CURRICULUM

For

DIPLOMA PROGRAMME
In

MECHATRONICS

2nd Year (3rd and 4th Semester)

FOR THE STATE OF HIMACHAL PRADESH

(N-22 SCHEME)

Prepared by
Composite Curriculum Development Centre
Directorate of Technical Education,
Vocational & Industrial Training, Sundernagar (H.P.)

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SALIENT FEATURES

Programme	Diploma in Mechatronics
Duration	Three years (Six Semesters)
Entry Qualification	As prescribed by H.P. Takniki Shiksha Board /AICTE
Intake	As approved by H.P. Takniki Shiksha Board
Pattern	Semester System
Curriculum for	2nd Year Mechatronics

Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Practical (P) per week	0.5 credit
2 Hours Practical (P) per week	1 credit

Course code and definition:

Course code	**Definitions**
L	Lecture
T	Tutorial
P	Practical
BS	Brainstorming
DC	Doubt clearing
PC	Program Core
PE	Program Elective
OE	Open Elective
HS	Humanities & Social Sciences
BS	Basic Science
ES	Engineering Science
AU	Audit Courses
SE	Seminar
PR	Project
SI	Summer Internship

PROGRAMME OUTCOMES (POs)

PO1	**Basic and Discipline specific knowledge:** An ability to apply knowledge of basic mathematics, science and Engineering to solve the Engineering and applied Engineering problems.
PO2	**Problem analysis:** Identify and analyze well-defined engineering problems using codified standard methods.
PO3	**Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.
PO4	**Engineering Tools, Experimentation and Testing**: Apply modern engineering tools and appropriate techniques to conduct standard tests and measurements.
PO5	**Engineering practices for society, sustainability and environment:** Describe and formulate appropriate solutions in context of society, sustainability, environment and ethical practices.
PO6	**Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well- defined Engineering activities.
PO7	**Life-long learning:** Ability to analyze individual needs and engage in updating in the context of technological changes.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO-1	Solid foundation of sensors, data acquisition, robotics, PLC, control systems and latest software and hardware tools to solve mechanical and electronics related problems.
PSO-2	Solve the real world problems in the emerging fields like robotics, drones, and hybrid and electric vehicles and to analyze the innovative technologies relevant to social, ethical, economic and environmental issues.
PSO-3	Apply the knowledge of Robotics for addressing societal, health and safety issues

List of Programme Core Courses 2nd Year [PC]

S.No	Code No.	Course Title	Hours per week			Semester	Credits
			L	DCS	P		
1.	MAPC201	BASIC MECHANICAL ENGINEERING	3	1	0	III	3
2.	MAPC203	MANUFACTURING ENGINEERING	3	1	0	III	3
3.	MAPC205	MANUFACTURING ENGINEERING LAB	0	2	4	III	2
4.	MAPC207	DIGITAL ELECTRONICS	3	1	0	III	3
5.	MAPC209	DIGITAL ELECTRONICS LAB	0	0	2	III	1
6.	MAPC211	ELECTRONIC DEVICES AND CIRCUITS	3	1	0	III	3
7.	MAPC213	ELECTRONIC DEVICES AND CIRCUITS LAB	0	0	2	III	1
8.	MAPC215	ELECTRIC CIRCUITS AND NETWORKS	3	1	0	III	3
9.	MAPC217	ELECTRONIC WORKSHOP	0	1	2	III	1
10.	MAPC202	HYDRAULICS AND PNEUMATIC SYSTEMS	3	1	0	IV	3
11.	MAPC204	HYDRAULICS AND PNEUMATICS SYSTEMS LAB	0	1	2	IV	1
12.	MAPC206	MICROPROCESSOR AND MICROCONTROLLER	3	1	0	IV	3
13.	MAPC208	MICROPROCESSOR AND MICROCONTROLLER LAB	0	1	2	IV	1
14.	MAPC210	INDUSTRIAL ELECTRONICS	4	0	0	IV	4
	Total Credits						**32**

List of Program Elective Courses 4th Semester [PE]

S. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	DCS	P		
1	MAPE202-I	ELECTRONIC INSTRUMENTS & MEASUREMENTS	3	0	0	IV	3
2	MAPE202-II	PROCESS CONTROL AND DATA COMMUNICATION	3	0	0	IV	3
3	MAPE204-I	COMPUTER INTEGRATED MANUFACTURING	3	0	0	IV	3
4	MAPE204-II	HYBRID VEHICLES	3	0	0	IV	3

Note: MAPE204-I, MAPE204-II Common with Mechanical Engineering

List of Audit Courses 2nd Year [AU]

S. No	Code No.	Course Title	Hours per week		Semester	Credits
			L	P		
1	AU202	ESSENCE OF INDIAN KNOWLEDGE AND TRADITIONS	2	0	IV	0

AU202 Common with other Branches

STUDY AND EVALUATION SCHEME SEMESTER WISE
DETAILED CURRICULUM

SEMESTER III

S.NO	CATEGORY	CODE NO.	COURSE TITLE	HOURS PER WEEK			TOTAL CONTACT HRS/WEEK	CREDIT	MARKS IN EVALUATION SCHEME								TOTAL MARK S
									INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
				L	DCS	P			TH	PR	TOTAL	TH	HRS	PR	HRS	Total	
1.	Program core course	$ **MAPC201**	BASIC MECHANICAL ENGINEERING	3	1	0	4	3	40		**40**	60	3			**60**	**100**
2.	Program core course	$$ **MAPC203**	MANUFACTURING ENGINEERING	3	1	0	4	3	40		**40**	60	3			**60**	**100**
3.	Program core course	**MAPC205**	MANUFACTURING ENGINEERING LAB	0	2	4	6	2		40	**40**			60	3	**60**	**100**
4.	Program core course	# **MAPC207**	DIGITAL ELECTRONICS	3	1	0	4	3	40		**40**	60	3			**60**	**100**
5.	Program core course	**MAPC209**	DIGITAL ELECTRONICS LAB	0	0	2	2	1		40	**40**			60	3	**60**	**100**
6.	Program core course	## **MAPC211**	ELECTRONIC DEVICES AND CIRCUITS	3	1	0	4	3	40		**40**	60	3			**60**	**100**
7.	Program core course	**MAPC213**	ELECTRONIC DEVICES AND CIRCUITS LAB	0	0	2	2	1		40	**40**			60	3	**60**	**100**
8.	Program core course	### **MAPC215**	ELECTRIC CIRCUITS AND NETWORK	3	1	0	4	3	40		**40**	60	3			**60**	**100**
9.	Program core course	**MAPC217**	ELECTRONICS WORKSHOP	0	1	2	3	1		40	**40**			60	3	**60**	**100**
10.			SCA	… ..	… ….	2	2	… …..		25	**25**						**25**
	TOTAL			**15**	**8**	**12**	**35**	**20**	**200**	**185**	**385**	**300**		**240**		**540**	**925**

* The students shall undergo Internship-I at the end of 3rd semester (During semester break after board examinations of duration 04 weeks) which will be evaluated and reflected in study and evaluation scheme of 4th semester.

$ MAPC201 & $$ MAPC203 common with Mechanical Engineering (ME) and Refrigeration and Air conditioning (RAC)

MAPC207 common with Electronics and Communication Engineering (ECE) and Electrical & Electronics Engineering (EEE)
MAPC211 common with Electronics and Communication Engineering (ECE), Electrical Engineering (EE) and Electrical & Electronics Engineering (EEE)
MAPC215 common with Electronics and Communication Engineering (ECE).

STUDY AND EVALUATION SCHEME SEMESTER WISE
DETAILED CURRICULUM
SEMESTER IV

S. NO	CATEGORY	CODE NO.	COURCE TITLE	HOURS PER WEEK			TOTAL CONTACT HRS/WEEK	CREDIT	MARKS IN EVALUATION SCHEME								TOTAL MARKS
									INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
				L	DCS	P			TH	PR	TOTAL	TH	HRS	PR	HRS	TOTAL	
1.	Program core course	**MAPC202**	HYDRAULICS AND PNEUMATIC SYSTEMS	3	1	0	4	3	40		**40**	60	3			**60**	**100**
2.	Program core course	**MAPC204**	HYDRAULICS AND PNEUMATICS SYSTEMS LAB	0	1	2	3	1		40	**40**			60	3	**60**	**100**
3.	Program core course	**MAPC206**	MICROPROCESSOR AND MICROCONTRLLER	3	1	0	4	3	40		**40**	60	3			**60**	**100**
4.	Program core course	**MAPC208**	MICROPROCESSOR AND MICROCONTROLLER LAB	0	1	2	3	1		40	**40**			60	3	**60**	**100**
5.	Program core course	**MAPC210**	#INDUSTRIAL ELECTRONICS	4	0	0	4	4	40		**40**	60	3			**60**	**100**
6.	Program Elective course	**MAPE202**	Program Elective-1 (Choose one of following): **MAPE202-I:** ELECTRONIC INSTRUMENTS & MEASUREMENTS Or **MAPE202-II:** PROCESS CONTROL AND DATA COMMUNICATION	3	0	0	3	3	40		**40**	60	3			**60**	**100**
7.	Program Elective course	**MAPE204**	Program Elective-2 (Choose one of following): $ **MAPE204-I**: COMPUTER INTEGRATED MANUFACTURING Or **MAPE204-II:** HYBRID VEHICLES	3	0	0	3	3	40		**40**	60	3			**60**	**100**
8.	Minor Project	**PR202**		0	2	4	6	2		40	**40**			60	3	**60**	**100**
9.	Mandatory Course	**AU202**	##ESSENCE OF INDIAN KNOWLEDGE AND TRADITIONS	2	0	0	2	0	40		**40**	60	3			**60**	**100**
10.	Internship I (4 weeks) after 3rd sem.	**SI-1**	INTERNSHIP	0	0	0	0	2		40	**40**			60	3	**60**	**100**
11			SCA	….	…	2	2			25	**25**						**25**
	TOTAL			**18**	**6**	**10**	**34**	**22**	**240**	**185**	**425**	**360**		**240**		**600**	**1025**

* * The students shall undergo Internship-II at the end of 4th semester (During semester break after board examinations of duration 06 weeks) which will be evaluated and reflected in study and evaluation scheme of 5th semester.

MAPC210 common with Electronics and Communication Engineering (ECE)

AU202 Common with other branches

$ MAPE204-I (COMPUTER INTEGRATED MANUFACTURING) common with Refrigeration and Air conditioning (RAC)

THIRD SEMESTER SUBJECTS

Course Code	**[$]MAPC201**
Course Title	**BASIC MECHANICAL ENGINEERING**
Number of Credits	**3 (L:3, DCS:1 P:0)**
Prerequisites	**NIL**
Course Category	**PC**

Course Objectives

- To understand General Principles of Mechanical Engineering.
- To understand laws of thermodynamics, thermal and thermodynamic Processes.
- To understand working principles of power developing and power absorbing devices.
- To understand basic materials and manufacturing processes.

Course Content

UNIT-I (14Hrs)

Introduction to Thermodynamics: Role of Thermodynamics in Engineering and science, Types of Systems, Thermodynamic Equilibrium, Properties, State, Process and Cycle, Elementary introduction to Zeroth, First and Second laws of thermodynamics, Heat and Work Interactions for various processes; Concept of Heat Engine, Heat Pump & Refrigerator, Efficiency/COP; Kelvin-Planck and Clausius Statements, Carnot Cycle, Carnot Efficiency, T-S and P-V Diagrams, Concept of Entropy.

Unit-II (14Hrs)

Heat transfer & Thermal Power Plant: Heat Transfer, Modes of Heat Transfer; Conduction: Fourier Equation, Conduction heat transfer through Composite Walls, Simple Numerical Problems, Convection Heat transfer: Natural and forced convection, Radiation: Absorption, Reflection and transmission of radiation, Concept of black body, Stefan-Boltzman Law (concept only , No derivation), Thermal Power Plant Layout; Rankine Cycle; Fire Tube and Water Tube boilers, Babcock& Wilcox, Cochran Boilers.

Unit-III (12Hrs)

Steam Turbines: Impulse and Reaction Turbines; Condensers: Jet & Surface Condensers, Cooling Towers.

Internal Combustion Engines: Otto, Diesel and Dual cycles; P-V and T-S Diagrams; IC Engines:2-Stroke and 4-Stroke I.C. Engines, S.I. and C.I. Engines.

Unit-IV (12Hrs)

Materials and Manufacturing Processes (derivations and Problems omitted): Engineering Materials, Classification and their Properties; Metal Casting, Moulding, Patterns, Metal Working: Hot Working and Cold Working, Metal Forming: Extrusion, Forging, Rolling, Drawing, Gas Welding, Arc Welding, Soldering, and Brazing.

Unit-V (12Hrs)

Machine Tools and Machining Processes: Machine Tools: Lathe Machine and types, Lathe Operations, Milling Machine and types, Milling Operations, Shaper and Planer Machines: Differences, Quick Return Motion Mechanism, Drilling Machine: Operations, Grinding Machine: Operations

Reference:

1. Basic Mechanical Engineering– M.P. Poonia & S.C. Sharma, Khanna Publishing House, Delhi
2. Elements of Mechanical Engineering– M.L. Mathur, F.S.Mehta and R.P. Tiwari, Jain Brothers, New Delhi
3. Engineering Heat Transfer–Gupta & Prakash, Nem Chand & Brothers, New Delhi
4. Workshop Technology (Vol.1and2)– B.S. Raghuvanshi, Dhanpath Rai and Sons, New Delhi.
5. Basic Mechanical Engineering–J Benjamin
6. Elements of Mechanical Engineering–Roy and Choudhary
7. Engineering Thermodynamics–Spalding and Cole

Course outcomes

At the end of the course, the student will be able to:

CO1	Understand basics of thermodynamics and components of a thermal power Plant
CO2	Understand basics of heat transfer, refrigeration and internal combustion engines
CO3	Understand mechanism of thermal power plant and boiler operation
CO4	Identify engineering materials, their properties, manufacturing methods encountered in engineering practice
CO5	Understand functions and operations of machine tools including milling, shaping, grinding and lathe machines

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	**Time Allotted (Hrs)**	**Marks Allotted**
1	14	12
2	14	12
3	12	12
4	12	12
5	12	12
Total	**64**	**60**

$ Common with. Diploma in Mechanical Engineering and Refrigeration and Air conditioning (RAC).

Course Code	**[$$]MAPC203**
Course Title	**MANUFACTURING ENGINEERING**
Number of Credits	**3 (L: 3, DCS:1, P:0)**
Prerequisites	**Basic Mechanical Engineering**
Course Category	**PC**

Course Objectives

- To understand the importance of cutting fluids & lubricants in machining.
- To study various types of basic production processes. To select, operate and control the appropriate processes for specific applications.
- To understand the concept of gear making and list various gear materials.
- To understand the importance of press tools and understand various die operations.
- To understand Grinding and finishing processes.

Course Content

UNIT-I (12Hrs)

Cutting Fluids & Lubricants: Introduction; Types of cutting fluids, Fluids and coolants required in turning, drilling, shaping, sawing & broaching; Selection of cutting fluids, methods of application of cutting fluid; Classification of lubricants(solid, liquid, gaseous), Properties and applications of lubricants.

Lathe Operations: Types of lathes – light duty, Medium duty and heavy duty geared lathe, CNC lathe (Concept only); Specifications; Basic parts and their functions; Operations and tools– Turning, parting off, Knurling, facing, Boring, drilling, threading, step turning, taper turning.

Unit-II (12Hrs)

Broaching Machines: Introduction to broaching; Types of broaching machines–Horizontal type (Single ram & duplex ram),Vertical type, Pull up, pull down, and push down; Elements of broach tool; Nomenclature; Tool materials for broaching.

Drilling: Classification; Basic parts and their functions; Radial drilling machine; Types of operations; Specifications of drilling machine; Types of drills and reamers.

Unit-III (14Hrs)

Welding: Classification; Gas welding techniques; Types of welding flames; Arc Welding – Principle, Equipment, Applications; Shielded metal arc welding; Submerged arc welding; TIG / MIG welding; Resistance welding - Spot welding, Seam welding, Projection welding; Welding defects; Brazing and soldering.

Milling: Introduction; Types of milling machines: plain, Universal, vertical; constructional details – specifications; Milling operations: simple, compound and differential indexing (No Numerical); Milling cutters –types; Teeth materials; Tool signature in ASA; Tool & work holding devices.

Unit-IV (14Hrs)

Gear Making: Manufacture of gears–by Casting, Moulding, Stamping, Coining, Extruding, Rolling, Machining; Gear generating methods: Gear Shaping with pinion cutter & rack cutter; Gear hobbing; Description of gear hob; Operation of gear hobbing machine; Gear finishing processes; Gear materials and specification; Heat treatment processes applied to gears.

Press working (derivations and problems omitted): Types of presses and Specifications, Press working operations- Cutting, bending, drawing, punching, blanking, notching, lancing; Die set components- punch and die shoe, guide pin, bolster plate, stripper, stock guide, feed stock, pilot; Punch and die clearances for blanking and piercing , effect of clearance.

Unit-V **(12Hrs)**

Grinding and finishing processes: Principles of metal removal by Grinding; Abrasives – Natural & Artificial; Bonds and binding processes: Vitrified, silicate, shellac, rubber, bakelite; Factors affecting the selection of grind wheels: size and shape of wheel, kind of abrasive, grain size, grade and strength of bond, structure of grain, spacing, kinds of bind material; Grinding machines classification: Cylindrical, Surface, Tool & Cutter grinding machines; Construction details; Principle of centerless grinding; Advantages & limitations of center less grinding; Finishing by grinding: Honing, Lapping, Super finishing; Electroplating: Basic principles, Plating metals, applications; Hot dipping: Galvanizing, Tin coating, Parkerising, Anodizing; Metal spraying: wire process, powder process and applications; Organic coatings ; Finishing specifications.

Reference:

1. Manufacturing technology–P N Rao, Tata Mc Graw –Hill Publications
2. Elements of workshop Technology (Volume I&II)–S.K. Hajra Chaudary, Bose &Roy, Media Promoters and Publishers Limited.
3. Production Technology (Volume I&II)–O.P. Khanna & Lal, Dhanpat Rai Publications.
4. Fundamental of metal cutting and machine tools–B.L. Juneja, New age international limited.
5. Manufacturing Technology, Metal Cutting & Machine tools–P.N. Rao, Tata McGraw-Hill Publications
6. Production Technology–R.B. Gupta, Satya Prakashan, New Delhi

Course outcomes:

At the end of the course, the student will be able to:

CO1	Know and identify basic manufacturing processes for manufacturing different components.
CO2	Operate & control different machines and equipment.
CO3	Produce jobs as per specified dimensions and inspect the job for specified dimensions.
CO4	Select the specific manufacturing process for getting the desired type of output.
CO5	Adopt safety practices while working on various machines.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	**Time Allotted (Hrs.)**	**Marks Allotted**
1	12	12
2	12	12
3	14	12
4	14	12
5	12	12
Total	**64**	**60**

$$ Common with. Diploma in Mechanical Engineering and Refrigeration and Air conditioning (RAC).

Course Code	**MAPC205**
Course Title	**MANUFACTURING ENGINEERING LAB**
Number of Credits	**2(L:0, DCS: 2, P:4)**
Prerequisites	**Basic Mechanical Engineering, Manufacturing Engineering**
Course Category	**PC**

Course Objectives:

- To know the working and practice different operations of Lathe.
- To know the working of Drilling machine, shaper, slotter, planning machines and practice different operations on these machines.
- To know various pattern allowances, pattern materials, different types of patterns.
- To Practice the casting principles and operations in foundry.

LIST OFPRACTICALS

Note-: Demonstration of all machines should be given before starting the practical. The instructor should explain parts of machine, work & tool holding devices, different types of cutting tools and safety measures.

1. Job on facing and turning.
2. Job on step tuning and grooving on jobnumber1.
3. Job on taper turning and chamfering, knurling on jobnumber1.
4. Job on internal turning and threading on jobnumber1.
5. Job on marking and drilling practice on mild steel round pieces.
6. Job on Boring and reaming on jobnumber5.
7. Drilling Exercise(Three different sized hole for different materials maintaining uniform distance between them)
8. Shaping a Hexagon on a round bar, key ways and groove.
9. Shaping step block cut dovetail to angles60/90/120degrees
10. Moulding & casting of (i)Solid bearing(ii)V-Pulley/Gear Pulley by preparing suitable pattern.
11. Simple planning exercise.
12. Grinding the Lathe Cutting tools to the require dangles
13. Study of Lathe, Drilling machine, shaping machine and slotting machine
14. The dismantling of some of the components of lathe and then assemble the same
15. List the faults associated with lathe and its remedies
16. The routine and preventive maintenance procedure for lathe

Reference:

1. Elements of Workshop Technology (Volume-I & Volume-II)- Hajra Chowdry & Bhattacharaya, Media, Promoters, 11thEdition2007 19
2. Introduction of Basic Manufacturing Processes and Workshop Technology- Rajender Singh, New Age International (P) Ltd. NewDelhi,2006
3. Workshop Technology-Raghuwanshi, Khanna Publishers, Jain& Gupta, NewDelhi,2002
4. Production Technology- Jain & Gupta, Khanna Publishers, New Delhi,2006
5. Production Technology-HMT,18th edition, Tata McGraw Hill, New Delhi
6. Manufacturing process- Myro N Begman, 5th edition, Tata McGraw Hill, New Delhi.

Course Outcomes:

At the end of the course, the student will be able to:

CO1	Centre the job and select the proper tool to perform the job on lathe machine.
CO2	Calculate the taper angle and practice different taper turning methods on lathe.
CO3	Perform operations on drilling, shaping and planning machines.
CO4	Prepare different types of patterns along with allowances.
CO5	Prepare a mould, sand mix and molten metal and calculate the amount of metal to be Poured in the mould.

Course Code	**#MAPC207**
Course Title	**DIGITAL ELECTRONICS**
Number of Credits	**3 (L:3, DCS: 1, P:0)**
Prerequisites	**Basics Electronics**
Course Category	**PC**

Course Objectives:

1. To acquire the basic knowledge of digital logic gates and understanding, application of digital electronics circuits.
2. It covers the building blocks of embedded systems used in today in smart devices.

Course Content:

UNIT-I **(12 Hrs)**

Number Systems & Boolean Algebra: Introduction to different number systems – Binary, Octal, decimal, Hexadecimal. Conversion from one number system to another. Boolean variables – Rules and laws of Boolean algebra. De-Morgan's Theorem. Karnaugh Maps and their use for simplification of Boolean expressions.

UNIT-II **(14 Hrs)**

Logic Gates: Logic Gates – AND, OR, NOT, NAND, NOR, XOR, XNOR: Symbolic representation and truth table. Implementation of Boolean expressions and Logic Functions using gates. Simplification of expressions.

UNIT-III **(12 Hrs)**

Combinational Logic Circuits: Arithmetic Circuits – Addition, Subtraction, 1's &2's Complement, Half Adder, Full Adder, Half Subtractor, Full Subtractor, Parallel and Series Adders Encoder, Decoder. Multiplexer – 2 to 1 MUX, 4 to 1 MUX, 8 to 1 MUX and their Applications, Demultiplexer – 1-2 DEMUX, 1-4 DEMUX, 1- 8 DEMUX.

UNIT-IV **(14 Hrs)**

Sequential Logic Circuits: Flip Flops – SR, JK, T, D, JK-MS, Triggering. Counters – 4bit Up – Down Counters, Asynchronous/ Ripple Counter, Decade Counter- Mod 3, Mod 7 Counter, Johnson Counter, Ring Counter. Registers – 4bit Shift Register: Serial In Serial Out, Serial In Parallel Out, Parallel In Serial Out, Parallel In Parallel Out.

UNIT – V **(12 Hrs)**

Memory Devices: Classification of Memories – RAM Organization, Address Lines and Memory Size, Static RAM, Bipolar RAM, Cell Dynamic RAM, D RAM, DDR RAM. Read only memory – ROM organization, Expanding memory, PROM, EPROM, EEPROM, Flash memory. Data Converters – Digital to Analog converters, Analog to Digital Converters.

Reference:

1. Digital principles & Applications Albert Paul Malvino & Donald P. Leach McGraw Hill Education; Eighth edition ISBN: 978-9339203405.
2. Digital Electronics Roger L. Tokheim Macmillian McGraw-Hill Education (ISE Editions); International 2nd Revised edition ISBN: 978-0071167963.
3. Digital Electronics – An introduction to theory and practice William H. Gothmann Prentice Hall India Learning Private Limited; 2 edition ISBN: 978-8120303485.

4. Fundamentals of Logic Design Charles H. Roth Jr. Jaico Publishing House; First edition ISBN: 9788172247744.
5. Digital Electronics R. Anand Khanna Publications, New Delhi (Edition 2018) ISBN: 978-93-82609445.

Course Outcomes:
At the end of the course, the student will be able to:

CO 1	Recall and order the logic gates and their circuits.
CO 2	Design combinational and sequential circuits.
CO 3	Design and implement hardware circuit to test performance and application.
CO 4	Recognition of various memory devices.

Suggested Distribution of Marks (For Paper Setters and Students)

Topic	Time (In Hrs.)	Distribution of Marks
1	12	12
2	14	14
3	12	10
4	14	14
5	12	10
Total	**64**	**60**

 # Common with. Diploma in Electronics & Communication Engineering, Electrical & Electronics Engineering

Course Code	**MAPC209**
Course Title	**DIGITAL ELECTRONICS LAB**
Number of Credits	**1 (L:0, DCS: 0, P:2)**
Prerequisites	**Basic Electronics**
Course Category	**PC**

Course Content:

1. To verify the truth tables for all logic fates – NOT OR AND NAND NOR XOR XNOR using CMOS Logic gates and TTL Logic Gates
2. Implement and realize Boolean Expressions with Logic Gates
3. Implement Half Adder, Full Adder, Half Subtractor, Full subtractor using ICs
4. Implement parallel and serial full-adder using ICs
5. Design and development of Multiplexer and De-multiplexer using multiplexer ICs
6. Verification of the function of SR,D, JK and T Flip-Flops
7. Design controlled shift registers
8. Construct a Single digit Decade Counter (0-9) with 7 segment display
9. To design a programmable Up-Down Counter with a 7 segment display.
10. Study of different memory ICs .
11. Study Digital- to – Analog and Analog to Digital Converters.
12. Simulate in Software (such as PSpice) an Analog to Digital Converter.

Practical Outcomes (Pros)

The practical in this section are Pros (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

Course Code	**##MAPC211**
Course Title	**ELECTRONICS DEVICES AND CIRCUITS**
Number of Credits	**3 (L:3, DCS: 1, P:0)**
Prerequisites	**NIL**
Course Category	**PC**

Course Objective:

1. To introduce semiconductor devices BJT, FET, MOSFET and their characteristics, operations, circuits and applications.
2. To introduce concepts of rectifier, oscillator, amplifier and various amplifier configuration.
3. Description of SCR and family devices, their characteristics and applications.

Course Content:

UNIT-I (12 Hrs)

Semiconductor and Diodes: Definition, Extrinsic/Intrinsic, N-type & P-type. PN Junction Diode – Forward and Reverse Bias Characteristics. Zener Diode – Principle, characteristics, construction, and working. Diode Rectifiers – Half Wave and Full Wave. Filters – C, LC, and PI Filters.

UNIT-II (14 Hrs)

Bipolar Junction Transistor (BJT): NPN and PNP Transistor – Operation and characteristics. Common Base Configuration – characteristics and working. Common Emitter Configuration– characteristics and working. Common Collector Configuration– characteristics and working. High frequency model of BJT. Classification of amplifiers, negative feedback.

UNIT-III (12 Hrs)

Field Effect Transistors: FET – Working Principle, Classification. MOSFET Small Signal model. N-Channel/ P- Channel MOSFETs – characteristics, enhancement, and depletion mode, MOS-FET as a Switch. Common Source Amplifiers. Uni-Junction Transistor – equivalent circuit and operation.

UNIT- IV (14 Hrs)

SCR DIAC & TRIAC: SCR – Construction, operation, working, characteristics. DIAC - Construction, operation, working, characteristics. TRIAC - Construction, operation, working, characteristics. SCR and MOSFET as a Switch, DIAC as bidirectional switch. Comparison of SCR, DIAC, TRIAC, MOSFET.

UNIT-V (12 Hrs)

Amplifiers and Oscillators: Feedback Amplifiers – Properties of negative Feedback, impact of feedback on different parameters. Basic Feedback Amplifier Topologies: Voltage Series, Voltage Shunt, Current Series, Current Shunt. Oscillator – Basic Principles, Crystal Oscillator, Non-linear/ Pulse Oscillator

Reference:

1. Analog Circuits A.K. Maini Khanna Pub. House Ed. 2018 ISBN:9789386173 584
2. Electronic Devices and Circuits S. Salivahanan and N. Suresh Kumar McGraw Hill Education; Fourth edition (1 July 2017) ISBN:978-9339219505

3. Electronics Devices and circuit theory Boyestad & Nashelsky Pearson Education India; 11 edition (2015) ISBN:978-9332542600
4. Electronic Principles Albert Malvino & David Bates Tata McGraw Hill Publication 2010 ISBN:9780070634244
5. Electronics Devices & Circuits Jacob Millman McGraw Hill Education; 4 edition (2015) ISBN:978-9339219543

Course Outcomes:

At the end of the course, the student will be able to:

CO 1	To understand various diodes and transistors used in analog electronics.
CO 2	Recognition of amplifier configuration and cascading of amplifiers.
CO 3	Analyze small signal model of FET and MOSFET
CO 4	Demonstration of rectifier, Feedback and oscillators.

Suggested Distribution of Marks (For Paper Setters and Students)

Topic/Unit	Time (In Hrs.)	Marks Allotted
1	12	12
2	14	12
3	12	12
4	14	12
5	12	12
Total	**64**	**60**

Common with. Diploma in Electronics & Communication Engineering, Electrical Engineering, Electrical & Electronics Engineering,

Course Code	**MAPC213**
Course Title	**ELECTRONICS DEVICES AND CIRCUITS LAB**
Number of Credits	**1 (L:0, DCS: 0, P:2)**
Prerequisites	**NIL**
Course Category	**PC**

LIST OFPRACTICALS:

1. Construct the circuit and plot the VI characteristics of the PN Junction Diode, find the cut in voltage
2. Construct the circuit and plot the characteristics of a Zener Diode. Find the breakdown voltage
3. Construct a Half Wave Rectifier and obtain regulation characteristics – Without Filters and with Filters Compare the results
4. Construct a Full Wave center tap rectifier and obtain regulation characteristics – Without Filters and with Filters Compare the results
5. Construct a Bridge Rectifier and obtain regulation characteristics – Without Filters and with Filters
6. Obtain the characteristics of DIAC and TRIAC
7. Simulate half wave, full wave and bridge rectifier using simulation tool like PSpice/ ORCAD/Multisim.
8. Develop a simulation model for Voltage Series and Voltage Shunt Feedback Amplifiers

   Or

   Develop circuits for Voltage Series and Voltage Shunt Feedback Amplifiers and obtain output plots. Compare the results with the simulation model.
9. Develop a simulation model for Current Series and Current Shunt Feedback Amplifiers
10. Develop circuits for Current Series and Current Shunt Feedback Amplifiers and obtain output plots. Compare the results with the simulation model.

Practical Outcomes (Pros):

The practical in this section are Pros (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

Course Code	**###MAPC215**
Course Title	**ELECTRIC CIRCUITS & NETWORK**
Number of Credits	**3 (L:3, DCS: 1, P:0)**
Prerequisites	**NIL**
Course Category	**PC**

Course Objective:

1. To learn a number of powerful engineering circuit analysis techniques such as nodal analysis, mesh analysis, theorems, source transformation and several methods of simplifying networks.
2. To understand frequency response in electrical circuits
3. Different types of two-port network analysis using network parameters, with different types of connections

Course Content:

UNIT-I (12 Hrs)

Basics of Network and Network Theorem: Node and Mesh Analysis, Superposition Theorem, Thevenin Theorem, Norton Theorem, Maximum Power transfer theorem, Reciprocity Theorem.

UNIT-II (14 Hrs)

Graph Theory: Concept of Graph, Node Tree of network, and incidence matrix and Analysis of resistive network using cut-set and tie-set, Duality Theorem and their application in the electrical circuits.

UNIT-III (12 Hrs)

Time Domain and Frequency Domain Analysis: Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits. Initial and Final conditions in network elements. Forced and Free response, time constants. Steady State and Transient State Response. Analysis of electrical circuits using Laplace Transform for standard inputs (unit, Ramp, Step).

UNIT-IV (14 Hrs)

Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform. Steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values. Fourier transform and continuous spectra.

UNIT-V (12 Hrs)

Two Port Network: Introduction of the Two Port Network and the various network parameters i.e., Open Circuit Impedance Parameters. Short Circuit Admittance Parameters. Transmission Parameters, Introduction of Hybrid Parameters.

Reference:

1. Networks and Systems Ashfaq Husain Khanna Publishing House
2. Network Analysis M. E. Van Valkenburg Prentice Hall ofIndia
3. Engineering Circuit Analysis W. H. Hayt, J. E. Kemmerly and S. M. Durbin McGraw Hill
4. Electrical Circuits Joseph Edminister Schaum's Outline, Tata McGraw Hill

5. Basic Circuit Theory Lawrence P. Huelsma Prentice Hall of India
6. Network & Systems D. Roy Choudhury Wiley Eastern Ltd
7. Linear Circuit Analysis De Carlo and Lin Oxford Press

Course Outcomes:
At the end of the course, the student will be able to:

CO 1	Demonstration of network theorems and network graph
CO 2	Describe the response and state of 1st order & 2nd order circuit.
CO 3	Define the time domain & frequency domain analysis.

Suggested Distribution of Marks (For Paper Setters and Students)

Topic/Unit	Time (In Hrs.)	Marks Allotted
1	12	12
2	14	12
3	12	12
4	14	12
5	12	12
Total	**64**	**60**

Common with Diploma in Electronics & Communication Engineering

Course Code	**MAPC217**
Course Title	**ELECTRONICS WORKSHOP**
Number of Credits	**1 (L:0, DCS: 1, P:2)**
Prerequisites	**NIL**
Course Category	**PC**

Course Objective:
The course provides the students with necessary knowledge and competency to diagnose the faults for trouble shooting and for systematic repair and maintenance of electronic equipment and testing of components.

Course Content:
Repair, Servicing and Maintenance Concepts

1. Introduction, Modern electronic equipment Mean time between failures (MTBF) Mean time to repair (MTR)
2. Maintenance policy
3. Potential problems Preventive maintenance Corrective maintenance.
4. Study of basic procedure of service and maintenance Circuit tracing techniques
5. Concepts of shielding, grounding and power supply considerations in instruments.
6. Fundamental Trouble Shooting Procedures Fault location
7. Fault finding aids Service manuals
8. Test and measuring instruments Special tools
9. Trouble Shooting Techniques
10. Functional Areas Approach, Split half method
11. Divergent, convergent and feedback path circuit analysis Measurement techniques

Mobile Phones
Identification of various parts of mobile phones Repair and maintenance of mobile phones Software installation in mobile phones
Common faults
Trouble shooting and maintenance of testing equipment like C.R.O , function generator, power supplies and other measuring devices, detailed discussion about trouble shooting of medical, electronic equipment like, ECG, EEG, Ultra sound. Repair and maintenance and exposure of medical electronics equipment through industrial visits.
Troubleshooting Digital Systems
Typical faults in digital circuits. Use of logic clip, logic pulsar, IC tester
Demonstration and Practicals to be performed on following groups of Electronic equipment, Choice of one equipment from each group is compulsory.

Group-I Communication	**Group-II Consumer**	**Group-III Audio- video**	**Group-IV Computer**
Telephone Handsets.	Inverters/UPS emergency Lights	TV, CRT, LCD/HD	Monitor
Cordless Phones	Stabilizers	VCD, DVD Players	Printer (Laser)
Fax Machine	EPABX	CCTV	Printer (Inkjet)
Modem	Hub/Switches	Audio Systems	Scanner

Walkie /Talkie	Electronic Toys		Keyboard, Mouse
			Video Games

LIST OF PRACTICALS

Demonstration and practice of fault finding and repair of mobile telephones

1. Demonstration and practice of fault finding and repair of:
   - C.R.O
   - Function Generator
   - Power supplies
   - Digital multimeter
2. Demonstration practice of fault finding and repair of any one equipment from group-I i.e. Communication
3. Demonstration practice of fault finding and repair of any one equipment from group- II i.e. Consumer
4. Demonstration practice of fault finding and repair of any one equipment from group- III i.e. Audio/Video systems.
5. Demonstration practice of faultfinding and repair of any one equipment from group IV i.e. Computer.
6. Testing of Integrated Circuits (ICs). Use of digital tools for troubleshooting digital equipment.

Reference:

1. Repair Manual
2. Specifications of Equipment supplied by the manufacturer
3. Introduction to Biomedical Equipment Technology–Joseph J. Carrand John M Brown.
4. PrinciplesofBiomedicalInstrumentationandmeasurement–RichardAston.
5. Introduction to Biomedical Equipment Technology by Carrand Brown, Regents and Prentice Hall of India, New Delhi
6. Principles of Bio-medical Instrumentation and Measurements by Leslie Cromwell, Fred J Weibell, Erich A Pfeiffer Prentice Hall of India, New Delhi
7. Hand book of Biomedical Engineering-R.S. Khandpur.
8. Modern Electronic Equipment Troubleshooting, Repair and Maintenance by RS Khandpur, Tata McGraw Hill Education Pvt Ltd, New Delhi
9. Bio-medical Instrumentation by M Arumugam, Anuradha agencies Publishers, Vidayakaruppur, Kumbakonam RMS

COURSE OUTCOME:

After undergoing the subject, the student will be able to:

- Understand the basic concept of troubleshooting, repairing and maintenance of electronics equipment's.
- Find fault and errors
- Learn the use of different testing and measuring instruments
- Learn different troubleshooting techniques for electronics equipment repairing
- Repair and maintain mobile phones
- Install software in mobile phones

Course Code	:	**SI-I**
Course Title	:	**Internship-I**
Number of Credits (Teaching Load)	:	2 (L: 0; T:0; P:0)
Prerequisites	:	-
Course Category	:	SI (Internship)

Guidelines

An internship of four weeks after 3rd semester during vacations should be undertaken in an industry/ Govt. or Pvt. Certified Agencies which are in social sector/ Govt. Skill Centres/ Institutes/ Schemes. The assessment of internship will be carried out in 4th semester. The faculty members must visit the internship site during the course of internship to monitor the progress of the students.

Evaluation Criteria

The internal assessment of internship is to be carried out by the Industry/ Organization where the students have undergone the internship. The internal assessment done by the industry/ organization may be rationalized by the Department, if needed. The external assessment is to be done at the Institute. The department shall finalize external assessment within a month of the beginning of the 4th semester. The students have to prepare a daily diary of their internship period and the same has to be submitted at the institute after completion of the internship. The students have also to present the experience gained during internship in a seminar for the purpose of external evaluation.

(a) The assessment criteria (Internal Assessment) by the industry/ organization where the students have undergone the internship is as follows:

- Attendance and general behavior : 20%
- Daily diary maintenance : 20%
- Initiative and participative attitude during internship : 20%
- Performance in the assigned activities by the industrial supervisor : 40%

(b) The assessment criteria (External Assessment) by the institute is as follows:

- Presentation : 60%
- Report : 20%
- Viva : 20%

FOURTH SEMESTER SUBJECTS

Course Code	**MAPC202**
Course Title	**HYDRAULICS AND PNEUMATIC SYSTEMS**
Number of Credits	**3 (L:3, DCS: 1, P:0)**
Prerequisites	**Basic Mechanical Engineering**
Course Category	**PC**

Course Objectives:
The subject deals with basic concepts of hydraulic and pneumatics which are required by students for automation purpose. This subject enhances the knowledge and skills of students in the area of hydraulics and pneumatics.

CONTENTS:

UNIT-I (8hrs.)
Introduction: Need scope and importance of hydraulic and pneumatic, Hydrostatic and hydrodynamic definitions, properties of fluid, Pascal's law, Continuity equation and Bernoulli's equation. Advantages and limitations of hydraulic and pneumatic systems

UNIT-II (20hrs)
Hydraulic Elements: Hydraulic Pipes-Type, materials, designations, pressure ratings and selection criteria. Piping Layout, Concept, rules/norms. Hydraulic Pump-Type, construction, working applications and selection criteria. Power pack Control Valves- Type, designation, symbols, working and applications. Hydraulic Actuators-Type, working and applications. Other Element such as filters, manifold, receivers, coolers and connecters.

UNIT-III (06 hrs)
Fundamentals of Pneumatics: Compressible fluid flow, mass flow rate, compressible fluid-Type, properties and applications.

UNIT-IV (20 hrs)
Pneumatic Elements: Pipes-Type, designations, applications and properties.
Air Compressor- Type (Reciprocating and rotary), working and selection criteria.
Pneumatic Cylinders- Type, symbol, cushion, assemblies, mounting and installation.
Air Motors-Type, working and applications.
Pneumatic Valves-Type, symbols, working, applications and selection criteria.
Other elements-Air receivers, filters, pressure regulator, lubricator.

UNIT-V (10hrs.)
Hydraulic and Pneumatic Circuits: Concept, Meaning and ISO symbols, Basic hydraulic and pneumatic circuits-Type, circuit diagrams. Rules/Norms for designing hydraulic and pneumatic circuits.

COURSE OUTCOMES:
After undergoing this course, the students will be able to:

- Define the basic law of hydrostatic and hydrodynamics, advantage and disadvantage of hydraulic & pneumatic systems.
- Identify &use of hydraulic elements like pipes & its layout, hydraulic pumps, control valves, hydraulic actuators and service unit.
- Define compressible fluid, its type, properties &application.

- Identify & use of pneumatic pipes, air compressor, pneumatic cylinders, air motors, pneumatic valves and service unit elements.
- Design and apply these of hydraulic and pneumatic circuits.

Reference:

1. Hydraulics and Pneumatics (A Technician and Engineer Guide) by Andrew Parr; Butterworth Publishers.
2. Hydraulic and Pneumatic Systems by S.R Majumdar TMH Publishers.
3. Mechatronics by W. Bolton; Pearson.
4. Hydraulic and Hydraulic Machines by R.K. Bansal
5. Industrial Pneumatic control by Z.J Lansky Marcel Dekker, Inc.
6. Hydraulic and Pneumatic Power and control Design, Performance and Application by Yeaple; McGraw hill.
7. Pneumatic Controls: An Introduction to the Principles by Werner Deppert and Kurt Stoll; Vogel-Verlag

Suggested Distribution of Marks (For Paper Setters and Students)

Topic/Unit	Time (In Hrs.)	Marks Allotted
1	08	09
2	20	18
3	06	06
4	20	18
5	10	09
Total	**64**	**60**

Course Code	**MAPC204**
Course Title	**HYDRAULIC AND PNEUMATIC SYSTEMS LAB**
Number of Credits	**1 (L:0, DCS: 1, P:2)**
Prerequisites	**Basic Mechanical Engineering**
Course Category	**PC**

LIST OF PRACTICALS

1. Study and demonstration of various hydraulic devices/elements.
2. Study and demonstration of various pneumatic devices/elements.
3. Operate hydraulic circuits based on simple system requirements. (atleast3)
4. Operate pneumatic circuit based on simple systems requirements(atleast3)
5. Visit to a related industry.

Practical Outcomes (PrOs):
The practical in this section to be developed and assessed in the student for the attainment of the knowledge of Hydraulic and Pneumatic Systems and how they work.

Course Code	**MAPC206**
Course Title	**MICROPROCESSOR AND MICROCONTROLLER**
Number of Credits	**3 (L:3, DCS: 1, P:0)**
Prerequisites	**Digital Electronics**
Course Category	**PC**

Course Objectives:
Embedded systems and Micro-controllers have also assumed a great significance in the electronic and consumer goods industry and are a very vital field. The subject aims to expose students to the embedded systems besides giving them adequate knowledge of Microcontrollers.

CONTENTS

UNIT-I **(02hrs)**
Evolution of Microprocessor: Typical organization of a microcomputer system and functions of its various blocks Microprocessor, its evolution, function and impact on modern society.

UNIT-II **(10hrs)**
Architecture of a Microprocessor (8085 microprocessor); Concept of Bus , bus organization of 8085, Functional block diagram of 8085 and function of each block ,Pin details of 8085 and related signals, Demultiplexing of address/data bus generation of read/write control signals, Steps to execute a stored programme.

UNIT-III **(10hrs)**
Microcontroller series (MCS) –51Overview; Architecture of 8051Microcontroller, Pin details, I/O Port structure, Memory Organization, Special Function Registers (SFRs), External Memory

UNIT-IV **(14hrs)**
Instruction Set of 8051, Assembler and addressing modes; Instruction types, Instruction set of 8051, Addressing modes, Assembler directives, Assembler operation

UNIT-V **(12hrs)**
Timer and interrupts; Timer operation, Serial Port operation, Interrupts

UNIT-VI **(12hrs)**
Design and Interface (12hrs)
Examples like: keypad interface, 7- segment interface, LCD, stepper motor. A/D, D/A, RTC interface.

UNIT-VII **(04hrs)**
Block diagram and pin details: ARDUINO

Reference:

1. Microprocessor Architecture, Programming and Applications with the 8085 by Ramesh Gaonkar, Penram International Publishing
2. Microcontrollers by Deshmukh, Tata McGraw Hill Education Pvt Ltd, New Delhi
3. Microcontrollers by Ayala
4. Microcontrollers by Mazidi, Pearon Education, Delhi

5. Microcontrollers by Neil Makanzi, Pearon Education, Delhi
6. Embedded GSM Applications
7. Microcontrollers and Embedded Systems by Sangar and Sahdev, Uneek Publications, Jalandhar

COURSE OUTCOMES:

After undergoing this course, the students will be able to:

CO1	Recall and apply a basic concept of digital fundamentals to Microprocessor based system.
CO2	Identify a detailed s/w & h/w structure of the Microprocessor.
CO3	Illustrate how the different peripherals are interfaced with Microprocessor.
CO4	Distinguish and analyze the properties of Microprocessors &Microcontrollers.
CO5	Analyze the data transfer information through serial & parallel ports.
CO6	Train their practical knowledge through laboratory experiments.

SUGGESTIVE DISTRIBUTION OF MARKS

Topic No.	**Time Allotted (Hrs)**	**Marks Allotted**
1.	02	02
2.	10	12
3.	10	10
4.	14	14
5.	12	08
6.	12	10
7.	04	04
Total	**64**	**60**

Course Code	**MAPC208**
Course Title	**MICROPROCESSOR AND MICROCONTROLLER LAB**
Number of Credits	**1 (L:0, DCS: 1, P:2)**
Prerequisites	**Digital Electronics**
Course Category	**PC**

LIST OF PRACTICALS

1. Demonstration of Micro-controller Kit
2. Assembly Language Programming
3. C Language Programming- (PC Based)
4. To study the LCD Interface.
5. To study the interface of A/D converter
6. To study the interface of D/A converter
7. To study the interface of controller with sensors

Practical Outcomes (PrOs):

Understand and apply the fundamentals of assembly level programming of microprocessors and microcontroller.

Course Code	**#MAPC210**
Course Title	**INDUSTRIAL ELECTRONICS**
Number of Credits	**4 (L:4, DCS: 0, P:0)**
Prerequisites	**Circuit theory**
Course Category	**PC**

Course Objectives:

1. To introduce the various thyristor family devices
2. Understand the working of controlled rectifiers, invertor and choppers.
3. Application of power devices for AC and DC power conversion.
4. Familiarization of DC electric drives.

CONTENTS

UNIT-I **(18 hrs)**

Introduction to thyristor family:

- Overview of SCR, DIAC and TRIAC.
- Different methods of SCR triggering.
- Different commutation circuits for SCR.
- Series & parallel operation of SCR.
- Construction, working principle of UJT, V-I characteristics of UJT, UJT as relaxation oscillator.
- Brief introduction to Gate Turnoff thyristor (GTO).

UNIT-II **(12 hrs)**

Controlled Rectifiers:

- Single phase half wave-controlled rectifier with R & R-L load.
- Single phase fully controlled full wave bridge rectifier R &R-L Load.
- Single phase fully controlled full wave center tap rectifier R&R-L Load.
- Single phase half controlled full wave rectifier with R & R-L Load.

UNIT-III **(18 hrs)**

Inverters, Choppers, Dual Converters and Cyclo converters:

- Principle of operation of basic inverter circuits, concepts of duty cycle, series & parallel inverters & their applications.
- Choppers: Introduction, types of choppers (Class A, Class B, Class C and Class D). Step up and Step-down choppers.
- Dual Converters and cyclo-converters: Introduction, types & basic working principle of dual converters and cyclo converters & their applications

UNIT-IV **(08 hrs)**

Thyristorised Control of Electric drives

- DC drive control mechanism (Basic working principle)
  - i) Half wave drives.
  - ii) Full wave drives
  - iii) Chopper drives (Speed control of DC motor using choppers).

UNIT-V **(08 hrs)**

Application of Power Electronic Devices:

- UPS system, its block diagram and operation. Types of UPS systems: on-line, offline, line-interactive & their applications
- Light intensity control of lamp using TRIAC
- Speed control of universal motors
- fan regulator
- Automatic battery charger circuit.

COURSE OUTCOMES:

After undergoing this course, the students will be able to:

CO1	Understanding the working mechanisms of various power devices.
CO2	Understanding the controlled power conversion concepts AC to DC, DC to AC, AC to AC and DC to DC conversion.
CO3	Understanding of working mechanism of DC electric drives
CO4	Use of power devices in different areas

Reference:

1. Power Electronics by P.C.Sen Tata McGraw Hill. New Delhi
2. Power Electronics by P.S.Bhimbhra, Khanna Publishers, New Delhi
3. Power Electronics by M.S.Berde, Khanna Publishers, New Delhi.
4. Power Electronics by M. D. Singh and K. B. Khanchandani, Tata Mc-Graw Hill, New Delhi.
5. Industrial Electronics and Control by SK Bhattacharya and S.Chatterji, New Age Publications, New Delhi
6. Power Electronics by S Rama Reddy, Narosa Publishing House Pvt. Ltd., New Delhi

Suggested Distribution of Marks (For Paper Setters and Students)

Topic/Unit	Time (In Hrs.)	Marks Allotted
1	18	15
2	12	12
3	18	15
4	08	08
5	08	10
Total	**64**	**60**

 # Common with. Diploma in Electronics & Communication Engineering

Course Code	:	**SI-II**
Course Title	:	**Internship-II**
Number of Credits (Teaching Load)	:	3 (L: 0; T:0; P:0)
Prerequisites	:	-
Course Category	:	SI (Internship)

Guidelines

An internship of Six weeks after 4th semester during vacations should be undertaken by the students in relevant Industry. The objective of this mandatory internship is to expose the students to the real world of work and get experience with the latest tools, best practices, work & culture, etiquettes and ethics followed in modern industries. The assessment of internship will be carried out in 5th semester. The faculty members must visit the internship site during the course of internship to monitor the progress of the students.

Evaluation Criteria

The internal assessment of internship is to be carried out by the Industry/ Organization where the students have undergone the internship. The internal assessment done by the industry/ organization may be rationalized by the Department, if needed. The external assessment is to be done at the Institute. The department shall finalize external assessment within a month of the beginning of the 5th semester. The students have to prepare a daily diary of their internship period and the same has to be submitted at the institute after completion of the internship. The students have also to present the experience gained during internship in a seminar for the purpose of external evaluation.

(a) The assessment criteria (Internal Assessment) by the industry/ organization where the students have undergone the internship is as follows:

- Attendance and general behavior : 20%
- Daily diary maintenance : 20%
- Initiative and participative attitude during internship : 20%
- Performance in the assigned activities by the industrial supervisor : 40%

(b) The assessment criteria (External Assessment) by the institute is as follows:

- Presentation : 60%
- Report : 20%
- Viva : 20%

PROGRAMME ELECTIVE COURSES

Course Code	**MAPE202-I**
Course Title	**ELECTRONIC INSTRUMENTS AND MEASUREMENT**
Number of Credits	**3 (L:3, DCS: 0, P:0)**
Prerequisites	**Electrical Circuit and Networks**
Course Category	**PE**

Course Objectives:
In the real world of work, the technician is required to handle wide variety of instruments while testing, trouble shooting, calibration etc. The study of this subject will help students to gain the knowledge of working principles and operation of different instruments. During practical sessions, he will acquire the requisite skills.

CONTENT

UNIT-I **(10hrs)**
Basics of Measurements-Measurement, method of measurement, types of instruments Specifications of instruments: Accuracy, precision, sensitivity, resolution, range, errors in measurement, sources of errors, limiting errors, loading effect, importance and applications of standards and calibration

UNIT-II **(10hrs)**
Transducers Distinction between active and passive transducers with examples. -Basic requirements of a transducer - Principle of operation of the following transducers and their applications in measuring the physical quantities listed against each one of them:
Variable Resistance Type (Strain gauge, Thermistor, Hygrometer)
Variable capacitance type (pressure gauge, dielectric gauge)
Variable inductance type (LVDT, Burdon pressure gauge)
Others (solid state sensor, thermocouple, piezoelectric device, photoelectric device, proximity probe)

UNIT-III **(09hrs)**
Electrical Measuring Instruments Megger; Earth Tester.; Power Factor Meter.; Frequency Meter. Tong-Tester.

UNIT-IV **(09hrs)**
Instrument Transformer Current Transformer and its need in measurement. Potential Transformer and its need in measurements.

UNIT-V **(10hrs)**
Electronic Instruments Digital Multimeter. Cathode Ray Oscilloscope (CRO) or Digital Storage Oscilloscope (DSO). Function Generator.

Reference:

1. A Course in Electrical Measurement and Measuring Instruments A K Sawhney Dhanpat Rai
2. Electronic Instrumentation and Measurement Technique W.D. Cooper &A.D. Helfrick Pearson

3. Electronic Instrumentation H.S. Kalsi Mc Graw Hill

Course Outcome:
After undergoing this course, the students will be able to:

CO1	To identify the type of electrical/electronic measuring Instrument
CO2	To purpose suitable type of electrical/electronic instruments for electrical parameter measurement
CO3	To identify electrical insulation failure in electrical wiring

Suggested Distribution of Marks		
UnitNo./Chapter	**Time In Hrs.)**	**Marks Allotted**
1	10	12
2	10	12
3	09	12
4	09	12
5	10	12
Total	**48**	**60**

Course Code	**MAPE202-II**
Course Title	**PROCESS CONTROL AND DATA COMMUNICATION**
Number of Credits	**3 (L: 3, DCS:0, P:0)**
Prerequisites	**Electric Circuits & Networks**
Course Category	**PE**

Course Objectives:

- Emphasis on automatic control is vital since a process designed and constructed with proper consideration for its control is the need of modern industry
- This course introduces various control mechanisms, modes and devices which are necessary to understand simple control systems in a process plant
- The contents of the course have been selected and arranged so as to treat it in a logical manner, to understand the important laws of operation of industrial automatic control systems and to provide a practical background of theory
- The course will enable the student to visualize and evaluate the effect of changes in process parameters on the control response
- This course also provides the basics of electronic communication systems including transmitters and receivers.

Course Content:

UNIT I **(07 hrs)**

Introduction: Basics of control system. Time varying and time in variant system. Continuous and discrete time control system. Open loop and close loop control system. Comparison between open loop and closed loop control system. Components/elements of closed loop system

UNIT II **(14 hrs)**

Basics of Process Control: Basics of process control and Process variable. Concept of on-off. Proportional, Integral, Derivative, PI, PD and PID examples. Relative merits and demerits. Response of different control modes to step and ramp test inputs.

UNIT III **(06 hrs)**

Control Elements: Principle of operation and constructional details of solenoid valves. Diaphragm operated valve. Piston operated valve. Valve Petitioners. Control valve characteristics and their sizing.

UNIT IV **(06 hrs)**

Basic Communication System: Need and types of modulation systems. Analog and digital modulation. Electromagnetic spectrum and its various ranges: VLF, LF, MF, HF, VHF, UHF, microwave.

UNIT V **(07 Hr)**

Analog Modulation Systems: Block diagram of AM transmitters and AM receivers. DSB , DSB-SC, SSB system. FM transmitters and receivers. Vestigial side band systems.

UNITVI **(08 Hrs)**

Data Communication: Basic block diagram and principle of working of the following ASK,

FSK, PSK, and QPSK. Spread Spectrum Techniques, Frequency Hopping Technique.

Reference:

1. Control Systems Engineering by I.J. Nagrath and M.Gopal.
2. Linear Control Systems by B.S. Manke; KhannaPublishers.
3. Process Control by Harrist P; McGrawHill.
4. Process Control Instrumentation Technology by Johnson, Curtis D; John Willey and Sons.
5. Communication Systems by George Kennedy, Tata McGraw Hill Education Pvt Ltd, New Delhi.
6. Introduction to Data Communication by Blanchard.

Course outcomes:

At the end of the course, the student will be able to:

CO1	Understand about the Basics of Control System, Time varying and Time invariant system and Components/elements of Closed Loop System.
CO2	Develop skills in Basics of Process Control- PI, PD, PID Examples, Merits and Demerits with response of different control models to step and ramp test inputs.
CO3	Get the knowledge about Control Elements-Solenoid valve, piston operated valve, sizing.
CO4	Aware about the Concept of Basics Communication System-Analog And Digital modulation, Electromagnetics spectrum and its various ranges: VLF, LF, MF, HF, UHF, Microwave.

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Hrs)	Mark Allotted
1	07	10
2	14	14
3	06	08
4	06	08
5	07	10
6	08	10
Total	**48**	**60**

Course Code	**$MEPE204-I**
Course Title	**COMPUTER INTEGRATED MANUFACTURING**
Number of Credits	**3(L:3, DCS:0, P:0)**
Prerequisites	**NIL**
Course Category	**PE**

Course Objectives:

- To understand the basic concept of Computer integrated manufacturing.
- To understand the hardware and software applied in product modeling.
- To understand the applications of computer based technologies in manufacturing processes.
- To understand the flexible manufacturing system

Course Content:

UNIT-I **(10Hrs)**

Concept of Computer Integrated Manufacturing (CIM); Basic components of CIM; Distributed database system; distributed communication system, computer networks for manufacturing; future automated factory; social and economic factors

UNIT-II **(08Hrs)**

Computer Aided Design (CAD): CAD hardware and software; product modelling, automatic drafting; engineering analysis; FEM design review and evaluation; Group Technology Centre.

UNIT-III **(12Hrs)**

Computer Aided Manufacturing (CAM): Computer assisted NC part programming; Computer assisted robot programming; computer aided process planning (CAPP); computer aided material requirements planning (MRP)

UNIT-IV **(08Hrs)**

Computer aided production scheduling; computer aided inspection planning; computer aided inventory planning, Flexible manufacturing system (FMS); concept of flexible manufacturing.

UNIT-V **(10Hrs)**

Integrating NC machines, robots, AGVs, and other NC equipment; Computer aided quality control; computer aided forecasting; office automation

Reference:

1. CAD, CAM, CIM, P. Radhakrishnan and S. Subramanyan, New Age International Publishers.
2. Computer Integrated Manufacturing- Paul G. Rankey, Prentice Hall.
3. Robotics Technology and Flexible Automation–S. R. Deb, Tata McGraw Hill.

Course outcomes:
At the end of the course, the student will be able to:

CO1	Understand the concept of computer integrated manufacturing.
CO2	Understand the hardware and software applied in product modeling.
CO3	Analyze and convert the problem into a mathematical model.
CO4	Understand and implement the transportation problems at workplace.
CO5	Solve the assignment problems, solving linear programming approach using software

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	**Time Allotted (Hrs)**	**Marks Allotted**
1	10	12
2	08	10
3	12	14
4	08	10
5	10	14
Total	**48**	**60**

$ Common with diploma in Refrigeration and Air conditioning

Course Code	**MEPE204-II**
Course Title	**HYBRID VEHICLES**
Number of Credits	**3(L:3, DCS:0, P:0)**
Prerequisites	**NIL**
Course Category	**PE**

Course Objectives:

- To understand the basics of electric vehicle history and components. To understand properties of batteries.
- To understand the electrical machine properties and classifications. To understand the properties of electric vehicle, drive systems
- To understand the concepts of hybrid electric vehicles.

Course Content:

UNIT-I (14Hrs)

Electric Vehicles: Introduction; History of Hybrid and Electric Vehicles; Social and Environ mental importance of Hybrid and Electric Vehicles; Components, Vehicle mechanics: Roadway fundamentals, Vehicle kinetics, Dynamics of vehicle motion; Propulsion System Design.

UNIT-II (09Hrs)

Battery: Basics; Types; Parameters: Capacity, Discharge rate, State of charge, State of Discharge, Depth of Discharge; Technical characteristics, Battery pack Design, Properties of Batteries.

UNIT-III (09Hrs)

DC & AC Electrical Machines: Motor and Engine rating; Requirements; DC machines; Three phase A/c machines; Induction machines; Permanent magnet machines; Switched reluctance machines.

UNIT-IV (09Hrs)

Electric Vehicle Drive Train: Transmission configuration; Components: Gears, Differential, Clutch, Brakes; Regenerative braking, Motor sizing; Fuel efficiency analysis.

UNIT-V (07Hrs)

Hybrid Electric Vehicles: Types: Parallel, Series, Parallel and Series configurations; Drive train; Sizing of components; Basics of Micro, Mild, Mini, Plug-in and Fully hybrid.

Reference:

1. Electric & Hybrid Vehicles–A. K. Babu, Khanna Publishing House, New Delhi, 2018
2. Electric & Hybrid Vehicles–Design Fundamentals-Iqbal Hussain, Second Edition, CRC Press,2011.
3. Electric Vehicle Technology Explained-James Larminie, JohnWiley&Sons,2003.
4. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals - Mehrdad Ehsani, Yimin Gao, Ali Emadi, CRC Press,2010.
5. Electric Vehicle Battery Systems-Sandeep Dhameja, Newnes,2000.

Course outcomes:
At the end of the course, the student will be able to:

CO1	Understand the basics of electrical vehicle history and components.
CO2	Understand the properties of batteries.
CO3	Understand the electrical machine properties and classifications.
CO4	Understand the properties of electrical vehicle drive systems.
CO5	Understand the concepts of hybrid electric vehicles.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	**Time Allotted (Hrs)**	**Marks Allotted**
1	14	14
2	09	12
3	09	12
4	09	12
5	07	10
Total	**48**	**60**

Appendix-II

AUDIT COURSES

Course Code	**##AU202**
Course Title	**Essence of Indian Knowledge & Tradition**
Number of Credits	**0 (L: 2, DCS:0; P:0)**
Prerequisites	**-**
Course Category	**AU (Audit Course)**

Course Objectives

The objective of this course is to expose the students with the concepts of Indian traditional knowledge and to make them appreciate the importance of the roots of indigenous knowledge system.

Course Content

UNIT-I **(08 Hrs)**

Indian Knowledge System (IKS):

- Introduction and Function of Indian Knowledge System(IKS).
- The Basic Structure of Indian Knowledge System(IKS) (only Introduction)
    1. The 4 Vedas, Namly ऋग्वेद (Rigveda) ,यजुर्वेद (Yajurveda),सामवेद (Samaveda) ,अथर्ववेद (Atharvaveda) .
    2. The 4 UpVedas, Namely आयुर्वेद (Ayurveda (health-care)), धनुर्वेद (Dhanurveda (archery)), गंधर्ववेद (Gandharva-veda (dance, music etc.)) and स्थापत्यवेद (Sthapatyaveda (architecture)).
    3. The 6 Vedagangs ,namely Shiksha (शिक्षा), Kalpa (कल्प), Vykaraṇa (व्याकरण), Chhandas छंदस्), Nirukta (निरुक्त), and Jyotisha(ज्योतिष).
    4. Itihasa (इतिहास) (Ramayana रामायण and Mahabharata महाभारत) and Purana पुराण (Vishnupurana विष्णुपुराण , Bhagavata Purana (भागवत पुराण) etc.)
    5. Dharmashatraधर्मशास्त्र (Manusmriti मनुस्मृति, Yajnavalkya-smriti याज्ञवल्क्य स्मृति, etc.).
    6. Darshan दर्शन (आस्तिक तथा नास्तिक).
    7. Nyaya न्याय (Logic तर्कशास्त्र and Epistemology ज्ञानमीमांसा).

UNIT-II **(06 Hrs)**

Modern Science

- Modern science: Introduction, Characteristics, importance and Example
- Difference between modern Science and Indian knowledge system
- Role of IKS in modern science

UNIT-III **(05 Hrs)**

Traditional knowledge

- Traditional knowledge: Definition, nature, characteristics, scope and importance
- Indigenous Knowledge (IK): characteristics
- Traditional knowledge vis-a-vis Indigenous knowledge

- Traditional knowledge Vs western knowledge
- The need for protecting traditional knowledge

UNIT-IV **(08 Hrs)**

Yoga and Holistic Health Care

- Yoga: Meaning and Importance of Yoga
- Yoga and physical health, Yoga and psychological health, Yoga and intellectual health, Yoga and spiritual health, Yoga and social approach.
- Introduction to Ashtanga Yoga, Yogic Kriyas (Shat Karma)
- Pranayama and its types; Active lifestyle and stress management through Yoga
- Physical Fitness, Health and wellness: Meaning and Importance of Wellness,
- Components of Wellness, Health and physical Fitness;
- Traditional sports & Regional Games for promoting wellness:
- Leadership through Physical Activity and Sports; Introduction to First Aid.

UNIT-V **(05 Hrs)**

Himachal Pradesh: A Basic Information

- History, Culture, Heritage/ Tradition, Customs & Manners,
- Regional Knowledge, Geographical Features, Constitutional History
- Tourism Place & Scope

Festivals and Fairs **References:**

1. Cultural Heritage of India-Course Material by V. Sivaramakrishna Bharatiya, Vidya Bhavan, Mumbai, 5th Edition, 2014
2. Modern Physics and Vedant by Swami Jitatmanand Bharatiya, Vidya Bhavan
3. The wave of Life by Fritzof Capra
4. Tao of Physics Fritzof Capra
5. Tarkasangraha of Annam Bhatta, International by V N Jha, Chinmay Foundation, Velliarnad, Ernakulam
6. Science of Consciousness Psychotherapy and Yoga Practices by RN Jha, Vidyanidhi Prakashan, Delhi, 2016
7. Himachal Pradesh History, Culture & Economy by Mian Goverdhan Singh & Prof. Dr. C.L. Gupta.

Course Outcomes

After completing this course the students will be able to :

- Identify the concept of Indian Knowledge System (IKS).
- Understand the need and importance of protecting traditional knowledge.
- Compare the Indian traditional knowledge and modern science.
- Understand the use of Yoga in stress management, mental health, mindfulness, healthy eating, weight loss and quality sleep.
- Aware of the general knowledge of Himachal Pradesh.

SUGGESTED DISTRIBUTION OF MARKS (Internal Assessment)		
Project Component	**Time Allotted (Hrs)**	**Marks Allotted (%)**
Unit 1: Indian Knowledge System (IKS)	8	25%
Unit 2: Modern Science	6	20%
Unit 3: Traditional knowledge	5	15%
Unit 4: Yoga and Holistic Health Care	8	25%
Unit 5: Himachal Pradesh: A Basic Information	5	15%
Total	32	100%

Common with other branches