controlled by computers, provide very high accuracy in product with the involvement of less manual labour. Therefore it is very essential to introduce this course of CNC machines and technology for study in Mechatronics.

M. P. BOARD OF TECHNICAL EDUCATION 50/166

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

NAME OF SUBJECT : **CNC-1**

SCHEME OF STUDIES AND SPECIFICATION TABLE

S. No.	Topic	Hrs. of Study			K	C	A	Total
		Th.	Pr.	Total				
1	Basics of NC	10	02	12	06	04	04	14
2.	Constructional Features of CNC Machine Tools	15	08	23	08	06	04	18
3.	CNC Machine Control & Controller	10	08	18	08	06	06	20
4.	Axis designation	10	10	20	06	04	04	14
5.	CNC Machining & Tooling	15	10	25	06	05	04	15
6.	CNC Programming	20	10	20	06	05	08	19
	TOTAL	80	48	128	40	30	30	100

Abbreviations : K - Knowledge
C - Comprehension
A - Application

M. P. BOARD OF TECHNICAL EDUCATION 36/167

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

ME OF SUBJECT : **CNC-1**

ry/ week : 5 Hrs. Practical/ week : **3** Hrs.

pic No	Topic Details	Hours of Study T+P=Total
1.	**Basics of Numerical Control** Introduction,Convetional machine tools and their limitations,special purpose machines,Need for CNC machines,History of the origin of NC/CNC machines,Definition of NC,CNC and DNC,difference between NC/CNC and DNC,Advantages and disadvantages,comparision to CNC & conventional machines,industrial application of CNC machines.	10 + 2 = 12
2.	**Constructional features of CNC machine tools :** Utility of conventional constructional features,structural configuration,slide ways,Ball screws,vee and flat roller,linear ball bushings,Rotax 'Tychoway'. Dexter ball slide,Hydrostatic slideways.,Spindle drives : DC drive,AC drive for spindle mountings,Feed drives :DC servo motor ,linear motors & stepper motors,Automatic Tool Clamping and work clamping,Tool magazines and Automatic selection from a magazine and Automatic Tool Changers (ATC) - Drum,chain and engg. box type tool selection from a magazine,tool identification,location of tool magazine.Automatic work changers (AWC), dual pallet changers,multiple pallet pool & types,Special features : Lubrication system,coolant system,chip handling of CNC machines.	15 + 8 = 23
3.	**CNC controls and controllers :** Types of CNC controls ,tool control, Control of speed,control of slide movement, velocity control of slide position,types of controllers, panel discription, function-	10 + 8 = 18

M. P. BOARD OF TECHNICAL EDUCATION 30/16B

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

NAME OF SUBJECT : **CNC-1**

Theory/ week : Hrs. Practical/ week : Hrs.

Topic No	Topic Details	Hours of Study T+P=Total
	ing, controllers of major international CNC manufacturers. Reversal error compensation, Machine set up Data, Memory featues, Programme features,Diagnostic Advance features, CNC System elements : Control Panel-display unit, keyboard, status, indicators, control circuits, control circuits,Tape Reader, power supplies, Logic elements and memory device Actual study of control system of major international manufacturers of CNC systems.	
4.	**Axis Designation and Programming Geometry :** ISO Standards, Axis identification, Objective of Designation, Block diagrams of different CNC machines with axis identified, Co-ordinate system with 2 axes,2 1/2 and 3 axes machine co-ordinate system. Detailed drawing for CNC, NC related dimensioning - absolute and incremental,choice of workpiece zero point, Reference points-machine zero point, tool reference points,machine traverse and Linear and circular interpolation.	10 + 10 = 20
5.	**CNC Machining & Tooling :** Selection of tools, cutting tool materials, Hard metal insert & tool loading planning and non insert filling, Chip breakers, Qualified and preset tooling, Machining forces for drilling, turning and milling, Cutting spindle speed and feed rate calculations, Horse power, Torque surface roughness, Acceleration and deacceleration, distance for thread turning, Trailing Error and precision Step, Tool life calculation, Work holding and setting,	15 +10 = 25

M. P. BOARD OF TECHNICAL EDUCATION

301169

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

AME OF SUBJECT : **CNC-1**

heory/ week : Hrs. Practical/ week : Hrs.

Topic No	Topic Details	Hours of Study T+P=Total
6.	Workholding, Pricnciple of location, Principle of clamping. Workholding devices, Setting of CNC machine tool. **CNC Programming:** Part program, flow chart, address format-work address, fixed- sequential and tab sequential format, Basic Machine codes- prepatory function, Miscellaneous functions, Dimensional work,Tool function, Feed rate, spindle speed, word, EOB, Tape coding of these functions, Arc-centre offset, Decimal point programming, programming examples on CNC milling machine, CNC-turning centre, Cutter center line programming, Tool offsets for tool length compensation,cutter diameter compensation, position of a fixture or part, multiple part machining tool radius compensation, thread radius compensation, Thread cutting, canned cycles, cycle subroutines, parametric subroutines, safery zones, users macros,proving of part program , verification, visual inspection, single step execution, Dry run, Graphical simulation. Pen slot. FMST-off manual Data Input (MDI), digitising. Computer Aided Programming- Post Processors, Programming, languages, APT programming, APT-commands, other important computer aided programming.	20 + 10 = 30

30/170

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

NAME OF SUBJECT : **CNC-1**

REFERENCES

S.No.	TITLES	AUTHOR / PUBLISHER
1.	Numarical Control and Computer Aided Manufacturing	Kundra Rao & Tiwari Tata Mc Graw Hill
2.	CNC Technology and Programming	Krar Mc Graw Hills Book Co.
3.	Computer Numerical Control	Pusztai Sava.Prantice hall
4.	Essential of Numerical Control	Rapello, Prantice Hall
5.	Numerical Control and Computer Aided Manufacturing	Roger S. Pressman & Johan E. Williams John Wiley and Sons.
6.	Numerical Control of Machine Tools	S. J. Martin ELBS (Edward Arenold)
7.	Numerical Control of Machine tools	Yoram Koren & Joseph Benruri Khanna Publishers
8.	Numerically Controlled Machine Tools	G. W. Vickers Mhly & R. G. Other Ellis Harwood.
9.	Computer Numerical Control	Hans B. Kief & T. Fredrick Waters McMillan/McGraw Hill.
10.	Introduction to CNC Machine, Vol. I and II	Central Manufacturing Technology Institute Banglore.
11.	Introduction to Computer Numerical Control Barry	Leatham Jones Pitman London (John Wiley and Sons).
12.	Fundamentals of CNC Machines Part 1 and Part 2	Hanser Publication (Germany)
13.	Self Learning Module in NC/CNC machine Tools	Prof. K.K.Jain, TTTI, Bhopal.
14.	CNC Machines	B. S. Pabla & M. Adithan Wiley Eastern Ltd.

30/771

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VI - SEMESTER

NAME OF SUBJECT : **CNC - I**

Total Practical Hrs. 48

LIST OF EXPERIMENTS

S. No.	EXPERIMENTS
1.	Study of main constructional features of CNC Machine.
2.	Study of feed and spindle drives.
3.	Study of tool measuring instruments.
4.	Study of CNC Machine control features of different manu facturers.
5.	Designation of CNC Machine axes of drilling, milling, shaper, grinder, lathe, planner, machining centre, drafting machines with block diagrams and working envelope of different machines with different reference points.
6.	Setting up procedures for CNC Machines and pre-set tooling.
7.	Preparation of simple part-programs and actual machining of components on CNC milling machine/machining centre.
8.	Preparation of part-programmes with different tool-off set compensation and actual machining of components on CNC milling / machining centre.
9.	Preparation of part-programmes with canned cycles and subroutines and there on actual machining on CNC milling /machining centre.
10.	Preparation of part-program on CNC lathe with roughing cycle and actual machining of components.
11.	Preparation of part-program for thread cutting on CNC lathe and actual machining of component.
12.	Preparation of part-programmes for different contours and taper turning on CNC lathe and there on actual machining.
13.	Preparation of user macros and then utility for some components.
14.	Proving of part-programmes on CNC milling/CNC machining centre.

CURRICULUM

30/172

ADVANCED DIPLOMA IN MECHATRONICS

(SEVENTH SEMESTER)

STATE CURRICULUM DEVELOPMENT CENTRE

M.P. BOARD OF TECHNICAL EDUCATION

A/4, OFFICE COMPLEX, GAUTAM NAGAR, BHOPAL - 462023

TEL : (0755) 583656, 583673, 583627

30/173

REPORT

A workshop on curriculum development for subject of VII Sem.of Advanced Diploma in Mechatronics Branch was organised by M.P.Board of Technical education Bhopal as per the following schedule;

Venue : **Production Engineering Department,**

S.V.Govt.Polytechnic Bhopal.

Dates : **22-24 January 1998.**

Timings : 9:00 AM to 5:00 PM.

The following Experts/Faculty from Engineering College,Polytechnic and PDU have participated in the above workshop.

1. Prof. Dr. C. M. Sadiwala, M.A.C.T. Bhopal.
2. Mr. U. K.Jain, Principal, S.V. Govt. Polytechnic, Bhopal.
3. Mr. K. C. Mahajan, HOD & Expert Teacher, PDU, Bhopal.
4. Mr. S.R.Madan, HOD Mechanical, S.V.Govt.Polytechnic, Bhopal.
5. Mr. R. M. Khan, Lecturer in Mechanical, S.V.Govt.Polytechnic, Bhopal
6. Mr. P. K. Shrivastava, Expert Teacher, PDU Bhopal.
7. Mr. Arvind Jain Lect. Mech. S.V.G.P. Bhopal.
8. Mr. Sharad Saxena, Lecturer in Production Engg.,S.V.Govt.Polytechnic, Bhopal.
9. Mr. A. K.Tuli, Lecturer in Production Engg., S.V.Govt.Polytechnic, Bhopal.
10. Mr. Rajeev Gupt, Lecturer in Mechanical, S.V.Govt.Polytechnic, Bhopal
11. Mr. T.R.Arora, Dy.Secretary M.P. B.T.E Bhopal.

* The groups have discussed about job survey and competencies required by industries and norms proposed by AICTE and then came to common view for working on subject detailing.

* After discussion subjects have been identified and detailed by the groups for

30/12/04

VII semester of Advanced Diploma in Mechatronics,

1. Industrial Management
2. CNC - II
3. Maintenance Engineering.
4. CIM [Computer Integrated Manufacturing]
5. Entrepreneurship Project

* The contents of the subject "Entrepreneurship Project" are same as the contents of the subject "Entrepreneurship Project" of VI semester of Production Engg. Branch, as such the theory paper only will be same for both.

* Groups were of the opinion that after the course completion of first batch of Advanced Diploma in Mechatronics the curriculum should be reviewed through a seminar/workshop in order to restructure the course curriculum with the objective of making it more relevant/realistic. The review shall be done by mixed group of passouts, faculty & users.

(T. R. A

Course Coord

30/75

§5§

मैकाट्रानिक्स पाठ्यक्रम समिति का कार्यवाही विवरण

आज दिनांक 11.3.98 को एडवांस डिप्लोमा इन मेकाट्रानिक्स के पाठ्यक्रम समिति की बैठक मण्डल कार्यालय में प्राचार्य, शासकीय पोलीटेकनिक, ... की अध्यक्षता में सम्पन्न हुई । समिति में निम्न सदस्यों ने भाग लिया –

1. प्राचार्य, शासकीय पोलीटेकनिक, धार
2. श्री एम.जी. रावल, व्याख्याता, शास.कलानिकेतन, जबलपुर
3. श्री एस.यू. किदवई, वरिष्ठ उपमहाप्रबंधक, बीएचईएल, भोपाल
4. श्री के.सी. गहाजन, विशेषज्ञ शिक्षक, पीडीपू भोपाल
5. श्री एस.एन. डागा, अपर महाप्रबंधक, बीएचईएल, भोपाल

समिति ने निम्न प्रमुख निर्णय लिए –

1. समिति ने उक्त पाठ्यक्रम के छठवे सेमे.की प्रस्तावित पढ़ाई एवं परीक्षा योजना एंव प्रस्तावित पाठ्यचर्या को यथावत अनुमोदित कर तुरंत प्रभाव से लागू करने की अनुशंसा की ।
2. समिति ने उक्त पाठ्यक्रम के सातवे सेमे.की प्रस्तावित पढाई व परीक्षा योजना को यथावत अनुमोदित किया, परंतु पाठ्यचर्या को आवश्यक संशोधनोपरांत अनुमोदित किया एवं इसे वर्ष 1998 से लागू करने की अनुशंसा की । संशोधन संलग्नक क्र.1 पर अंकित है ।

§एम.एस. झामड§

§एम.जी. रावल§

ADVANCED DIPLOMA PROGRAMME IN MECHATRONICS

(To be introduced from 1998-99)

VII Semester

PERIOD PER WEEK

TOTAL TIME FOR SEMESTE

SCHEME OF STUDIES AND EXAMINATION

S NO	NAME OF SUBJECT	SCHEME OF STUDY			SCHEME OF EXAMINATION										
		CONTENT HRS. PER WEEK (SEMESTER)			SESSIONAL MARKS		PROGRESSIVE ASSIGNMENT		BOARD EXAMINATION						
		THEORY	LAB	TOTAL	TERM WORK	LAB WORK	I	II	THEORY PAPER	DURA -HRS	MKS	PRACTICAL	DURA -HRS	MKS	REMARKS
1.	INDUSTRIAL MANAGEMENT	80	-	80	20	-	10	10	1	3 Hrs	100	Nil	Nil	Nil	
2.	C. N. C. II	80	48	128	20	25	10	10	1	3 Hrs	100	1	3 Hrs	50	
3.	MAINTENANCE ENGINEERING	80	48	128	20	25	10	10	1	3 Hrs	100	1	3 Hrs	50	
4.	COMPUTER INTEGRATED MANUFACTURING	80	48	128	20	25	10	10	1	3 Hrs	100	1	3 Hrs	50	
5. *	ENTREPRENEURSHIP PROJECT	48	64	112	20	25	10	10	1	3 Hrs	100	1	3 Hrs	50	
	TOTAL	368	208	576	100	100	50	50	5	-	500	4	-	200	

* Theory Paper ONLY Common with ' Entrepreneurship Project' of VI semester of Production Engg. Course

1. No. of Theory Paper	05	7. Ratio of Theory Marks and (Sessional+Prog.Assess+ Practical+Inplant Training Marks) i.e	500 / 500 1 / 1	9. PASSING MARKS FOR	
2. Total Theory Marks	500			(a) Theory	- 33%
3. No. of Practicals	04			(b) Practicals	- 40%
4. Total Practical Marks	200			(c) Sessionals	- 60%
5. Inplant Training Marks	-	8. Total Marks	1000	(d) Inplant Trg.	- 50%
6. Total Marks of Sessional + Prog. Assessment + Pract & Inplant Training	300				

30/1/98

30/17

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VII- SEMESTER

NAME OF SUBJECT : **INDUSTRIAL MANAGEMENT**

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 segements of our society have forced the developments of new management concepts, techniques and tools to cope up with complexity of groath and change. To meet the challenges of complexity, the systematic and organized approach in every disipline 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 familierize 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 organization.

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VII-SEMESTER

NAME OF SUBJECT : **INDUSTRIAL MANAGEMENT**

SCHEME OF STUDIES AND SPECIFICATION TABLE

S. No.	Topic	Hrs. of Study			K	C	A	Total
		Th.	Pr.	Total				
1.	Management an overview	08	-	08	06	02	-	08
2	Organization & Organ-aizational climate	10	-	10	06	02	02	10
3.	Human factors in production	08	-	08	06	02	-	08
4.	Materials management	08	-	08	04	02	4	10
5.	Production Planning & Control	08	-	08	06	02	-	08
6.	Project Planning by Network Analysis	10	-	10	06	02	6	14
7.	Work Study	10	-	10	06	02	4	12
8.	Plant Layout & Materials Handling	04	-	04	04	01	2	07
9.	Operation Research	04	-	04	04	02	02	08
10.	Application of Computers in management	04	-	04	06	02	-	08
11.	New trends in Management	06	-	06	06	01	-	07
				80	60	20	20	100

Abbreviation :

K - Knowledge

C - Comprehension

A - Application

M. P. BOARD OF TECHNICAL EDUCATION 30/179

ADVANCED DIPLOMA IN MECHATRONICS

VII - SEMESTER

NAME OF SUBJECT : **INDUSTRIAL MANAGEMENT**

Topic No	Topic Details	Hours of Study T+P=Total
1.	**MANAGEMENT AN OVERVIEW** What is Management ?, Brief history of Management, Functions of Management : Planning, Organizing, Staffing, Directing, Coordinating, Controlling, Reporting, Innovating, Budgeting, Evaluation Management Phases: Preplanning, Planning, Implementation and Control, Application of Management in different areas such as Finance, Personnel, Marketing, Purchasing, Storing, Production etc. System Approach Definition, Parameters Classification of System : Open, Closed and Isolated system. Productive, Non-Productive and service systems System design procedure Evaluation of system by considering productivity and effectiveness.	8 + 0 = 8
2.	**ORGANIZATION AND ORGANIZATIONAL CLIMATE** Introduction : Definition, Illustration, Principles of Organization, Organizational Structure and Organizational Chart. Types of Organization : Formal Organization : Line, Functional, Line & Staff, Committee, Project, Matrix Informal Organization Classification of Organization Authority and Delegation of Authority, Centralization and Decentralization, Authority and Responsibility.	10 + 0 = 10

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VII - SEMESTER

30/180

NAME OF SUBJECT : **INDUSTRIAL MANAGEMENT**

Topic No	Topic Details	Hours of Study T+P=Total
	Group Dynamics : Concept, Characteristics of Groups, Reasons for formation of groups, Types of groups, Advantages and disadvantages of groups. **Organizational Change** : Introduction, Causes of Organizational change, Response to change, Overcoming resistance to change. **Organizational Conflict** : Concept, Types of conflict, Conflict between individuals, Conflict between an individual and group, Conflict between groups within an organization, Conflict between organization, Process/Stages of conflict, Source of Conflict, Impact of Conflict, Resolution of Conflict or modes of Conflict management.	
3.	**HUMAN FACTORS IN PRODUCTION** **Managing Men** **- Motivation** : Introduction, Factors affecting motivation, External Job/Company environment, Internal Human needs, Motivation Process **- Secondary Motivation drives** : Aggressiveness, Acquisitiveness, Self assertion, Constructiveness, Gregariousness. **- Outlet for drives** : Expression, - Representation, Control and redirection. Leadership qualities, Relationship between motivation and leadership **- Morale** : - Definition, Importance **- Morale and Productivity** **Job - Satisfaction** : Importance, Factors	8 + 0 = 8

M. P. BOARD OF TECHNICAL EDUCATION 30/181

ADVANCED DIPLOMA IN MECHATRONICS

VII - SEMESTER

NAME OF SUBJECT : **INDUSTRIAL MANAGEMENT**

TopicNo	Topic Details	Hours of Study T+P=Total
	- **Training** : Concept of training, Needs of Training, Benefits of Training - **Leadership** : Definition, Personal skill required such as persuasion, influence, and rapport, Leadership qualities, Relationship between motivation and leadership, Kinds of leadership :Traditional, Autocratic, Democratic, Free . **Management By Objectives** Introduction to MBO, Application of MBO, Advantages and disadvantages of MBO, Recent, Result centered (MBO), Contingency or situational. **Management Grid** **Supervision** Definition of Supervisor, Personal attitude of supervisor Duties and responsibilities of a supervisor, Time Management ,Importance, Techniques employed : Steps to be taken, Avoiding time wastes, Communication at peaks, Using diaries, **Grievances: Definition, Causes** of grievances ,recognising grievances, Solving grievances of : (a) individual - knowing the individual, watching for changes, analyse change and information , consult with employee, treatment, follow -up (b) Of group- Group discussion ,introduction, stating the case controlling the discussion, the conclusion **PROBLEM SOLVING & DECISION MAKING** **Steps in problem solving** : Define the problem, collect relevant information, list possible causes, select the most likely causes, suggest alternative solution, evaluate alternatives, choose one solution, plan for implementation, receive feedback, replan and implement	

M. P. BOARD OF TECHNICAL EDUCATION 30/182

ADVANCED DIPLOMA IN MECHATRONICS

VII - SEMESTER

NAME OF SUBJECT : **INDUSTRIAL MANAGEMENT**

Topic No	Topic Details	Hours of Study T+P=Total
	Methods of problem solving : Institution, analytical thinking, creative thinking, group discussion and brain storming, lateral thinking , logic thinking, (cause, effect diagram), Synectics, Swot analysis:- Definition (factor involved), (S- Strengths), (w-weakness), (O-Opportunity), (T-threats), procedure ,Application area, Importance of problem solving **DECISION MAKING**:- Introduction, Definition, Types of decision : Programmed and Non Programmed decision, Major and Minor decision, Routine and Strategic decision, Organisation and Personal decision, Policy and Operation decision, long term, Departmental and Nondepartmental decision, Decision making process, Barriers in decision making, Qualitative method in decision making : Introduction, Deterministic model, Break even analysis, Linear programming, Capital budgeting, Inventory management, Probabilistic models : Expected value model, decision tree, simulation, Other techniques : Waiting line theory, Game theory, Information theory, Utility theory, Heuristic problem solving.	
4.	**Materials Management** : Functions of Materials Management system encompassing **(a) The purchasing** : Objectives of purchasing **(b) Decisions to be made before purchasing (Apply system Approach)** Materials requirements : Planning , Definition, Importance, Factors to be considered. Buying techniques such as Batch, Speculative, Scheduled and purchasing by sole supplier agreement. Purchasing procedure, Purchasing documentation, Computerised Purchasing system	8 + 0 = 8

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VII - SEMESTER

30/183

NAME OF SUBJECT : **INDUSTRIAL MANAGEMENT**

Topic No	Topic Details	Hours of Study T+P=Total
	Purchasing organisation based on the principles of Function, Product, Location, Stages of manufacturing. Stores management : Stores functions, stores organization centralized and decentralized. **Stores systems and procedures** (1) Identification system, Arbitrary approach , Symbolic approach, Use of Engineering drawing number, (2) Receipt System, (3) Storage system (a) Physical system - closed, open , and random access stores. (b) storage record system , Bin cards Storage ledger. (4) Issue system, (5) Stores issues includes FIFO (First-In-First-Out), LIFO (Last-In-First-Out), Average cost system, Market value systems, Standard cost system, System of costing the closing stock, (6) Stores verification system - includes annual and periodic verification, Perpetual Inventory and continuous stock taking system, Low point Inventory System, (7) Stores address system, Stores location and layout, Standardization, Certification and variety reduction. **(c) Inventory control** :Definition, Function of Inventory, Economic order quality, Stock turn over, Definition, Importance. Inventory models : Order Quantity, Buffer Stock, Reorder point, Lead time, Stock out, Fixed order quantity model (Wilson model). Two Bin Model : ABC, VED (Virtual, Essential and Desirable), FSN (Fast, Slow and Non-moving) analysis. SDE (Scarce, Difficult and Easy) analysis.	

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS 30/184

VII - SEMESTER

NAME OF SUBJECT : **INDUSTRIAL MANAGEMENT**

Topic No	Topic Details	Hours of Study T+P=Total
	VALUE ENGG. AND VALUE ANALYSIS Introduction to value engg. and value analysis, - Difference between value engg. and value analysis * Scope and objectives. * Reasons for unnecessary costs. * DASTIRI method for value analysis.	
5.	**PRODUCTION PLANNING AND CONTROL** Introduction, Productivity : Definition, Importance, Factors to be considered. Functions of production planning and control (PPC) to include the following Planning for men, machines, Materials, Estimating, Routing, Scheduling, Despatching, Follow-up, Inspection & Evaluation, Sequencing. Loading and Scheduling : Critical Ratio, Definition, Importance. Types of production system, Job, Batch, Mass/Flow, Group Technology, FMS project. Determination of optimum/Economic batch size for production Documents used in production : Production order, Work Ticket, Job Card, Job Ticket. Machine and labour utilization chart.	8 + 0 = 8
6.	**PROJECT PLANNING BY NETWORK ANALYSIS** Introduction and Definition Steps/Phases of project management : Preplanning, Planning to include scheduling, - Implementation, Controlling, Reviewing and updating. Tools/Techniques applied for project management : Bar-charts, & Milestone Charts (Gantt chart), Network Methods, i.e. C.P.M. & P.E.R.T., Development of	10 + 0 = 10

M. P. BOARD OF TECHNICAL EDUCATION 30/185

ADVANCED DIPLOMA IN MECHATRONICS

VII - SEMESTER

NAME OF SUBJECT : **INDUSTRIAL MANAGEMENT**

Topic No	Topic Details	Hours of Study T+P=Total
	Networks, Fulkerson's Rule for numbering events, updating, crashing, Resource profile, Resource smoothening/Resource levelling.	
7.	**WORK STUDY** **Introduction**, Objectives, Components Method study and work measurement.. **Method Study** : Introduction, Objectives, Steps for method study, Work measurement, Procedure, Techniques to include the time study, work sampling, predetermined motion, time system. Principles of motion economy.	10 + 0 = 10
8.	**PLANT LAYOUT AND MATERIAL HANDLING** **Plant Layout :** Introduction, Importance and function, Objectives, Basic types of plant layouts such as Product or line layout, Process or functional layout, Cellular or functional layout, Job shop layout, Project or fixed position layout. **Material Handling :** Introduction, Importance, Material Handling equipments, Types of equipments, Area of application.	4 + 0 = 4
9.	**OPERATION RESEARCH** Introduction to operation research, Application areas of Operation such as : Inventory Control, Project Management (Network analysis), Decision Theory, Queueing theory, Simulation, Game theory, Optimisation etc. Linear Programming Problems : Characteristics and limitations, Identification and formulation for solving the problems by graphical method.	4 + 0 = 4

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

30/186

VII - SEMESTER

NAME OF SUBJECT : **INDUSTRIAL MANAGEMENT**

Topic No	Topic Details	Hours of Study T+P=Total
10.	**APPLICATION OF COMPUTERS IN MANAGEMENT** **Role of computers** in effective performance of various management functions. **Application of Computer** in : Finance, Production, Inventories, Maintenance, Marketing, Personnel, Process, Planning.	4 + 0 = 4
11.	**NEW TRENDS IN MANAGEMENT** **Total Quality Management** : Introduction Stages of Development : Inspection, Quality Control, Quality assurance, Total Quality Control, Total Quality Management (TQM). ISO-9000, Bench Marking Phillip Crosby's five absolutes of Quality Management. W.E Deming's fourteen point approach about improving quality and Deming's PDCA Cycle (Plan, Do, Check, Action) The Juron trilogy (Quality Planning, Control, and Improvement) and two major kinds of quality management (break through, encouraging the occurrence of good things, to attack chronic problems, and control, preventing the occurrence of bad things, to attack sporadic problems) Feigenbaum's concepts about total-quality cost comprising of Appraisal cost, Preventive cost and Failure cost. Taguchi Quality system cycle - off-line and on-line and Quadratic (Taguchi) quality / loss function. Japanese Quality Management Culture ,Kaizen strategy (continuous improvement), - Quality circle, Ishikawa's cause and effect Diagram (Fishbone Diagram) Just - In - Time (JIT) : Concepts and application area in materials management and production control. Logic structure : - Definition, Purpose, Procedure, Application area Trends in Modern Management : TQM (Total Quality management), SWOT analysis.	6 + 0 = 6

BUSINESS EXCELLENCE

30/187

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VII - SEMESTER

NAME OF SUBJECT : **INDUSTRIAL MANAGEMENT**

REFERENCES

S. No.	TITLE	AUTHOR/PUBLISHER
1.	Supervisory Management	Belts, P.W. ELBS with Pitman Publication
2.	Industrial Engineering and Management	Khanna, O.P. Dhanpat Rai & Sons.
3.	Essentials of Management	Koontz, O'Donnell, Weihrich McGraw Hill Book Co.
4.	Module publication for Diploma in Management Courses	IGNOU
5.	Modern Production operations Management	Buffa Wiley Eastern Ltd.
6.	Production Operations Management	Goel, B. S. Pragati Prakashan

30/188

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VII- SEMESTER

NAME OF SUBJECT : **CNC-II**

RATIONALE

In the 21st Century, for increasing of production with higher degree of accuracy with the minimum efforts, there is need of change in conventional manufacturing systems. So now a days modern manufacturing methods are totally tending towards Automation and Flexibility of manufacturing. This can be implemented in industries by new techniques of Computer Aided Manufacturing machines. These machines which are operated and controlled by computers, provide very high accuracy in product with the involvement of less manual labour. Therefore it is very essential to introduce this course of CNC-II machines and technology for study in Mechatronics.

M. P. BOARD OF TECHNICAL EDUCATION 30/189

ADVANCED DIPLOMA IN MECHATRONICS

VII - SEMESTER

NAME OF SUBJECT : **CNC - II**

SCHEME OF STUDIES AND SPECIFICATION TABLE

S. No.	Topic	Hrs. of Study			K	C	A	Total
		Th.	Pr.	Total				
1.	NC Organisation	16	6	22	15	5	5	25
2.	Recent advances in CNC Machine	12	4	16	5	5	-	10
3.	Economic of CNC Machine Tools	10	4	14	10	-	10	20
4.	Retrofitting of CNC Syetem on Conventio-nal Machine Tools	10	10	20	5	5	-	10
5.	Installation and Mainte-nance of CNC Machine	20	16	36	15	10	-	25
6.	Programmable Logic Controllers	12	8	20	10	-	-	10
		80	48	128	60	25	15	100

Abbreviations : K- KNOWLEDGE
C- COMPREHENSION
A- APPLICATION

M. P. BOARD OF TECHNICAL EDUCATION 30/190

ADVANCED DIPLOMA IN MECHATRONICS

VII-SEMESTER

NAME OF SUBJECT : **CNC -II**

Topic No	Topic Details	Hours of Study T+P=Total
1.	**NC ORGANISATION** Programming procedures, programming in planning deptt., Programming in workshop, Structure of CNC organisation, Programming data, Workpiece drawing, Operation sequencing, Cutting data tables, Programming and operating handbook, Tool card index, Work holding equipment, Card index, Programming schedule, set-up schedule.	16 + 6 = 22
2.	**RECENT ADVANCES IN CNC MACHINE** In process gauging, diagnostic programmes, adaptive controls, Need block diagram, Tools wear sensing, Broken tool detection, conversational programming. *Virtual - CNC System.*	12 + 4 = 16
3.	**ECONOMICS OF CNC MACHINE TOOLS** CNC versus conventional machining, profitable applications of CNC, Adopting CNC , Drawbacks of CNC, Calculation of cost per piece, elements of cost economic batch quantity, use of CNC in special cases , case studies on justification of CNC machines.	10 + 4 = 14
4.	**RETROFITTING OF CNC SYSTEM ON - CONVENTIONAL MACHINE TOOLS** Judging suitability of conventional machine tools cost considerations, Retrofitting procedures, - *of Thyrister drives & sensers Mechanical/Electrical reconditioning of CNC system*	10 + 10 = 20
5.	**INSTALLATION AND MAINTENANCE OF CNC MACHINE** Installation of CNC machines : Introduction, pre-planning, installation, locating, foundation, installation equipment, proving of machine, Maintenance of CNC machines	20 + 16 = 36

M. P. BOARD OF TECHNICAL EDUCATION 30/191

ADVANCED DIPLOMA IN MECHATRONICS

VII- SEMESTER

NAME OF SUBJECT : **CNC - II**

Topic No	Topic Details	Hours of Study T+P=Total
	Introduction,need for maintenance, preventive measures, replacement parts inventory, the level of maintenance operations, fundamentals of NC machine maintenance, CNC self diagnostic, trouble shooting, documentation of maintenance programmes.	
6.	**PROGRAMMABLE LOGIC CONTROLLERS (PLC)** ~~Definition, PLCs versus PC, Elements of PLC~~ (To be deleted), Operation of PLCs, Programming and documentation, applications reason for using PLCs, Economics of PLCs. Retrofitting of P.L.C. in Conventional machine incorporating analogue systems DE	12 + 8 = 20

M. P. BOARD OF TECHNICAL EDUCATION 30/192

ADVANCED DIPLOMA IN MECHATRONICS

VII- SEMESTER

NAME OF SUBJECT : **CNC - II**

LIST OF EXPERIMENTS

TOTAL PRACTICAL HOURS : 48

S. No.	EXPERIMENTS
1.	Computer aided programming of the following practicals in more than one popular programming language such as APT, Compact-II etc.
(i)	Preparation of simple programs and actual machining of components on CNC milling machine/machining centre.
(ii)	Preparation of programmes with different tooloff-set compensation and actual machining of components on CNC milling/machining centre.
(iii)	Preparation of programmes with canned cycles and subroutines and there on actual machining on CNC milling/machining centre.
(iv)	Preparation of program on CNC lathe with roughing cycle and actual machining of components.
(v)	Preparation of program for thread cutting on CNC lathe and actual machining of component.
(vi)	Preparation of programmes for different contours and taper turning on CNC lathe and there on actual machining.
(vii)	Preparation of user macros and their utility for some components.
(viii)	Proving of programmes on CNC milling/CNC machining centre.
(ix)	Proving of programmes on CNC lathe machine.
2.	Study of CNC co-ordinate measuring machine.
3.	A case study on selection of job for CNC machine.
4.	Study and preparation of maintenance system for CNC machine.
5.	Programming and integration of PLCs.

M. P. BOARD OF TECHNICAL EDUCATION 30/193

ADVANCED DIPLOMA IN MECHATRONICS

VII- SEMESTER

NAME OF SUBJECT : **CNC - II**

REFERENCES

S.	TITLES	AUTHOR / PUBLISHER
1.	Numarical Control and Computer Aided Manufacturing	Kundra Rao & Tiwari Tata Mc Graw Hill
2.	CNC Technology and Programming	Krar Mc Graw Hills Book Co.
3.	Computer Numerical Control	Pusztai Sava Prantice hall
4.	Essential of Numerical Control	Rapello Prantice Hall
5.	Numerical Control and Computer Aided Manufacturing	Roger S. Pressman & Johan E. Williams John Wiley and Sons.
6.	Numerical Control of Machine Tools	S. J. Martin ELBS (Edward Arenold)
7.	Numerical Control of Machine tools	Yoram Koren & Joseph Benruri Khanna Publishers
8.	Numerically Controlled Machine Tools	G. W. Vickers Mhly & R. G. Other Ellis Harwood.
9.	Computer Numerical Control	Hans B. Kief & T. Fredrick Waters McMillan/McGraw Hill.
10.	Introduction to CNC Machine, Vol. I and II	Central Manufacturing Technology Institute Banglore.
11.	Introduction to Computer Numerical Control	Barry Leatham Jones Pitman London (Jhon Wiley and Sons).

M. P. BOARD OF TECHNICAL EDUCATION

30/194

ADVANCED DIPLOMA IN MECHATRONICS

VII- SEMESTER

NAME OF SUBJECT : **CNC - II**

12.	Fundamentals of CNC Machines Part 1 and Part 2	Hanser Publication (Germany)
13.	Self Learning Module in NC/CNC machine Tools	Prof. K.K.Jain, TTTI, Bhopal.
14.	CNC Machines	B. S. Pabla & M. Adithan Wiley Eastern Ltd.
15.	CAD/ CAM/ CIM	Radhakrishnan & S. Subrahmanian Wiley Eastern Ltd.

M. P. BOARD OF TECHNICAL EDUCATION 20/195

ADVANCED DIPLOMA IN MECHATRONICS

VII - SEMESTER

NAME OF SUBJECT : **MAINTENANCE ENGINEERING**

RATIONALE

Job of maintenance is the back bone of Industries and is similar to that of a physician. It has a vital effect on production as well as on productivity of the industry as a whole. The curricula provides the basics of maintenance and general practice 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 its estimate) to meet the production targets.

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.

M. P. BOARD OF TECHNICAL EDUCATION 30/196

ADVANCED DIPLOMA IN MECHATRONICS

VII - SEMESTER

NAME OF SUBJECT : **MAINTENANCE ENGINEERING**

SCHEME OF STUDIES AND SPECIFICATION TABLE

S. No.	Topic	Hrs. of Study			K	C	A	Total
		Th.	Pr.	Total				
1.	Siginificance of Maintenance	5	-	05	5	5	-	10
2.	Concept of Basic Maintenance Practice	20	6	26	5	8	5	18
3.	Wear and its effects	10	8	18	5	5	Nil	10
4.	Lubrication and Lubrication System	15	8	23	5	2	Nil	07
5.	Fault tracing, trouble shooting & remedies	5	10	15	2	5	5	12
6.	Leakage	5.	2	07	3	5	Nil	8
7.	Assembly & Disasembly of M/C parts	6	8	14	5	5	5	15
8.	Maintenance of Hydraulics & Pneumatic System	6	3	09	5	5	-	10
9.	Diagnostic Maintenance	8	3	11	5	5	-	10
		80	48	128	40	45	15	100

Abbreviations : K KNOWLEDGE
C COMPREHENSION
A APPLICATION

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

30/197

VII - SEMESTER

NAME OF SUBJECT : **MAINTENANCE ENGINEERING**

Topic No	Topic Details	Hours of Study T+P=Total
1.	**Significance of maintenance :** - Introduction to maintenance, its need & economic significance effect on productivity. - Scope and Functions of Maintenance. - Organizational structure of Maintenance Departments.	5 + 0 = 5
2.	**Concept of Basic Maintenance Practices :** - Different Maintenance Practices., Basic Concept, Advantages & Disadvantages - Principles & Procedures of Preventive Maintenance- schedule preparation for, predictive maint. & signature analysis - Maintenance stages. - Schedule of Maintenance. - Maintenance Hand Tools & Measuring Equipments. - Maintenability - Definition & objective.	20 + 6 = 26
3.	**Wear & its effects :** - Definition - Causes of wear. - Types of wear with examples. - Effects of wear on performance. - Methods of measurement of wear. - Concept of permissible wear. - Wear reduction factors. - Component replacements.	10 + 8 = 18
4.	**Lubrication & Lubrication System :** - Functions of Lubrication. - Principle of liquid lubrication.	15 + 8 = 23

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

30/198

VII - SEMESTER

NAME OF SUBJECT : **MAINTENANCE ENGINEERING**

Topic No	Topic Details	Hours of Study T+P=Total
	- Types of lubrication - Hydrodynamic, Boundary layer Externally Pressurized. - Selection of lubricants. - Peservation of lubricants. - Types of lubrication system - Causes of lubrication failures.	
5.	**Fault tracing, trouble Shooting & Remedies :** - Definition and purpose. - Sequence of activities in fault finding. - Measures to prevent repetition of similar faults. - Trouble Shooting Charts. - Identification of operational errors & replacement of bearings, gears, bushes, clutches, belt drives etc.	15 + 0 = 15
6.	**Leakages :** - Checking & Stopping of leakages. - Different methods of detection of leakages. - Types of Seals & Packings.	5 + 2 = 7
7.	**Assembly and Disassembly of M/C parts. :** - Process & Steps of assembly & disassembly of M/C parts like- Bearing, Belts, Pulleys, Gears, Clutches, Couplings, Gearbox etc.	6 + 8 = 14

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

30/199

VII - SEMESTER

NAME OF SUBJECT : **MAINTENANCE ENGINEERING**

Topic No	Topic Details	Hours of Study T+P=Total
8.	**Maintenance of Hydraulics & Pneumatic Systems** Working principles, Common troubles & repair methods, assembly and disassembly of pneumatic valves & Hydraulic valves, cylinders.	6 + 3 = 9
9.	**Diagnostic Maintenance** - Basic concepts. - Diagnostic Maintenance Techniques, Vibration & Noise Monitoring, Thermographing, Lubricating oil Analysis, Wear, partical Analysis etc.	8 + 3 = 11

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VII - SEMESTER

30/200

NAME OF SUBJECT : **MAINTENANCE ENGINEERING**

Topic No	Topic Details	Hours of Study T+P=Total
	List of Practicals	
1.	Demonstration and Operation of protective equipments.	
2.	Measurement of wear on surfaces by- (a) Microscope & Steel string method. (b) Official Method. (c) Hydrostatic Method. (d) Vernier Calipers. (e) Micrometre. (f) Dial indicator & V block..	
3.	Measurement of wears of gears by thickness gauge & gear tooth vernier gauge.	
4.	Demonstration and operation of grease gun in lubricating various components of any available M/C or engine	
5.	Study of various tools and gauges used in mechanical maintenance.	
6.	Visit of large/ medium/ small scale industries for collecting information in respect of : (a) Record keeping for condition of equipment maintenance and replacement of parts. (b) Lubrication plan etc.	
7.	Study of preparation of maintenance system for CNC machinery.	
8.	Study of Electrical instruments i.e. multimeter, torque tester, megger etc.	
9.	Study of Electronic Instruments i.e. in circuit tester, I.C. Tester	
	TOTAL HOURS	48

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VII - SEMESTER

30/201

NAME OF SUBJECT : **MAINTENANCE ENGINEERING**

Topic No	Topic Details	Hours of Study T+P=Total
	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 Chicago, 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 Council Chicago, U.S.A.	
3.	Commentary on - Factories Act with M.P. by krishanlal Sethi, The Lawyers Home, Indore - 7	
4.	Industrial accident prevention by H. W. Heinrich, McGraw Hills Book Company, IWC.	
5.	An Introduction to safety Engineering and Management by N.V. Krishnan, C.P.S. Publishers Pvt. Ltd. Calcutta	
6.	Maintenance of Industrial Equipment by B. Gelberg. G. Peklis.	
7.	A guide to efficient Maintenance management by H. V. Mstwatt.	
8.	Modern Maintenance Management by Miller and Blood.	
9.	Maintenability - by Benjamin S. BNLanshard, E. Edward Lowery.	
10.	Maintenance Engineering Hand Book by Morrow.	
11.	Rapair of Industrial Equipment by B.G. Gilberg. G-Peklis.	

M. P. BOARD OF TECHNICAL EDUCATION

30/202

ADVANCED DIPLOMA IN MECHATRONICS

VII- SEMESTER

NAME OF SUBJECT : **COMPUTER INTEGRATED MANUFACTURING**

RATIONALE

In the 21st Century, for increasing of production with higher degree of accuracy with the minimum efforts, there is need of change in conventional manufacturing systems. Now a days modern manufacturing methods are totally tending towards Automation and Flexibility of manufacturing. This can be implemented in industries by new techniques of Computer Aided Manufacturing machines. These machines which are operated and controlled by computers, provide very high accuracy in product with the involvement of less manual labour. Therefore, it is very essential to introduce this course of CIM for study in Mechatronics.

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

30/203

VII- SEMESTER

NAME OF SUBJECT: **COMPUTER INTEGRATED MANUFACTURING**

SCHEME OF STUDIES AND SPECIFICATION TABLE

S. No.	Topic	Hrs. of Study			K	C	A	Total
		Th.	Pr.	Total				
1.	Automated Assembly	10	02	12	8	4	2	14
2.	Computer Aided Manufacturing	14	10	24	4	6	4	14
3.	Computer Aided Process Planning	08	04	12	6	6	3	15
4.	Group Technology	08	02	10	4	6	2	12
5.	Flexible Manufacturing System	10	06	16	5	5	3	13
6.	Computer Integrated Manufacturing	10	10	20	5	5	2	12
7.	Introduction to Automatic Storage and Retrieveal System	10	04	14	4	4	2	10
8.	Industrial Robotics	10	10	20	4	4	2	10
		80	48	128	40	40	20	100

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VII - SEMESTER

30/204

NAME OF SUBJECT : **COMPUTER INTEGRATED MANUFACTURING**

Topic No	Topic Details	Hours of Study T+P=Total
1.	**AUTOMATED ASSEMBLY** Concept of automated assembly, need for automated assembly, criteria for automated assembly process, impact of design on automated assembly, control of automated assembly systems, Principal components of robot assembly system, Transfer line, joining and fastening in automated assembly, machine vision in automated assembly, artificial intelligence and automated assembly.	10 + 2 = 12
2.	**COMPUTER AIDED MANUFACTURING** Define CAM, Basic elements of CAM, the computer's role in manufacturing, the evolution of CAM, type of data used in manufacturing, sources of data used in manufacturing, computer application in manufacturing, modern computer-based process technologies, computer based tools and techniques affecting the engineering process of manufacturing system, explain how control task are allocated at each level and identify subsequent steps.	14 + 10 = 24
3.	**COMPUTER AIDED PROCESS PLANNING** Basic concepts of process planning, manual process planning, work group approach variant approach, generative approach, semi-generative approach, role of process planning in concurrent engineering and applications.	8 + 4 = 12
4.	**GROUP TECHNOLOGY** Philosophy of group technology, establishment of family groups, benefits of comprehensive coding system,	8 + 2 = 10

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

30/2015

VII - SEMESTER

NAME OF SUBJECT : **COMPUTER INTEGRATED MANUFACTURING**

Topic No	Topic Details	Hours of Study T+P=Total
	comparison between functional and cellular layout, group technology and CNC manufacture, benefits of group technology.	
5.	**FLEXIBLE MANUFACTURING SYSTEM** Definition, origin of FMS, classification of FMS, examples of FMS, project structure and design of FMS, components of FMS, FMS-Processes, Material Handling in FMS-AGV's, conveyors, Robots, Gantry, loaders, manual material handling, computer simulation and computer control systems, communications in FMS, Finalising, justification, installation and commissioning of FMS.	10 + 6 = 16
6.	**COMPUTER INTEGRATED MANUFACTURING SYSTEM** Introduction, integrated database system, data collection system, material handling system, integrating manufacturing system. Relational database & Computer networking and simulation of CIM systems	10 + 10 = 20
7.	**INTRODUCTION TO AUTOMATIC STORAGE AND RETRIEVAL SYSTEM**	10 + 4 = 14
8.	**INDUSTRIAL ROBOTS** Introduction, need for a robot, categories of a robot, selection of robot, configuration, mechanical parts of robot, servomotors, robot programming and control, robot vision, proximity sensors, applications, safety and robots.	10 + 10 = 20

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VII - SEMESTER

30/206

NAME OF SUBJECT : **COMPUTER INTEGRATED MANUFACTURING**

LIST OF EXPERIMENTS

S. No.	EXPERIMENTS
1.	Study of Industrial Robot.
2.	Study of FM System.
3.	Programming Robot for 2 axis movement.
4.	Programming Robot for Multi axis movement.
5.	Development of a program for a simple object on CIM System.
6.	Running of developed program for CIM System.

Total Hours - 48

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VII - SEMESTER

30/207

NAME OF SUBJECT : **COMPUTER INTEGRATED MANUFACTURING**

REFERENCES

S.	TITLES	AUTHOR / PUBLISHER
1.	Numerical Control and Computer Aided Manufacturing	Kundra Rao & Tiwari Tata Mc Graw Hill
2.	CNC Technology and Programming	Kar Mc Graw Hills Book Co.
3.	Computer Numerical Control	Pusztai Sava Prantice hall
4.	Essentials of Numerical Control	Rapello Prantice Hall
5.	Numerical Control and Computer Aided Manufacturing	Roger S. Pressman & Johan E. Williams John Wiley and Sons.
6.	Numerical Control of Machine Tools	S. J. Martin ELBS (Edward Arenold)
7.	Numerical Control of Machine tools	Yoram Koren & Joseph Benruri Khanna Publishers
8.	Numerically Controlled Machine Tools	G. W. Vickers Mhly & R. G. Other Ellis Harwood.
9.	Computer Numerical Control	Hans B. Kief & T. Fredrick Waters McMillan/McGraw Hill.
10.	Introduction to CNC Machine, Vol. I and II	Central Manufacturing Technology Institute Banglore.
11.	Introduction to Computer Numerical Control	Barry Leatham Jones Pitman London (John Wiley and Sons).

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VII - SEMESTER

30/208

NAME OF SUBJECT : **COMPUTER INTEGRATED MANUFACTURING**

12.	Fundamentals of CNC Machines Part 1 and Part 2	Hanser Publication (Germany)
13.	Self Learning Module in NC/CNC machine Tools	Prof. K.K.Jain, TTTI, Bhopal.
14.	CNC Machines	B. S. Pabla & M. Adithan Wiley Eastern Ltd.
15.	Implementating Flexible Manufacturing system	Nigal R. Greenwood Mc Millan Education
16.	Advance Manufacturing Technology	Goeschts Delmar Publication
17.	Computer Automated Manufacturing	John H. Powers Jr McGraw Hills, International Adition
18.	Computer Aided Disign and Manufacturing	Nikell P. Groover and Emory Printice Hall
19.	CAD/ CAM/ CIM	P. Radhakrishnan & S. Subrahmanian Wiley Eastern Ltd.
20.	Computer Numerical Control	P. Radhakrishnan Wiley Eastern Ltd.

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHANOTRICS

VII - SEMESTER

NAME OF SUBJECT : **ENTREPRENEURSHIP PROJECT** 30/2009

RATIONALE

Subject Entrepreneurship project has been designed keeping in view the employment scenario of the country. The country is passing through socioeconomical changes imposed by internal pressures on one hand and impact of globalization on the other.Uptill 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, public undertakings and service systems such as Railways, Telecommunications 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 introduced as to prepare Diploma pass-outs in mechatronics to go for self-employment rather then become the job seekers.

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHATRONICS

VII- SEMESTER

39/210

NAME OF SUBJECT : **ENTREPRENEURSHIP PROJECT**

SCHEME OF STUDIES AND SPECIFICATION TABLE

S. No.	Topic	Hrs. of Study			K	C	A	Total
		Th.	Pr.	Total				
1.	Introduction to Entrepreneurship	10	-	10	4	4	2	10
2.	Institutional Assistance.	6	-	6	8	6	2	16
3.	Incentives	4	-	4	6	4	6	16
4.	Planning the Product/ Project	6	-	6	8	6	6	20
5.	Achievement Motivation	4	-	4	6	2	6	14
6.	Financial Management	10	-	10	4	4	4	12
7.	Marketing Management	8	-	8	4	4	4	12
	PRACTICAL							
	Phase- I	-	12	12	-	-	-	-
	Phase- II	-	34	34	-	-	-	-
	Phase- III	-	18	18	-	-	-	-
		48	64	112	40	30	30	100

Abbreviation :

K - Knowledge

C - Comprehension

A - Application

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHANOTRICS

30/211

VII- SEMESTER

NAME OF SUBJECT : **ENTREPRENEURSHIP PROJECT**

Theory/ week : Hrs. Practical/ week : Hrs.

Topic No	Topic Details	Hours of Study T+P=Total
1	**THEORY**	
	Knowledge on the following topics & areas should be imparted to the students as a ground preparation for	
1.	**Introduction to Entrepreneurship.**	10 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.	
2.	**Institutional Assistance.**	6 Hrs
	- Informational.	
	- Infrastructural.	
	- Financial and	
	- Marketing Assistance.	
3.	**Incentives.**	4 Hrs
	- Seed Money	
	- Subsidies and	
	- Others (like phones/ Lands etc.)	
4.	**Planning the Product/ Project.**	6 Hrs
	- Pre-Planning stage.	
	- Implementation stage	
	- Post Implementation stage.	

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHANOTRICS 30/2/12

VII - SEMESTER

NAME OF SUBJECT : **ENTREPRENEURSHIP PROJECT**

Theory/ week : Hrs. Practical/ week : Hrs.

Topic No	Topic Details	Hours of Study T+P=Total
5.	**Achievement Motivation.**	4 Hrs
	- Concepts	
	- Significance and	
	- Components of Achievement Motivation.	
6.	**Financial Management**	10 Hrs
	- Book of Account	
	- Principles of Accounting.	
	- Profit and Loss Account	
	- BAlance Sheet.	
7.	**Marketing Management.**	8 Hrs
	- Concept of 4 Ps of Marketing.	
	- Marketing strategy	
	- Packaging and Distribution	
	- After sales service	
II	**PRACTICAL.**	
	Practical assignments will be completed by undertaking the following activities sequentially in 3 phases.	
	* **Phase - I :**	
	Product/ Project selection	12 Hrs
	* **Phase-II :**	
	Manufactutring the Product/ Project Implementation	34 Hrs
	* **Phase-III :**	
	Preparation/ Presentation of Feasibility Report.	18 Hrs

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHANOTRICS

VII - SEMESTER

30/213

NAME OF SUBJECT : **ENTREPRENEURSHIP PROJECT**

GUIDELINES TO 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 involved 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 skills achievement of students.

.....

SUGGESTED STEPS FOR PRODUCT SELECTION

30/214

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

- Psychological - Social

(b) - Need analysis

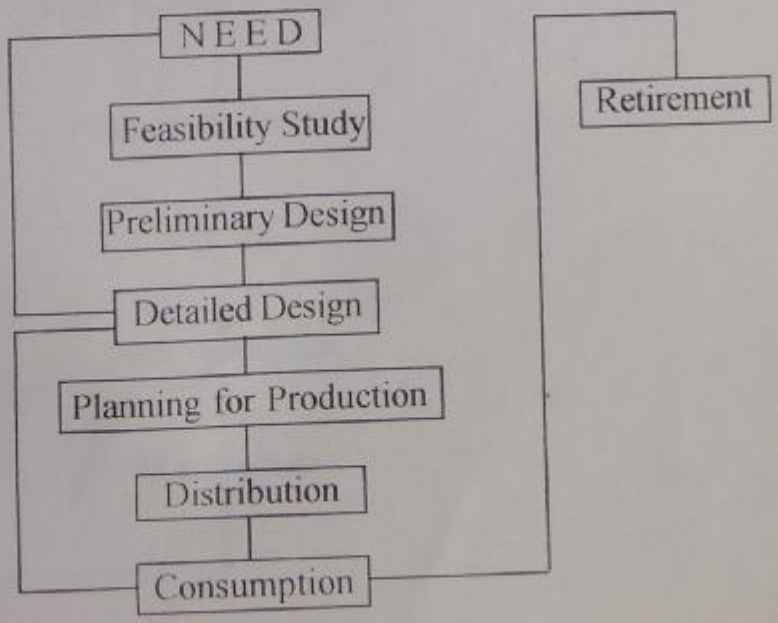
3. INFONOMICS :

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

4. DESCRIPTION

5. STRUCTURE AND MORPHOLOGY OF DESIGN :

6. Primary Design Phases:



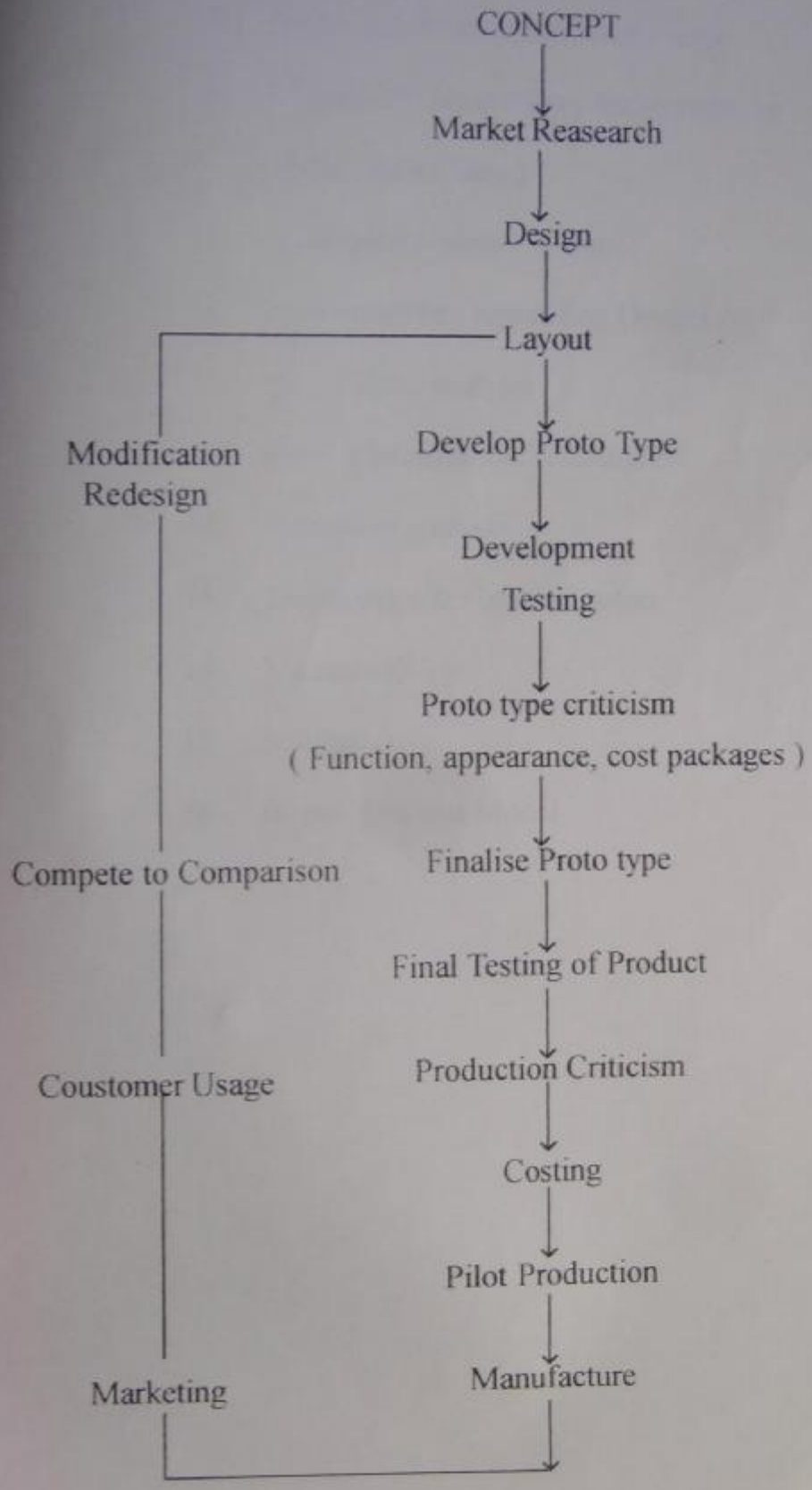
Production Consumption Cycle

7. **DESIGN :**

(a) By evolution

(b) By Creation

30/215



30/216

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

30/2/17

M. P. BOARD OF TECHNICAL EDUCATION

ADVANCED DIPLOMA IN MECHANOTRICS

VII - SEMESTER

NAME OF SUBJECT : **ENTREPRENEURSHIP PROJECT**

SUGGESTED STEPS FOR FEASIBILITY REPORT

A Feasibility report pertaining to the project selected be prepared, assuming that an industry is to be launched manufaturing 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 decision.

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

3.B - Equipment selection

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

5. - Organization chart.

6. - Man power requirement.
- Materials.
- Method

M. P. BOARD OF TECHNICAL EDUCATION

30/218

ADVANCED DIPLOMA IN MECHANOTRICS

VII - SEMESTER

NAME OF SUBJECT : **ENTREPRENEURSHIP PROJECT**

---

7. - Raw materials
   - Tools.
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 points.
11. - Registration from sales - tax, DIC etc.
12. - Factory laws.
12.A.- Subsidies, seed money, working capital.
12.B. - Money requirement.

M. P. BOARD OF TECHNICAL EDUCATION 30/219

ADVANCED DIPLOMA IN MECHANOTRICS

VII - SEMESTER

NAME OF SUBJECT : ENTREPRENEURSHIP PROJECT

REFERENCES

S.	TITLES	AUTHOR / PUBLISHER
1.	Entrepreneurial Development	Vasant Desai, "Himalaya Publishing House"
2.	A practical guide to Industrial Entrepreneurs	S. B.Shrivastava "S. Chand & Sons"
3.	Dynamics of entrepreneurial development and management	Vasant Desai, "Himalaya Publishing House"
4.	Trainers manual on developing entrepreneurial motivation	National Institute for Intrepreneurship and small business development New-Delhi
5.	Environment and Entrepreneur	Arvind Rai - N. Desai
6.	Entrepreneurship and venture management	Clifford M. Baumback, Joseph R. Mancuso "D.B. Taraporevala Sons and Co. Ltd published by arrange-ment with Prantice-Hall
7.	Entrepreneurial Development programme series, entrepreneur entrepreneur enterprise and growth options	P. Subba Rao & M. Sundaram "Kanishka Publishers Distributors"
8.	Industrial Engineering and Management	O. P. Khanna, "Dhanpat Rai & Sons." Wiley and Sons).

MADHYA PRADESH BOARD OF TECHNICAL EDUCATION, BHOPAL

Scheme of Evaluation
Advanced Diploma in Mechatronics

34220

VIII SEMESTER

~~Implant~~ Industrial Training (Duration 16 Weeks)

	Component of Assessment	Marks Alloted
A.	In Industry	
I.	Attendance and General discipline	25
II.	Daily diary maintenance	25
III.	Initiative & participative attitude during training	50
IV.	Assessment of training by Industrial Supervisor	100
B.	In Institution	
V.	Training report	100
VI.	Seminar	50
VII.	Viva-Voce	50
	Total	400

The proposed scheme, in my opinion is best for students of mechatronics.

(O. P. Sharma) T.P.O. Poly. BPL

(P. Vajpayee.)

श्री आई. के. अग्रवाल सदस्य पा. स.
से फोन पर सम्पर्क किया, वे भी इस प्रस्ताव से
सहमत हैं।