MSME TECHNOLOGY CENTRE BHOPAL

(A Government of India Society under Ministry of Micro, small and medium enterprises)

CURRICULUM & TERM WORK:

DIPLOMA IN MECHATRONICS

W. E. F. 2020-21

CONTENTS

THIRD SEMESTER

FOURTH SEMESTER

FIFTH SEMESTER

SIXTH SEMESTER

MSME TECHNOLOGY CENTRE, BHOPAL

OUTCOME BASED CURRICULUM: MECHATRONICS

I. INTRODUCTION

This course focuses on mechatronics engineering by emphasizing mechanical engineering, electrical engineering and computing. Conceiving, utilizing, maintaining and upgrading mechatronic devices and systems will require this knowledge. Also required will be an understanding of the synergies and trade-offs at the interfaces between the mechanical, electrical and computing elements in system and subsystem level that the devices and systems contain. Design projects at levels I & II of the course facilitate integration of mechanical, electrical and computing knowledge provided in the course.

II. PROGRAM EDUCATIONAL OBJECTIVES:

The Mechatronics Diploma Technician after completion of three year education & training will be able to function in and an as-

A. A Mechatronics Technician Engineer to work on shop floor

B. An Entrepreneur

C. A life-long learner of Higher Education leading to undergraduate & post Graduate program.

D. An Engineer as Leader

III. PROGRAM OUTCOMES

1. A Mechatronics Technician Engineer to work on shop floor
2. An ability to conduct experiments, as well as to analyse and interpret data
3. An ability to design a system component, or process to meet desired needs within Realistic constraints such as economic, environmental, social, political, ethical, Health and safety, manufacturability, and sustainability
4. An ability to function as individual and a member of multidisciplinary teams
5. An ability to identify, formulate, and solve engineering problems
6. An understanding of professional and ethical responsibility
7. An ability to communicate effectively
8. A recognition of the need for, and an ability to engage in life-long learning
9. A knowledge of contemporary issues
10. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
11. An ability to work on project and apply financial concept in project.

IV. SAMPLE ATTRIBUTES OF MECHATRONICS ENGINEER

GENERAL

1. Evaluate Personnel Appraisal
2. Conduct Mechatronic Product process study
3. Conduct Departmental Meeting
4. Working in multi-disciplinary team

PERFORM SHOP FLOOR FUNCTION

1. Mechatronic Product Production
2. Mechatronic Product Design
3. Maintenance Programme Activities
4. Mechatronic Equipment Reliability and Maintenance
5. System/Process Design

MANAGE MECHATRONIC PROJECT

- Perform Mechatronic Product Fabrication Activities Improvement

V. MECHATRONICS TRAINING PROGRAM INCLUDES:

- Electricity & Electronics
- Electrical & Mechanical Systems
- Electric Power & Controls
- Fluid Power Systems
- PLCs & Drives
- Automation & Robotics
- Instrumentation & Process Control
- Manufacturing Technologies
- Understand the interdisciplinary fundamentals of mechanical engineering, Electrical engineering, control systems, and their integration.
- Have strong team skills to solve complex problems that cross disciplinary boundaries.

- Perform design, and implementation of intelligent engineered products and Processes enabled by the integration of mechanical, electronic, computer, and software engineering technologies.

VI. CORE CURRICULUM AREAS

Mechanical Engineering Courses

- Engineering Graphics
- mathematics
- Engineering Mechanics
- Strength of Materials & Engineering Materials
- Fluid Mechanics
- Machine Dynamics for Mechatronics Engineers
- Instruments and Controls

Electrical & Electronics Engineering Courses

- Circuits
- Digital Circuits
- Electronics
- Power Electronics
- Electrical Paneling
- Electric Machines
- Control Systems

Software Engineering Courses

- Software Engineering
- C++ Programing
- Microprocessor Programing

Mechatronics Engineering Courses

- Survey of Mechatronics Engineering
- Mechatronics Engineering Fundamentals
- Robotics Analysis and Synthesis
- Digital Controls for Mechatronics Engineering
- Mechatronics System Design

VII. CURRICULUM STRUCTURE:

- Program Duration: **Six Semester (3 Years)**
- Hours Per Semester: **40 Hours/Week**
- No. of Weeks per semester/term: **20**
- No. of courses /Semester: Approximately **5 to 7**

BASIC SCIENCE

a. Understand and proficiently apply the relevant sciences and scientific methods to mechatronics engineering, to design solutions to complex problems
b. Identify, interpret and critically appraise current developments and advanced technologies and apply them to mechatronics engineering

1. Communication Skills
2. Mathematics I
3. Mathematics II
4. Applied Science I
5. Life Skills (Professional Practice)

ENGINEERING SCIENCE

a. Understand and proficiently apply the relevant sciences and scientific methods to mechatronics engineering, to design solutions to complex problems
b. Identify, interpret and critically appraise current developments and advanced technologies and apply them to mechatronics engineering

6. AUTOCAD for Engineering

7. Engineering Mechanics
8. Basics of Electrical Engineering
9. Electrical & Mechanical Workshop
10. Fluid Mechanics & Pneumatics
11. Industrial Automation
12. Engineering Materials

APPLIED TECHNOLOGY

a. Plan, organize and use resources efficiently
b. Demonstrate the highest standards of personal performance
c. Demonstrate commitment to lifelong learning and professional development
d. Understand the responsibilities of mechatronics engineers to the community, the engineering profession and the industrial and business world
e. Demonstrate commitment to ethical standards and legal responsibilities to the community and the profession

13. C Programing
14. Process systems analysis
15. PLC programming
16. Mechatronic & Manufacturing
17. Robotics
18. Mechatronic System design
19. CNC Programming
20. CNC Machine
21. Microprocessor Programing
22. Embedded System Design
23. Project I
24. Project II

CORE TECHNOLOGY

a. Identify and synthesize the constraints posed by economic factors, safety considerations, environment impacts and professional standards on mechatronics engineering practice and use them to inform professional judgments
b. Determine, analyses and proficiently apply theoretical and numerical analysis of phenomena to Conceive, control and optimize the performance of mechatronics engineering systems
c. Identify and critically evaluate the performance of a mechatronics engineering system in terms of economics, safety and the social and physical environment, and implement approaches to minimize any adverse impact leading to sustainable development.
d. Understand and proficiently apply a systems approach to the design cycle, addressing the broad contextual constraints, leading to sustainable development
e. Communicate effectively on both technical and general issues with peers, associates, clients and the general public
    i. Fundamentals of Mechatronic
    ii. Fundamentals of Programming
    iii. Strength of Materials
    iv. Electrical circuits & paneling
    v. Introduction to Electro-mechanical Sensors and CUIT AND Punctuators
    vi. Power Electronics
    vii. Digital Logic and Microcontrollers
    viii. Thermodynamics & Heat transfer
    ix. Best manufacturing Practices & Safety
    x. Professional Practice I
    xi. Professional Practice II

DIVERSIFIED TECHNOLOGY

a. Plan, organize and use resources efficiently
b. Demonstrate the highest standards of personal performance
c. Demonstrate commitment to lifelong learning and professional development
d. Understand the responsibilities of mechatronics engineers to the community, the engineering profession and the industrial and business world
e. Demonstrate commitment to ethical standards and legal responsibilities to the community and the profession
    i. Robotics II
    ii. Panel engineering
    iii. Automotive Mechatronics
    iv. Manufacturing System Design
    v. SCADA control system

VIII. TEACHING & EXAMINATION SCHEME

DIPLOMA IN MECHATRONICS CURRICULUM

I[ST] Semester

Sr. No.	Subject code	Subject Name	Teaching Scheme/ No. of Hours		Examination Scheme								
					Theory				Practice				Total Marks
					Sessional		Semester Exam		Sessional		Semester Exam		
			Theory	Practice	Max. Marks	Min to pass	Max. Marks	Min to pass	Max. Marks	Min to pass	Max. Marks	Min to pass	
1	M1 – 01	COMMUNICATION SKILLS -I	2	2	40	20	60	30	0	0	0	0	100
2	M1 – 02	ENIGINEERING MATHEMATICS –I	2	2	40	20	60	30	0	0	0	0	100
3	M1 – 03	APPLIED PHYSICS	2	2	40	20	60	30	0	0	0	0	100
4	M1 – 04	ENGINEERING GRAPHICS	2	6	50	25	00	00	40	20	60	30	150
5	M1 – 05	COMPUTER FUNDAMENTALS	2	4	50	25	00	00	40	20	60	30	150
6	M1 – 06	WORKSHOP PRACTICE	4	10	40	20	60	30	160	80	240	120	500
			14	**26**									**1100**
			40										

DIPLOMA IN MECHATRONICS CURRICULUM

IInd Semester

Sr. No.	Subject code	Subject Name	Teaching Scheme/ No. of Hours		Examination Scheme								
					Theory				Practice				Total Marks
					Sessional		Semester Exam		Sessional		Semester Exam		
			Theory	Practice/ Tutorial	Max. Marks	Min to pass	Max. Marks	Min to pass	Max. Marks	Min to pass	Max. Marks	Min to pass	
1	M2 – 01	ENGINEERING MATHEMATICS -II	2	2	40	20	60	30	0	0	0	0	100
2	M2 – 02	AUTOCAD FOR ENGINEERING	2	6	50	25	00	00	40	20	60	30	150
3	M2 – 03	ENGINEERING MECHANICS	2	2	40	20	60	30	0	0	0	0	100
4	M2 – 04	BASICS OF ELECTRICAL ENGINEERING	2	4	40	20	60	30	40	20	60	30	200
5	M2 – 05	BASICS OF ELECTRONICS ENGINEERING	2	4	40	20	60	30	40	20	60	30	200
6	M2 – 06	BASICS OF MECHANICAL ENGINEERING SYSTEMS & AUTOMATION	2	6	40	20	60	30	40	20	60	30	200
7	M2-07	COMMUNIATION SKILL II	2	2	40	20	60	30	0	0	0	0	100
			14	**26**									**1050**
			40										

DIPLOMA IN MECHATRONICS CURRICULUM

IIIrd Semester

Sr. No.	Subject code	Subject Name	Teaching Scheme/ No. of Hours		Examination Scheme								
					Theory				Practice				Total Marks
					Sessional		Semester Exam		Sessional		Semester Exam		
			Theory	Practice/ Tutorial	Max. Marks	Min to pass	Max. Marks	Min to pass	Max. Marks	Min to pass	Max. Marks	Min to pass	
1	M3 – 01	STRENGTH OF MATERIALS	2	2	40	20	60	30	0	0	0	0	100
2	M3 – 02	CONTROL SYSTEMS	2	4	40	20	60	30	40	20	60	30	200
3	M3 – 03	DIGITAL ELECTRONICS	2	4	40	20	60	30	40	20	60	30	200
4	M3 – 04	ELECTRICAL CIRCUITS & PANEELING	2	4	40	20	60	30	40	20	60	30	200
5	M3 – 05	INTRODUCTION TO ELECTRO – MECHANIC SENSORS & ACTUATORS	2	4	40	20	60	30	40	20	60	30	200
6	M3 – 06	THERMODYNAMICS & HEAT TRANSFER	2	2	40	20	60	30	0	0	0	0	100
7	M3 - 07	Industrial Training (In-house)	00	8	00	00	00	00	50	25	100	50	150
			12	**28**									**1150**
			40										

DIPLOMA IN MECHATRONICS CURRICULUM

IVth Semester

Sr. No.	Subject code	Subject Name	Teaching Scheme/ No. of Hours		Examination Scheme								
					Theory				Practice				Total Marks
					Sessional		Semester Exam		Sessional		Semester Exam		
			Theory	Practice	Max. Marks	Min to pass	Max. Marks	Min to pass	Max. Marks	Min to pass	Max. Marks	Min to pass	
1	M4 – 01	MANUFACURING PROCESS & MECHATRONICS FUNDAMENTALS	2	4	40	20	60	30	50	25	0	0	150
2	M4 – 02	POWER ELECTRONICS	2	4	40	20	60	30	40	20	60	30	200
3	M4 – 03	MICROCONTROLLER PROGRAMING	2	6	40	20	60	30	40	20	60	30	200
4	M4 – 04	METROLOGY & Quality Control	2	2	40	20	60	30	50	25	0	0	150
5	M4 – 05	C PROGRAMMING	2	6	40	20	60	30	40	20	60	30	200
6	M4 – 06	PROFESSIONAL PRACTICE & MINI PROJECT	00	8	0	0	0	0	50	25	100	50	150
			10	**30**									**1050**
			40										

DIPLOMA IN MECHATRONICS CURRICULUM

Vth Semester

Sr. No.	Subject code	Subject Name	Teaching Scheme/ No. of Hours		Examination Scheme								
					Theory				Practice				Total Marks
					Sessional		Semester Exam		Sessional		Semester Exam		
			Theory	Practice	Max. Marks	Min to pass	Max. Marks	Min to pass	Max. Marks	Min to pass	Max. Marks	Min to pass	
1	M5 – 01	CNC PROGRAMMING & MACHINING	2	6	40	20	60	30	40	20	60	30	200
2	M5 – 02	INDUSTRIAL HYDRAULICS & PNEUMATICS	2	6	40	20	60	30	40	20	60	30	200
3	M5 – 03	THEORY OF MACHINE & PROCESS SYSTEM ANALYSIS	2	4	40	20	60	30	0	0	0	0	100
4	M5 – 04	PLC PROGRAMMING	2	6	40	20	60	30	40	20	60	30	200
5	M5 – 05	BEST MANUFACTURING PROCESSES	2	00	40	20	60	30	0	0	0	0	100
6	M5 – 06	ELECTRICAL DRIVES & CONTROL	2	6	40	20	60	30	50	25	0	0	150
			12	**28**									**950**
			40										

DIPLOMA IN MECHATRONICS CURRICULUM

VIth Semester

Sr. No.	Subject code	Subject Name	Teaching Scheme/ No. of Hours		Examination Scheme								
					Theory				Practice				Total Marks
					Sessional		Semester Exam		Sessional		Semester Exam		
			Theory	Practice	Max. Marks	Min to pass	Max. Marks	Min to pass	Max. Marks	Min to pass	Max. Marks	Min to pass	
1	M6 – 01	EMBEDDED SYSTEM DESIGN	2	6	40	20	60	30	40	20	60	30	200
2	M6 – 02	MECHATRONICS SYSTEM DESIGN	2	6	40	20	60	30	100	50	0	0	200
3	M6 – 03	ROBOTICS	2	4	40	20	60	30	100	50	0	0	200
4	M6 – 04	LIVE PROJECT	00	12	0	0	0	0	100	50	200	100	300
		ANY ONE OF FOLLOWING											
6	M6 – 05	PANEL ENGINEERING	2	4	40	20	60	30	50	25	00	00	150
5	M6 –06	SCADA AND HMI	2	4	50	25	00	00	40	20	60	30	150
			8	**32**									**1050**
			40										

MSME TECHNOLOGY CENTRE BHOPAL

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FIRST SEMESTER: COURSE DETAILS

DIPLOMA IN MECHATRONICS

M1-01: COMMUNICATION SKILL

I. **SCHEME OF TEACHING & EVALUATION**

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	2	3	60	-	40	-	100

II. **COURSE RATIONALE**

The most commonly used medium to express oneself is language. English, being a global language, is used in all the spheres of human life i.e., personal, professional and social. A diploma student is expected to be proficient in English language and pursue the existing course of study to handle the future jobs. The content of the text includes the aspects related to language skills.

III. **COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVE.**

Students will be able to:

1. Develop vocabulary.
2. Apply the rules of grammar.
3. Comprehend the given unseen passage.

IV. **COURSE OUTCOMES**

Students will be able to construct the sentence in English. Students can apply grammar rules in sentence building. Understand the different types of paragraph. Comprehend main ideas and reproduce them. Describe an object, process or procedure.

V. **CONTENTS**

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	UNDERSTANDING GRAMMATICAL CONCEPTS	Student should be able to:- • Understand the part of speech • Describe the noun ,pronoun ,verb, adverb, adjective • Demonstrate types of preposition ,conjunction ,interjection ,articles	Part of speech, Noun, Pronoun, Verb, Adverb, Adjective, Preposition, Conjunction, Interjection, Articles	12	18
2	TENSES	Student will be able to:- • Construct the sentence in present ,past ,future tense forms	Present Tense and Its forms, Past tense and its forms, Future Tests and its forms	10	15
3	INTRODUCTION TO COMPONENTS OF GRAMMAR	Student should be able to:- • Apply grammar rules in sentence building by help of active voice ,passive voice ,direct speech and indirect speech	Active Voice, Passive voice, Direct Speech Indirect Speech	8	12
4	TYPES OF SENTENCES AND THEIR CONSTRUCTION	Student will be able to:- • Comprehend main ideas about sentence construction ,sentence patterns	Sentence construction, Sentence patterns	6	9
5	SYNONYMS AND ANTONYMS	Student will be able to:- • Process or procedure in synonyms , antonyms ,homonyms ,commonly confusing words	Synonyms, Antonyms, Homonyms Commonly confusing words	4	6

VI. **LIST OF TUTORIAL**

Describe an object, process or procedure. Prepare list of various communication activities carried out in your institute.
Study of word formation.

1. Identify sentence elements.
2. Draw the diagram of communication cycle for given situation. State the type and elements of communication involved in it.
3. Role play: Teacher should form the group of students based on no. of characters in the situation. Students should develop the conversation and act out their roles.
4. Collect five pictures depicting aspects of body language from different sources such as magazines, newspapers, internet etc. State the type and meaning of the pictures.

VII. **REFERENCE BOOKS**

Sr. No.	Author	Title	Publication
1	Doctor,Aspi H	A Course In Communication Skills In English	Sheth Publishers P. Ltd.
2	Mohan,Krishna	Developing Communication Skills	Macmillan India Ltd.
3	Bhatia,Pavin S.R.	Professional Communication Skills	S. Chand & Co.
4	Sethi,Rajeev	Communicating Effectively	Infinity Books
5	Board Of Editors	Communication Skill (Communication And Grammar) For 1st Yr. Diploma In Engineering	University Press
6	Mb.Shah, B.C.Rana	Written And Spoken Communication In English	University Press

M1-02: ENGINEERING MATHEMATICS – I

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	2	3	60	-	40	-	100

I. COURSE RATIONALE

Mathematics is the foundation of science and technology. The study of basic mathematics is helpful to understand concepts of Engineering. This subject enhances logical thinking capability. It also improves the systematic approach in solving engineering problem.
Algebra provides the language and abstract symbols of mathematics. It also helps to use that Language in real-life applications.
Matrix and Determinant topics are helpful for finding optimum solution of system of
Simultaneous equations which are formed in the various branches of engineering using different parameters.
Trigonometry is the study of triangles and angles.
Geometry gives emphasis on understanding the deductive reasoning process. It includes writing derivations of theorems and giving geometric relationships by reasoning. Co- ordinate geometry plays an important role in Animation, AutoCAD, Computer graphics etc. Contents of this subject will form foundation for further study in mathematics.

II. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

1. Apply Cramer's rule and matrix method to solve simultaneous equations in three Variables.
2. Use concept of allied angle, compound angle, multiple and sub-multiple angles to Solve engineering problems.
3. Use factorization and de-factorization formulae to solve examples.
4. Understand the relationship of two variables.

III. COURSE OUTCOMES

Student will be able to solve simultaneous equations in three variables, Use concept of allied angle, compound angle, multiple and sub-multiple angles to solve engineering problems, Use factorization and de-factorization formulae to solve example.

IV. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	ALGEBRA	Student should be able to:- • Define and expansion of determinants of order3 ,Cramer's rule to simultaneous equations in three variables • Derive the equations of matrices and partial fraction	**Determinant** Definition and expansion of determinant of order 3, Cramer's rule to solve simultaneous equations in three variables.	4	6
			Matrices Definition of a matrix of order m x n and types of matrices, Algebra of matrices with properties and examples, Transpose of a matrix with properties, Cofactor of an element of a matrix, Ad joint of matrix and inverse of matrix by ad joint method.	4	6
			Partial Fraction Definition of fraction, proper, improper fraction and partial fraction, Resolve proper fractions into partial fraction with denominator containing, i) non repeated linear factors, ii) repeated linear factors, iii) Non repeated quadratic irreducible factors.	6	9

2	TRIGONOMETRY	Student should be able to:- • Understand concepts of trigonometric ratios of allied multiple and sub multiple angles • Derive factorization and De-factorization formulae with examples	**Trigonometric Ratios of Allied, Compound, Multiple and Sub-Multiple Angles** Trigonometric ratios of any angle, Definition of allied angle, compound, multiple and sub-multiple angles. Trigonometric ratios of above angles with proofs. Simple examples	8	12
			Factorization and De-factorization Formulae Formulae for factorization and de-factorization with proof and examples	4	6
3	CO - ORDINATE GEOMETRY	Student should be able to:- • Derive the straight line equations between two lines with proof • Solve distance between parallel line with proof and examples • Measure of dispersion-range ,mean deviation from mean and median ,and standard deviation	**Straight Line** Angle between two lines with proof. Examples. Perpendicular distance between point and line with proof and Examples. Distance between two parallel line with proof and examples.	8	12
4	STATISTICS	Student should be able to:- • Measure of dispersion-range ,mean deviation from mean and median ,and standard deviation	**Measures of Dispersion** Measures of dispersion - range, mean deviation from mean and median, and standard deviation. Variance and its coefficient. Comparisons of two sets of observations.	6	9

V. LIST OF TUTORIAL

Sr. No.	Topic for tutorial
1	Determinant.
2	Matrices (Algebra of matrices)
3	Matrices (Ad joint , inverse and solution of equations using matrix inversion method)
4.	Partial fraction.
5	Trigonometric ratio of allied, compound, multiple and sub-multiple angles.
6	Factorization and de- factorization formulae.
7	Inverse trigonometric ratios.
8	Straight line.

VI. REFERENCE BOOKS

Sr. No.	Author	Title	Publication
1	S. S. Sastry	Engineering Mathematics	Prentice Hall of India
2	S.P. Deshpande	Mathematics for Polytechnic	Pune Vidyarthi Griha.
3	S. L. Loney	Trigonometry	S. Chand Publication
4	Ayres	Matrices	Schuam series McGraw Hill
5	B. S. Grewal	Higher Engineering Mathematics	Khanna publication

M1 - 03: APPLIED PHYSICS

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	2	3	60	-	40	-	100

II. COURSE RATIONALE

Physics is a foundation of all core technology subjects. Study of science and technology goes hand in hand. Technical knowledge can be gained more effectively using concepts of Physics. Curriculum of Engineering Physics includes fundamental concepts used in industrial applications.

Study of various properties of matter is helpful in the study of Strength of Material, Fluid mechanics, Fluid power etc., and selection of lubricant for machine parts. Property of Surface tension is applicable in Paint industry and capillarity phenomenon is useful in plumbing.

Thermal properties of matter are applicable in study of various core technology subjects like Thermal Engineering, Heat Transfer etc. Optical phenomena such as refraction and dispersion are required in higher study as well as in industry such as in characterization of material using Spectroscopy, X-ray diffraction (XRD), Atomic Force Microscopy (AFM).

Study of wave motion, Simple Harmonic Motion and their behavior is useful in field of Civil Engineering, Electronics & Communication Engineering, Mechanical Engineering and Electrical Engineering. Principle of Photocell and its applications are required in study of Solar cells, Photovoltaic cells.

III. COURSE OBJECTIVES / INSTRUCTIONAL OBJECTIVES

Student will be able to:

1. Understand method of selection of material for intended purpose.
2. Apply knowledge of good and bad conductors of heat in various engineering concepts.
3. Know the effect of interference between light waves.

IV. COURSE OUTCOMES

Student will be able to:

1. Understand method of selection of material for intended purpose.
2. Apply knowledge of good and bad conductors of heat in various engineering concepts.
3. Know the effect of interference between light waves.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	UNITS AND MEASUREMENTS	Student should be able to :- • Describe system of units ,fundamental and derived units ,accuracy and precision of measuring instruments • Analyse the errors in measurements ,dimension and its applications	**Units and measurements** Introduction, Need for measurement, system of units, fundamental and derived units, Accuracy and precision of measuring instruments. Errors in measurements. Dimensional analysis and its applications.	4	8
2	PROPERTIES OF LIQUIDS	Student Should be able to:- • Understand pressure ,pressure-depth relation, atmospheric pressure ,Pascal's law, Archimedes' principle • Define viscous force, viscosity, velocity gradient, newton's law of viscosity, coefficient of viscosity and its SI unit. • Describe streamline and turbulent flow ,critical velocity ,Reynolds's number and its significance ,up thrust force ,terminal velocity ,stake's law and derivation of coefficient of viscosity by stake's method	**Fluid friction:** Pressure, pressure-depth relation (P = p h g), atmospheric pressure, Pascal's law, Archimedes' principle. Viscous force, definition of viscosity, velocity gradient, Newton's law of viscosity, coefficient of viscosity and its SI unit. Streamline and turbulent flow with examples, critical velocity, Reynolds's number and its significance. Up thrust force, terminal velocity, Stokes law, and derivation of coefficient of viscosity by Stoke's method, effect of temperature and adulteration on viscosity of liquid.	8	8

		,effect of temperature and adulteration on viscosity of liquid • Find cohesive and adhesive force ,Laplace's molecular theory of surface tension , angle of constant • Solve the derivation of expression fore surface tension by capillary rise method. Define viscous force, viscosity, velocity gradient, newton's law of viscosity, coefficient of viscosity and its SI unit.	**Surface tension:** Cohesive and adhesive force, Laplace's molecular theory of surface tension, Surface Tension: definition and unit, effect of temperature on surface tension. Angle of contact, Capillarity and examples of capillary action, derivation of expression for surface tension by capillary rise method, applications of surface tension.		
3	WAVE MOTION	Student Should be able to:- • Evaluate wave motion ,velocity , wave period, frequency ,length ,amplitude • Derive simple harmonic motion with examples • Derive equations of SHM ,velocity and acceleration of a body • Understand the types progressive waves: transvers and longitudinal waves with examples	**Wave motion:** Definition of a wave, wave motion, wave velocity, wave period, wave frequency, wave length, vibratory motion, periodic motion, amplitude of a vibrating particle, derivation of v = n . Simple harmonic motion (SHM), examples of SHM, equation of SHM, expression of velocity and acceleration of a body executing SHM. Types of progressive waves: transverse and longitudinal waves with examples.	10	18
4	WAVE MOTION	Student Should be able to:- • Understand stationary wave ,characteristics of stationary wave , free and forced vibrations with examples • Calculate velocity of sound by resonance tube method	**Resonance:** Stationary wave, formation of stationary wave, examples of stationary wave, characteristics of stationary waves, free and forced vibrations with examples. Resonance: definition of resonance, examples of resonance, formula to calculate velocity of sound by resonance tube method.	10	18

5	ATOMIC STRUCTURE	Student Should be able to:- • Describe the structure of the atom. • State the location, relative charge, and atomic mass of the sub atomic particles. • Define atomic number. • Draw the Bohr structure of the first 20 elements.	**Atomic structure**, Introduction, Bohr's Atomic Model, structure of an atom. Atomic number and Atomic mass number. Orbital electronic configuration of atom Valency, concept of stable configuration Electrovalence and covalence. Isotopes and isobars. **Electrochemistry**, Introduction, Arrhenius theory of electrolytic dissociation, Degree of ionization, electrode potential, Faraday's laws of electrolysis, applications of electrolysis	8	8

VI. LIST OF TUTORIAL

1. Know your Physics Laboratory, measuring instruments and interpretation of graph,
2. Measure the dimensions of given objects using Venire calliper.
3. Measure the dimensions of given objects using micrometre screw gauge.

VII. REFERENCE BOOK:

Sr. No.	Author	Title	Publication
1	Bhandarkar,B.G.	Applied Physics	Nirali Prakashan
2	Manikpure,Prakash	A Text Book Of Applied Physics For Polytechnics	S.Chand & Co. Ltd.
3	BTE	A Laboratory Manual For Applied Physics	M.S.B. Of Tech. Education
4	Bapna,Raj	Memory Maps For Physics	Dhanpat Rai & Sons

M1-04: ENGINEERING GRAPHICS

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	6	3	-	60	50	40	150

II. COURSE RATIONALE

Engineering Graphics is the language of engineers. The concepts of Engineering Graphics are used to develop, express the ideas, and convey the instructions which are used to carry out jobs in the field Engineering. The course illustrates the techniques of graphics in actual practice. This preliminary course aims at building a foundation for the further course in drawing and other allied subjects. This subject is useful in developing drafting and sketching skills of students.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

The student after studying this subject will be able to:

1. Draw different engineering curves and know their applications.
2. Draw orthographic projections of different objects.
3. Visualize three dimensional objects and draw Isometric Projections.
4. Draw simple geometrical figures using CAD package.

IV. COURSE OUTCOMES

After completion of this course students will be:

1. Able to draw Orthographic Projections of line, planes and solids with given orientation.
2. Draw different engineering curves and know their applications.
3. Develop ability to draw sectional views and missing view from given orthographic views
4. Visualize three dimensional objects and draw Isometric Projections.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	INTRODUCTION	Student Should be able to:- • State the importance of Engineering Drawing. • Select the reference material. • Understand the ISO norms. • Understand the link diagram and integrate the flow of engineering drawing in tool room.	Introduction and observation of engineering drawing practices in the Tool Room environment and manufacturing industry. Definition of sketches, mechanical and computer generated drawings. Classification of drawing set and related information. The industrial drafting process from product conception to production. Procedure - To read link diagram and subject objective. To integrate the flow of engineering drawing Tool Room. To select reference material and ISO norms. To sketch flow charts of engineering drawing process of Tool Room. Exercise - Sketch the flow chart of engineering drawing observed in the Tool Room. List reference material and tools needed.	4	0
2	MEDIA USED FOR ENGINEERING DRAWING	Student Should be able to:- • List the drawing instruments. • Illustrate Different Sizes of standard drawing sheets.	Introduction to drawing instruments, machines, complete conventional and latest working stations, Definition, principles, procedures and exercise of media, Standard drawing sheets, Conventional drawing instruments accessories and aids, Reproduction, storage, retrieval, Definition	4	0

		• Draw the Layout of drawing sheets using drawing instruments & equipment's on drawing sheet. • Understand the latest CAD software.	and principles of latest drawing media, CAD station components, CAD software, Plotter		
3	SCALES, LINES & LETTERING	Student Should be able to:- • Understand the importance of lines. • Describe the types of lines and Factors for selection type of lines • Draw different types of lines according to applications. • Understand the importance of different types of scale ratios and as per BIS norms. • Describe Factors for choice of scale • Define Full scale, reduced scale and Enlarged scale. • Draw views in Full scale, reduced scale and Enlarged scale on drawing sheet / sketch book. • Describe the Relationship between size of letter and space between them • Write the sentences by using single stroke letters • Write the titles by using single stroke and gothic letters and numbers.	Scales, Introduction, Definition of drawing to scale, Full, Reduced, Enlarged, Factors for choice of scale, Purpose, actual size, size of sheet, BIS norms, Procedure for drawing to scale, Exercise for "Drawing to Scale" Lines - Introduction to lines, Types of lines, Application of line, Factors for selecting type of line, Purpose of line ,BIS norms, Exercises Lettering, Introduction to lettering, Types of lettering Relationship between size of letter and space between letters. Factors for selection type and size of letters, Purpose of lettering, BIS norms, Exercises	16	6
4	GEOMETRIC CONSTRUCTIONS	Student Should be able to:- • Understand the Definition, principle and procedure for drafting of simple geometrical construction Straight lines and	Introduction to examples of simple and advanced geometrical construction, Definition, principles, procedures, exercise of simple geometrical construction, Straight lines, Angles, Polygons, Circle/ Arcs, Definition, principles, procedures, exercise of	40	9

		perpendiculars to the line from different points. • Understand drafting procedures to bisect, trisect the Angles. • Understand drafting procedures of construction of Angles, and Polygons on drawing sheet / sketch book • Understand drafting procedures for construction of inscribe and describe the circles. • Understand the different methods used for construction of Ellipse, Parabola, Hyperbola and other curves on drawing sheet / sketch book.	advance geometrical construction Conic Section : Ellipse, Parabola, Hyperbola, Helix, Cycloid, Involute		
5	ORTHOGRAPHIC PROJECTIONS	Student Should be able to:- • Understand the Definition, importance and principle of Projection, types of projections and Orthographic projection. • Understand Principles of quadrants. • Understand drafting procedures and Principles of Horizontal Plane and Vertical Planes. • Understand Procedure for drawing orthographic projection of points, lines and planes in 1st & 3rd quadrants. • Understand Principles of First angle projection methods. • Understand Principles of Third angle projection methods.	Introduction to orthographic projections, Definition of orthographic projections, Points, Lines, Planes, Solids, Principles of quadrants and planes, Principles of different views, Procedure for drawing different views of points, lines, planes and solids (in 1st and 3rd quadrants) Exercise on orthographic projection of (in 1st and 3rd quadrants), Points, Lines in different positions to planes, Planes in different positions to planes, Solids in different positions to planes, Exercises of missing lines and views	24	6

		• Draw the different views of three dimensional objects by Third angle projection methods on drawing sheet / sketch book.			
6	IS CODE OF PRACTICE	Student Should be able to:- • Describe the drafting procedure of First angle and Third angle projection methods • Draw the orthographic views by using IS code of practice. • Draw the different views of three dimensional objects by Third angle projection methods by IS norms on drawing sheet / sketch book.	Orthographic projections of objects using is code of practice: Introduction to 1st angle and 3rd angle projections. Definition of orthographic projections, 1st angle and 3 angle. Principles of 1st angle and 3rd angle projections according to BIS norms. Procedure for drawing different views of an object in 1st angle and 3rd angle. Exercises on 1st angle and 3rd angle projections of different objects.	20	12
7	DIMENSIONING	Student Should be able to:- • Understand the Principles of dimensioning. • Identify the size and location dimensions. • Indicate the dimensions by different methods. • Understand the Rules of dimensioning. • Indicate / correct the dimensions to the views on drawing sheet / sketch book.	Introduction to dimension, Definition of dimension, Functional dimension, Non-functional dimension, Auxiliary dimension Principles of dimensioning Rules of dimensioning, Method of dimensioning, Indication of dimensioning, BIS norms Procedure of dimensioning Exercise on dimensioning (linear, circular, angular	8	6
8	ISOMETRIC PROJECTIONS	Student Should be able to:- • Understand the Definition and Principle of isometric axis, isometric lines and isometric planes. • Construct an isometric scale.	Introduction to isometric projection. Definition of isometric projections (axes, lines, planes)	24	9

		• Define Isometric projections and Isometric views. • Describe the concept of orthographic projection & isometric views. • Differentiate between Isometric projections and Isometric views.	Principles of co-ordinates (x, y, z), Principles of isometric projections of planes, prisms, pyramids, cylinders, cones, irregular objects. Principles of dimensioning isometric projections, Procedure for drawing isometric views of regular solids and irregular objects. Exercises on drawing isometric views of regular solids and irregular objects.		
9	CONVERSION OF ISOMETRIC VIEWS TO ORTHOGRAPHIC PROJECTIONS & VISA-VERSA	Student Should be able to:- • Understand the principle for Conversion of isometric views from orthographic projection. • Describe the Procedure for Conversion of isometric views to orthographic projection & visa-versa. • Draw Isometric projections and Isometric views from orthographic projection on drawing sheet / sketch book & visa-versa.	Introduction to conversion of orthographic projections to isometric view and vice versa. Recall the concepts of orthographic projections and isometric view. Principles of conversion of orthographic views to isometric and vice versa. Procedure of drawing orthographic views from isometric view and isometric view from orthographic views. Exercise on drawing orthographic views from the given isometric view and isometric view from the given orthographic views.	20	12

VI. LIST OF PRACTICAL EXPERIENCES

1. Drawing instrument practice
2. Types of lines and conventional representation of materials
3. Scales, lettering and numbering
4. Plane and advanced geometrical constructions
5. Dimensioning
6. Projection of points and lines
7. Orthographic projection of solids (first angle projection method)
8. Orthographic projection of solids (first angle projection method)
9. Orthographic projection of solids (third angle projection method)
10. Orthographic projection of solids (third angle projection method)
11. Conversion of orthographic views in to isometric views visa-versa
12. Conversion of orthographic views in to isometric views and visa-versa

VII. REFERENCE BOOKS

Sr. No.	Author	Title	Publication
1	Sonaversity	Course Material For Use With Cbt On Engineering Graphics And Drawing	Salem : Sonaversity
2	Dubey, N.H.	Engineering Graphics - I	Nandu Printer
3	Dubey,N.H	Engineering Graphics-II	Nandu Printer
4	Goel,B.K.	Engineering Graphics With AutoCAD	S.K.Kataria & Sons

M1-05: COMPUTER FUNDAMENTALS

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	4	3	-	60	50	40	150

II. COURSE RATIONALE

Since early 21st Century the use of Computer has been so rapidly that it is difficult to think of an area where computers are not being used. It is very desirable that everyone should have good knowledge of computer.

Main purpose of this subject is how to use a computer for basic needs. This subject covers application software like MS-Word, MS-Excel, MS- PowerPoint.

It is a gateway to wonderful world of information and part of various applications like business, academic, hospitals, construction, designing, chemical fields and many more.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

Students should be able to:

- Use of Operating System.
- Use MS- Word, MS-Excel, MS- PowerPoint, efficiently for documentation.
- Use browser for accessing Internet.
- Handle Personal Computer System.

IV. COURSE OUTCOMES

After completion of this course Students should be able to:

- Use of Operating System.
- Use MS- Word, MS-Excel, MS- PowerPoint, efficiently for documentation.
- Use browser for accessing Internet.
- Handle Personal Computer System.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	COMPUTER FUNDAMENTAL	At the end students should be able to • Define computer. • Understand the application of computer. • Describe basic idea of programming languages.	Definition of Computer ,Hardware & Software Classification , Generations, characteristics & History of computers Block diagram of computer Area of applications, Computer Programming Languages, Components of IT Data Representation Number system, converting between Binary , Decimal & Hexadecimal number system, Basic definition Bits, Byte, Word & Double Word, Memory unit, ASCII code Flowchart & Algorithm, Algorithm: Definition, Characteristics, Advantages and disadvantages, Examples Flowchart: Definition, Define symbols of flowchart, Advantages and disadvantages,	6	12
2	OPERATING SYSTEM & I/O DEVICES	At the end students should be able to • Define operating system and its function. • Differentiate between input and output devices. • Understand the application of I/O devices.	Meaning and Definition, Structure of O.S., Types of O.S., Functions of O.S., DOS - Internal & External commands, Batch files. Windows Operating system: Components of window desktop, windows explorer, control panel, Managing the files and folders, Accessories: Paint, calculator and notepad. I/O Devices Input Devices - Keyboard, Touch screen, Pointing: Mouse, digitizer, Joystick and scanning devices: Scanner, OMR, OCR, and MICR. Output Devices - Monitors (CRT, TFT, LCD, and Plasma), Screen Image Projector, Printers & its types, Plotters. Memory Devices - Primary Memory & its types (RAM, ROM,CMOS), Secondary memory & its types (Hard Disk, Flash Drives, Magnetic Tape, Optical Discs- CD, DVD, Blue-Ray)	12	18

3	MS OFFICE	At the end students should be able to • Create MS-word document file. • Create MS-excel file for worksheet. • Create MS-power point for presentation. • Understand different tool bars used in MS-office.	**MS-Word** Moving through a Word document menu bar and drop down menus toolbars, Entering text into a document, deleting text, Font formatting keyboard shortcuts, Paragraph formatting, Bullets and numbering, Page formatting, Headers and footers, Introducing tables and columns, printing within Word, Development of application using mail merge, Creating and using macros in a document **MS-Excel** Creating and opening workbooks & entering data, navigating in the worksheet, Selecting items, Inserting and deleting cells, rows and column, Moving between worksheets, Formatting and customizing data, Formulas, functions and named ranges, creating, manipulating & changing the chart type, Printing, Page setup, **MS-PowerPoint** Introduction to Power Point, Toolbars, Creating a Simple Presentation, Additional Features in PowerPoint, Creating Slide Show, Navigating through a slide show, Slide show transitions, Slide show timings, Animation effects Printing a Presentation	14	18
4	NETWORKING & INTERNET	At the end students should be able to • Understand data communication in computer network. • Classify types of communication in computer. • Setup network connection. • Use internet and handling of personal computer.	Data Communication Components of communication system, Computer network Advantages and applications. Types of Network LAN MAN WAN, Peer to Peer and Client Server Network. Parallel and Serial Synchronous and Asynchronous transmission, Transmission Mode, Network Topologies, Transmission Media ,Networking Devices, OSI Model, TCP/IP Protocols Internet History of Internet, Requirement for connecting Internet, Sending & receiving Emails, Browsing the WWW Creating own Email Account, Searching.	8	12

VI. LIST OF PRACTICAL EXERCISES

1. Demonstration of above peripheral devices to students.
2. Moving from one window to another window
3. Opening task bar buttons into a window.
4. Arranging icons on the desktop and create shortcuts.
5. Creating folders and files.
6. Copy, rename, and delete files and folders.
7. Moving folders and files from one drive to another drive.
8. Create and edit notepad document.
   Create and edit WordPad document.
   Create paint file by using different drawing tools.
9. Creating, editing, saving word document.
   Entering and formatting text.
   Paragraph formatting, use bullets and numbering.
   Page formatting – page margins, page size, orientation, page break, headers and footers.
   Create tables, insert, and delete rows and columns.
   Printer installation and printing document.
   Create and print mail merging address for envelop and letters.
10. Create, open and print worksheet with page setup and print options.
    Enter data and format cells.
    Select, insert, and delete cells, rows and columns.
    Insert formulas, functions and named ranges in worksheet.
    Create chart of different types.
11. Create a simple text slide using formatting, Selecting a slide layout. And insert pictures & backgrounds.
    Insert auto shapes, clip-arts and form group/un group objects from slides.
    Apply slide transitions and slide timings and animation effect for slide show
12. Perform Internet connection.
    Create own e-mail id, send and receive mail with attachment.
    Searching information using search engine (Google, MSN, Bing etc.)
    Do Internet chatting and understand the chat toolbar.
    Organize favourite websites in different browsers.

VII. REFERENCE BOOKS

Sr. No.	Author	Title	Publication
1	Bartee, Thomas.C.	Digital Computer Fundamentals	McGraw-Hill Pub. Co.
2	Sinha,P.K.	Computer Fundamentals : Concepts, Systems & Applications	BPB Publication
3	Bangia, Ramesh	Computer Fundamentals And Information Technology	Fire Wall Media
4	Dixit, J.B.	Computer Fundamentals And Programming In C	Fire Wall Media
5	Srivastav, S.S.	Computer Fundamentals And Information Technology	Fire Wall Media
6	Maidasani, Dinesh	Computer Fundamentals, M.S. Office, Internet And Web Technology	Fire Wall Media

M1-06: WORKSHOP PRACTICE

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
4	10	3	60	240	40	160	500

II. COURSE RATIONALE

Mechatronics diploma technicians are expected to know basic workshop practice like wood working, sheet metal, fitting and soldering. This subject will develop skills in handling various mechanical, electrical and electronics tools.
The students are required to select and use various tools & equipment's related to wood working, sheet metal process, soldering and de-soldering techniques required in project work

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

1. Read and interpret the drawing.
2. Draw sketch for given job.
3. Use specification tables.
4. Decide Sequence of procedure.
5. Recognize, identify and use of various tools used in soldering.
6. Use of soldering technique for efficient repair work.

IV. COURSE OUTCOMES

Student will be

1. Able to read job drawing.
2. Able to identify and select proper material, tools, equipment's and machine.
3. Able to select proper parameters (like cutting speed, feed, depth cut use of lubricants) in Machine.
4. Able to select proper material, tools and techniques used in soldering.

V. CONTENT (THEORY)

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	INTRODUCTION & SAFETY	Student should able to • Explain workshop technology • Explain the importance of workshop technology • List the safety precautions for working in workshop • Define manufacturing • List to do & not to do in workshop	Introduction to workshop Technology Safety Precautions	6	6
2	BASIC METAL WORKING TECHNIQUE	Student should able to • Define vice & Types of vices. • Define hand tools • List types of hand tools are there • Discuss metal working techniques • Describe metal working done by joining process • List the different types of metal joining process • Define is welding, types of welding • Explain metal working takes place by hot forming process • Describe the different hot forming processes	Metal working technique using hand tools Metal working technique - joining Metal working technique - hot forming	12	6

	BASIC METAL WORKING TECHNIQUE WITH GENERAL MACHINE TOOLS	Student should able to • Define machine tools • List the types of machine tools • Define drilling machine • List are the parts of drilling machine • List are the types of drilling machine • Working principle of drilling machine • Work holding devices in drilling machine • Tool holding devices in drilling machine • Define portable drilling machine, describe its operations • Define pedestal drilling machine, describe its operation • Explain column & radial drilling machine. Discuss its operation • Define gang drilling machine & explain its operation • Define special drilling machine & explain its operation • Differentiate gang drill, special drill • Explain shaper machine • List different type of shaper • List the different parts of shaper • Elaborate the parts of shaper with their function • Explain the mechanism of shaper • Discuss the various shaping operation • Define sawing machine • List different types of metal cutting saws	Drilling operations & drilling machines Level-I (bench, pedestal, portable)	8	6
			Drilling operations and drilling machines Level-II (Column and Radial Drilling Machines)	6	3
			Drilling operations and drilling machines Level-III(Gang Drills & Special Drilling Machines)	4	3
			Shaping operations and shaper	2	3
			Sawing operation and power hacksaw	2	3
			Sawing operation and band saw	2	3
			Hand grinding operations and pedestal grinder	2	3
			Turning operation and lathe Level-I (Centre Lathe)	18	12
			Milling operations and milling machine Level-I (Column Knee type [vertical and Horizontal] Milling Machine)	18	12

CONTENTS (PRACTICE)

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOME	CONTENTS	TEACHING HOURS	MARKS
1	MSME TECHNOLOGY CENTREBHOPAL & ENVIROMENT		Description of various courses. MSME TECHNOLOGY CENTREBHOPAL environment, Housekeeping, Functioning of Store & Procedure followed.	200	240
2	BENCH WORK	Student should able to • List Hand Tools. • List types of Files. • Identify the File for different operation. • Describe different parts of files. • Differentiate between types of Files. • Demonstrate Methods of filling. • Identify Special purpose file and needle files. • Understand Construction, parts and specification of vice. • List the measuring Instrument. • Describe Parts of different measuring instrument.	Introduction to hand tools (Hand Cutting Tools), Measuring tool, Equipment & their uses & applications. Basic metal cutting operations using hand tools, Sheet metal work , Manufacturing useful products		
3	MATERIAL PREPARATION	Student should able to • Cut the material in the required size as per the specification given in the drawing. • Write Process planning • Drawing reading • Select a material for the desired operation	Planning & cutting raw material as per requirement.		

4	BASIC TOOL GRINDING	Student should able to • Describe the pedestal grinding machine • Operate pedestal grinding machine • Describe single point cutting tool • Follow safety	Sharpening of Single point cutting tool for their basic geometrical knowledge & skill.		
5	TURNING	Student should able to • Demonstrate lathe machine • List Different types of turning tools • Perform lathe operations • List Different types of taper turning methods • Describe Thread cutting techniques on lathe machine • Draw Diagram of lathe machine. • Perform Calculation of R.P.M • Understand Tables Feeds & depth of cut • Calculate various parameters of turning operation • Calculate machining time , Setting time, Machining time, Auxiliary time, Delay time, Total time	Basic knowledge of working principle of Lathe machine, various parts of machine & their functioning, use of various accessories & attachments for work holding & tool holding. Knowledge & Basic skills for various turning operations. Knowledge of calculating metal cutting parameters.		
6	MILLING	Student should able to • Understand the Working principle of a milling machine. • Identify the different parts of a milling machine • Describe working principle of a milling cutters.	Basic knowledge of working principle of Milling machine, various parts of machine & their functioning, use of various accessories & attachments for work holding & tool holding. Knowledge & Basic skills for various Milling operations. Knowledge of calculating metal cutting parameters.		

		• List different types of milling cutters • Describe Different parts of a milling cutters and their specifications • Understand the working principle of a milling machine accessories and attachments • Understand and explain indexing principles and methods • Calculate various parameters of milling operation			

VI. LIST OF EXERCISES

BENCH FITTING:

Sr. No	Title of Exercise
1	U- Channel
2	Name Plate – Marking & Punching
3	Angle Plate
4	S Plate
5	C-Clamp
6	Open Fitting
7	Book Supporter

MILLING:

Sr. No	Title of Exercise
1	Screw jack Body
2	Center Punch
3	Chamfer Tool
4	C-Clamp Screw

5	Screw jack Screw
6	Rest button for Screw jack

TURNING

Sr. No	Title of Exercise
1	Tap Wrench Body
2	Parallel Block
3	Straight Clamp
4	Tap Wrench Jaw
5	Strap Clamp

VII. REFERENCE BOOKS

Sr. No.	Author	Title	Publication
1	Antherton, William	Workshop Practice Vol I TO V	Nein Era
2	Kapoor,V	Workshop Practice Manual With Quiz Question Bank	Dhanpat Rai & Sons
3	Singh,Swarn	Workshop Practice	S.K.Kataria & Sons
4	Kharche, Anand	A Text Book Of Basic Workshop Practice	Nirali Prakashan

MSME TECHNOLOGY CENTRE BHOPAL

(A Government of India Society under Ministry of Micro, small and medium enterprises)

SECOND SEMESTER: COURSE DETAILS

DIPLOMA IN MECHATRONICS

M2-01: ENGINEERING MATHEMATICS – II

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	2	3	60	-	40	-	100

II. COURSE RATIONALE

This subject is an extension of Basic mathematics of first semester and a bridge to further study of applied mathematics. The knowledge of mathematics is useful in other technical areas.
Differential calculus has applications in different engineering branches. For example
Concepts such as bending moment, curvature, maxima and minima.
Numerical methods are used in programming as an essential part of computer engineering.
For solution of problems in electrical circuits and machine performances complex number is used engineering mathematics lays the foundation to understand technical principles in various fields.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

1. Use complex numbers for representing different circuit component in complex form to determine performance of electrical circuit and machines.
2. Apply rules and methods of differential calculus to solve problems.
3. Apply various numerical methods to solve algebraic and simultaneous equations.

IV. COURSE OUTCOMES

Student will be able to find roots of algebraic equations which are not in real.
Identify the function and find the value of function.
To evaluate limit of function. Find the derivatives by first principle.
Solve problems using rules and methods of derivatives, Find the approximate root of algebraic equation. Solve the system of equations in three unknowns.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	COMPLEX NUMBER	At the end students should be able to • Define complex number and solve numerical based on it. • Explain DE-MOIVRE'S theorem. • Solve problem based on Euler's function.	**Complex Number** Definition of complex number, Cartesian, polar and exponential**,** Forms of complex number. Algebra of complex number such as equality, addition, Subtraction, multiplication and division. DE-MOIVRE'S theorem with simple examples. Euler's form of circular functions, hyperbolic functions and relation between circular and hyperbolic functions.	6	9
2	DIFFERENTIAL CALCULUS	At the end students should be able to • Define and find values of function. • Understand limit to solve different types of functions. • Define continuity and discontinuity of function using derivatives. • Evaluate function from differential equation. • Derive composite function using derivative. • Solve different types of derivatives of functions.	**Function** Definition of function, range and domain of function. Value of function at a point. Types of functions and examples.	6	12
			Limits Concept and definition of limit. Limits of algebraic, trigonometric, logarithmic and exponential functions with examples.	6	6
			Derivatives Definition of derivatives, notation, derivatives of standard function using first principle. Rules of differentiation such as, derivatives of sum or difference, product, and quotient with proofs. Derivative of composite function with proof (Chain rule) Derivatives of inverse trigonometric functions using substitution, Derivatives of inverse function. Derivatives of implicit function. Derivatives of parametric function. Derivatives of one function w.r.t another function. Logarithmic differentiation. Second order differentiation.	8	12

3	NUMERICAL METHOD	At the end students should be able to • Solve numerical based on algebraic equation. • Solve numerical based on simultaneous equation.	**Solution of algebraic equation** Bisection method**,** REGULA FALSI method**,** Newton RAPSHON method	6	9
			Numerical solution of simultaneous equations Gauss elimination method**,** Jacobi's method**,** Gauss SEIDAL method	8	12

VI. LIST OF TUTORIAL

Sr. No.	Topic for tutorial
1	Complex number (Examples based on algebra of complex numbers)
2	Complex number (Examples based on DE MOIVRE'S theorem and Euler's formulae)
3	Function
4	Limit (algebraic and trigonometric functions)
5	Limit (logarithmic and exponential functions)
6	Derivatives by first principle
7	Derivatives (Examples based on formulae of standard functions and rules)
8	Derivatives (Examples based on methods of differentiation)
9	Solution of algebraic equations
10	Solution of simultaneous equations

VII. REFERENCE BOOKS

Sr. No.	Author	Title	Publication
1	Vishwanath,	Engineering Mathematics II	Aggarwal,B.M.
2	Bilapatte, B.G.	A Text Book Of Engineering Mathematics II	Layeeq, Mohd.
3	Pathak,J.R	Engineering Mathematics II	Shinde,K.R
4	Pathak,J.R	Engineering Mathematics III	Mahajan,R.D.

M2 – 02: AUTOCAD FOR ENGINEERING

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	6	3	-	60	50	40	150

II. COURSE RATIONALE

Now a day a manual drafting is obsolete in industry. Computers being the inevitable part in an engineer's life due to its inbuilt characteristics which helps him to do various task with acceleration. Using computers and CAD software it is easy to create and modify drawings ultimately it saves time. It also may be useful to generate assembly and manufacturing drawings. In mechanical industry operating skills are required for computer aided drafting operations of machine components, handling of printers & plotters. This subject is also useful to apply concepts in 3 D modelling.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

Students will be able to

1. Draw, edit and modify 2D drawings.
2. Give dimensions, tolerances and geometrical tolerances.
3. Draw Isometric drawing and 3 D drawing.
4. Plot a drawing.

IV. COURSE OUTCOMES

After learning about AutoCAD engineering students can know using computers and CAD software, it is easy to create and modify drawings ultimately it saves time. It also may be useful to generate assembly and manufacturing drawings. This subject is also useful to apply concepts in 3 D design modelling.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HRS	MARKS
1	Introduction to Computer Aided Drafting	Student should be able to: • Define AutoCAD • Understand the Concept of AutoCAD • Understand the Concept of hard ware and software • Describe the Capability of Auto cad	**Introduction to Computer Aided Drafting (CAD) -** Applications, Various Software's for Computer Aided Drafting **Co-ordinate system-** Cartesian & Polar-Absolute, Relative mode. **CAD initial settings commands** - SNAP, GRID, ORTHO, OSNAP, LIMITS, UNITS, FILTERS, ITSCALE, MBUTTONPAN 1.4 Object Selection methods -picking, window, crossing, fence, last, previous etc.	6	10
2	Zoom and formatting Commands	Student should be able to: • Create new drawing • understand the command • Understand the mouse function • Design the templates	**Zoom Commands** - all, previous, out, in, extent, real-time, dynamic, window, pan. **Formatting commands** - Layers, block, line type, line weight, color.	10	12
3	Draw and Enquiry commands	Student should be able to: • Describe coordinate system • Define Cartesian coordinate system • Define polar coordinate system • Define absolute coordinate system • Define incremental coordinate system • Create solid filled areas –region	**Draw Command** - Line, arc, circle, rectangle, polygon, ellipse, spline, block, hatch **Enquiry commands** - distance, area	4	8
4	Edit and Modify commands	Student should be able to: • Editing the object • List the object properties • Describe matching properties	**Modify Command** - Erase, oops, break, trim, copy, move, mirror, offset, fillet, chamfer, array, extend, rotate, scale, lengthen, stretch, measure, divide, explode, and align. **Grips editing-** Move, Copy, Stretch.	4	8

		• Use trim ,resize, insert breaks, oops, rotate, chamfer, fillet, offset, align, extend, array, mirror, stretch, grip, lengthen, scale			
5	Dimensioning, Text and Plot Commands	Student should be able to: • Understand the snap & grid & ORTHO mode • Adjust the snap & grid alignment using ORTHO mode • Describe the point filter • Understand the construction line • Using tracking specify the measurement & division	**Dimensioning commands** - Dimension styles, Dimensional Tolerances and Geometrical Tolerances. **Text commands** - DTEXT, MTEXT command. **Plotting a drawing** - paper space, model space, creating table, plot commands.	6	10
6	**Isometric and 3D Drawings**	Student should be able to: • How to enter in 3d work space of auto-cad • Explain 3d co-ordinate system • Define a co-ordinate system • Create a 3d solid object • Editing and modify 3d solid objects	**3D Edit Commands** -PLINE, 3DPOLY, PEDIT, JOIN SPLINEDIT commands. **View Commands** - View ports, UCS, WCS commands **3D Object and 3D operations** - 3 D Object - Cube, Cylinder, Cone, Sphere, and Wedge. 3 D operations - extrude, revolve, 3Dmirror, 3Dmove, 3Dpan, 3Drotate, 3Darray, slice, sweep. Boolean operations - union, subtract, intersection. Using Isometric style option of snap command draw isometric drawing **Shade and Enquiry commands** - mass property, Shade and render command.	10	12

VI. LIST OF PRACTICAL EXERCISES

1. Draw component using command line & polyline
    1. Exercise-1 to 5
2. Draw component using command circle, rectangle, arc
    2. Exercise-6 to 10
3. Draw component using command hatch, region
    3. Exercise-11 to 15
4. Draw component using command move, copy, rotate
    4. Exercise-16 to 20
5. Draw component using command trim, extend, mirror
    5. Exercise-21 to 26
6. Draw component using command chamfer, fillet, stretch
    6. Exercise-27 to 31
7. Draw component using command array, offset, explode
    7. Exercise-32 to 36

   Draw component using command dimensions (linear, aligned, angular, arc length, radius, and diameter)
    8. Exercise-37 to 46
8. Draw component using command text, table
    9. Exercise-47 (bill of material-1) to 50 (bill of material-4)
9. Using command insert, layers
    10. Exercise-51 & 52
10. Draw component using command isometric-plan, ISO-ELLIPSE
    11. Exercise-53 to 67
11. Draw the solid(3d) component using command box, cylinder, cone, sphere, pyramid, wedge, torus
    12. Exercise-68 to 77
12. Draw the solid (3d) component using command extrude, subtract, PRESSPULL, POLYSOLID
    13. Exercise-78 to 87
13. Draw the solid (3d) component using command 3d array

14. Exercise-88 to 92

14. Draw the solid (3d) component using command union, intersect

15. Exercise-93 to 95

15. Draw the solid (3d) component using command sweep, revolve, loft

16. Exercise-96 to 100

16. Plotting jpeg & pdf format (wireframe, realistic, sketch, conceptual)

17. Exercise-101 to 110

VII. REFERENCES

Sr. No.	**Author**	Title	Publication
1	Singh, Ajit	Working With AutoCAD 2000 With Updates On AutoCAD 2000i	Tata McGraw Hill Co.
2	Shrock, Cheryl R.	Exercise Workbook For Advanced AutoCAD 2006	Industrial Press
3	Tickoo,Sham	AutoCAD 2012 For Engineers And Designers	Dreamtech
4	Shrock, C.R.	Exercise Workbook For Beginning AutoCAD 2006	New Age Int. P. Ltd Publishers
5	Gladfelter,Donnie	AutoCAD 2015 And AutoCAD Lt 2015 : No Experience Required	Wiley India P. Ltd

M2 – 03: ENGINEERING MECHANICS

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM (TH)	END TERM EXAM (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	2	3	60	-	40	-	100

II. COURSE RATIONALE

In day to day life we come across different structures, at the time design of the structures analysis plays an important role. Perfect analysis is possible only when one known the types and effect of forces acting on the structure. This subject provides knowledge about the different types of forces/loads their effects while acting in different conditions/systems. The subject also provides the knowledge about basic concepts of laws of engineering, their application to different engineering problem. This subjects work as a prerequisite for future subjects such as MOS, SOM, DOS, TOM, DOM. Etc.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

The students will able to:

- Understand the effect of different types of coplanar forces.
- Apply Principles of equilibrium in finding reactions of different types of beams.
- Apply principles of equilibrium for locating centroid and center of gravity for given solids.
- Understand working of different types of machines.

IV. COURSE OUTCOMES

This subject is purely related to mechanical engineering. This subject provides knowledge about the different types of forces/loads their effects while acting in different conditions/systems. The subject also provides the knowledge about basic concepts of laws of engineering, their application to different engineering problem. This subjects work as a prerequisite for future subjects such as MOS, SOM, DOS, TOM, DOM. Etc.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HRS/UNIT	MARKS
1	Simple Machines	At the end students should be able to • Define different types of machines and terms used in it. • Explain law of machine and solve numerical based on it. • Understand the working of simple machines. • Calculate efficiency of simple machines**.**	**Definitions :-** Simple machine, compound machine , load, effort, mechanical advantage , velocity ratio , input of a machine .output of a machine efficiency of a machine , ideal machine, ideal effort and ideal load, load lost in friction, effort lost in friction. **Analysis: -** Law of machine, maximum mechanical advantage and maximum efficiency of a machine, reversibility of a machine, condition for reversibility of a machine, self-locking machine. Simple numerical problems. **Velocity Ratio for simple machines :** - Simple axle and wheel, differential axle and wheel, Weston's differential pulley block, single purchase crab, double purchase crab, worm and worm wheel, geared pulley block, screw jack, calculation of mechanical advantage, efficiency, identification of type such as reversible or not etc.	8	12

2	Force systems	At the end students should be able to • Define fundamentals of force systems. • Classify force system. • Explain characteristics and principle of force. • Define moment and couple and explain its properties and characteristics.	**Fundamentals and Force systems: -** Definitions of mechanics, Engineering mechanics, statics, dynamics, Kinetics, Kinematics, rigid body. Classification of force system according to plane coplanar and non-coplanar, sub classification of coplanar force system-collinear, concurrent, non-concurrent, parallel, like parallel, unlike parallel, general etc. Definition of a force, S.I. unit of a force, representation of a force by vector and by Bow's notation method. Characteristics of a force, effects of a force, principle of transmissibility. **Resolution of a force and Moment of a force: -** Definition, Method of resolution, along mutually perpendicular direction and along two given direction. Definition of moment, S.I. unit, classifications of moments, sign convention, law of moments VARIGNON'S theorem of moment and its use. Definition of couple, S.I. unit, properties of couple with example.	6	6
3	Composition of Forces	At the end students should be able to • Understand different types of analytical methods to find resultant force. • Understand different types of graphical method to solve resultant force of a system.	**Analytical method: -** Definition of Resultant force, methods of composition OFFEREES, Law Of parallelogram OFFEREES, Algebraic method for determination of resultant for concurrent and non-concurrent, parallel coplanar force system. **Graphical method:-** Space diagram, vector diagram, polar diagram, and funicular:- polygon. Resultant of concurrent and parallel force system only.	6	12
4	Equilibrium Specific	At the end students should be able to • Define equilibrant and state relation between resultant and equilibrant. • Explain lami's theorem and solve problem based on it. • Define beams and its types. • Classify load and calculate its reaction on different types of beams.	**Equilibrant and Lami's Theorem:-** Definition of equilibrant, relation between resultant and equilibrant, equilibrant of concurrent and non-concurrent force system. Statement and explanation of Lami's theorem, Application of Lami's theorem for solving various engineering problems. **Beams :-**	8	12

			Definition, Types of beams (cantilever, simply supported, overhanging, fixed, continuous), Types of end supports (simple support, hinged, roller), classification of loads, point load, inclined point load, uniformly distributed load. Analytical method to determine reactions of simply supported, cantilever and over hanging beam subjected to point loads and UDL		
5	Friction	At the end students should be able to • Define friction and explain types of force acting on it. • Understand law of friction and its advantages and disadvantages. • Get the concept of equilibrium of a body on horizontal and inclined plane due to force applied on it.	**Definition :-** Friction, limiting frictional force, coefficient of friction, angle of friction, angle of repose, relation between angle of friction, angle of repose and coefficient of friction. Cone of friction, types of friction, laws of friction, advantages and disadvantages. **Equilibrium of body on Horizontal and inclined plane :-** Equilibrium of body on horizontal plane subjected to horizontal and inclined force. Equilibrium of body on inclined plane subjected to forces applied parallel to the plane only. Concept of ladder fraction.	4	6
6	Centroid and Centre Of Gravity	At the end students should be able to • Define centroid. • Find centroid of different geometrical figures and composite figures. • Define centre of gravity and its effect on simple solids.	**Centroid :-** Definition of centroid. Moment of an area about an axis. Centroid of basic geometrical figures such as square, rectangle, triangle, circle, semicircle and quarter circle. Centroid of composite figure with not more than three geometrical figures. **Centre of gravity : -** Definition, centre of gravity of simple solids such as cylinder, sphere, hemisphere, cone, cube, and rectangular block. Centre of gravity of composite solids with not more than Two simple solids. (Hollow solids are not expected.)	8	12

VI. LIST OF PRACTICAL TUTORIALS

I. To find MA, VR, Efficiency, Ideal Effort, Effort lost in friction for various loads and establish law of machine. Calculate maximum Efficiency and also check the reversibility of machines (Sr no. 1 to 4):

1) Differential axle and wheel.

2) Single purchase crab or Double purchase crab

3) Weston's differential pulley block or worm geared pulley block

4) Simple Screw jack.

5) Verify law of moments

6) Verify law of polygon of forces.

7) Verify of Lami's theorem.

8) Verify the Equilibrium of parallel forces - simply supported beam reactions.

9) Compare coefficient of friction on horizontal plane and inclined plane for the same surface.

II. Graphical solutions for the following on A4 Size Graph Paper:

1) Concurrent force system: Two problems

2) Parallel force system : Two problems

3) Reactions of beam : Two problems

VII. REFERENCES

Sr. No.	Author	Title	Publication
1	Malhotra,D.R.	Engineering Mechanics And Strength Of Materials	Satya Prakashan
2	Khurmi,R.S.	A Text Book Of Engineering Mechanics (Applied Mechanics)	S. Chand & Co Ltd.
3	Chapman,W.A.J.	A Text Book Of Engineering Mechanics	S. Chand & Co.
4	Ranmamrutham.S.	Engineering Mechanics: A Text Book Of Applied Mechanics	Dhanpat Rai & Sons

M2-04: BASICS OF ELECTRICAL ENGINEERING

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	4	3	60	60	40	40	200

II. COURSE RATIONALE

Electrical engineering concepts are very important to every engineering student now days. Every mechatronics engineer needs to do and develop various types of logics and circuits respectively. The subject content enhances the basic knowledge of engineer about solving the various circuit designing methods and logic development principles.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

The students will be able to

1. Understand single phase and three phase AC circuits.
2. Realize concept of electromagnetic induction and apply it to static and rotating machines.
3. Understand characteristics of rotating machines.
4. Know the importance of safety and various safety methods in electrical engineering.

IV. COURSE OUTCOMES

Student is able to understand the various concepts related to electricity which are very important in every industry.
Student is able to perform various tasks related to fault finding and troubleshooting of electrical circuits.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	Introduction	At the end students should be able to • Define the basic laws of electromagnetic induction. • Explain the process of conversion energy. • Understand the working of relays.	Concept of Potential difference. Current and resistance. Ohm's law, effect of temperature on Resistance, resistance temperature coefficient, insulation resistance. SI units of work Power and Energy. Conversion of energy from one form to another in electrical and thermal systems. **Electromagnetic Induction** Relation between Magnetism and Electricity. Production of Induced E.M.F. and Current. Faraday's Laws of Electromagnetic Induction. Fleming's Right Hand Rule. Lenz's Law Induced E.M.F: Self Induced E.M.F., Mutually Induced E.M.F., direction of Induced E.M.F. and Currents Energy Stored in Magnetic Field Electromagnetic relay and contactors	10	16
2	Single Phase Transformer	Student should be able to- • Understand the construction & operation single phase transformer. • Classify different types of transformers. • Explain the principle of mutual induction & its applications.	Construction and working of transformer, classification , brief description of each part, its function (power transformer, audio frequency transformer, radio frequency transformer, isolating transformer, pulse transformer, intermediate frequency transformer) Significance of EMF equation (no derivation) Voltage ratio, current ratio and transformation ratio. KV A rating of a transformer, Losses in a transformer % efficiency & % regulation Auto transformer - comparison with two winding transformer, Applications	8	12

3	Electric Motors	Student should be able to- • Understand the construction & operational features of all types of motors. • Understand the importance of starters. • Select the motors to be used based upon their characteristics.	Basic principle, types, constructional features, operational (input/output) parameters, selection criteria and applications of 1. DC motors 2. AC motors 3. Stepper motors 4. Servo motors Necessity of starter, star delta starter circuit	16	20
4	Electrical Safety	Student should be able to- • Define the commercial & electrical wiring. • Explain the importance & need of earthing. • Define earthing and it's types. • Classify the different circuit breakers.	Study of different accessories like Fuses, MCCB, RCCB, ELCB, cables and wires used in domestic and commercial electrical wiring. Necessity of earthing and list its types. Electrical safety.	6	12

VI. LIST OF PRACTICAL EXPERIENCES

1	a. Know your Electrical laboratory b. Learn the safety precautions to be followed in the laboratory
2	To determine impedance, resistance & reactance of a choke coil. (Ballast)
3	To determine current drawn & power factor of a series R-L-C circuit & to draw phasor diagram
4	To verify line & phase relationship between voltage & current for a three phase balanced star & delta circuit
5	To find transformation ratio of a single phase transformer.
6	To determine efficiency of a single phase transformer at half load, $3/4^{th}$ load & full load.
7	To determine slip of a three phase induction motor.
8	To reverse direction of rotation of a three phase induction motor.
9	To measure insulation resistance of a motor winding.
10	To study different types of wires/cables & switches.
11	Mini project on wiring (interconnection of switch, holder, fuse, plug socket indicator)

VII. REFERENCE BOOKS

Sr. No.	Author	Title	Publication
1	Sharma,B.R.	Elements Of Electrical Engineering & Electronics	Satya Prakashan
2	Theraja,B.L.	Fundamental Of Electrical Engineering And Electronics	Nirja Constructions
3	BTE	A Laboratory Manual For Fundamentals For Electrical Engineering	M.S.B. Of Tech. Education
4	Deshmukh, B.T.	A Text Book Of Elements Of Electrical Engineering	Shri Laxmi Prakashan
5	Theraja, B.L.	A Text Book Of Electrical Technology Vol I : Basic Electrical Engineering	S.Chand
6	Katre J.S.	Fundamentals Of Electrical Engineering And Electronics	Tech-Max Publication
7	Bolton, W.	Mechatronics : Electronic Control Systems In Mechanical And Electrical Engineering	Pearson Education

M2-05: BASICS OF ELECTRONICS ENGINEERING

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	END TERM EXAM. (PR)	TERM WORK	TOTAL MARKS
2	4	3	60	60	40	40	200

II. COURSE RATIONALE

Electronics engineering concepts are very important to every engineering student now days. Every mechatronics engineer needs to do and develop various types of logics and circuits respectively. The subject content enhances the basic knowledge of engineer about solving the various circuit designing methods and logic development principle

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

The students will be able to:

1) Identify types of components and understand construction, working principle, specifications and applications.
2) Realize the DC circuit applications by applying the fundamental electrical laws.
3) Apply various electrical theorems for different circuit which are the foundations for electronics subject.

IV. COURSE OUTCOMES

Student is able to understand the various concepts related to electronics which are very important in every industry.
Student is able to perform various tasks related to fault finding and troubleshooting of electronic circuits.
Student is able to develop various logics related to control circuit design.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	**Resistor,** **Capacitor,** **Inductor**	Student should be able to- • Understand the Electronic component and their general specification • Describe the Characteristics and behavior of the components when connected in circuit • Understand Manufacturing of electronic component and material used	**Resistor:** Classifications of resistors, material used for resistor. General specification of resistor- maximum voltage rating, power rating, temp, coefficient, ohmic ranges, operating temperature, Classification and application of resistor, Color coding: with three, four & five bands LDR- Working, Characteristics & application, TDR- listing of its type. Potentiometer. **Capacitor:** Classification of capacitor, dielectric materials used in capacitor, Capacitor specifications: working voltage, capacitive reactance, frequency characteristic**,** Fixed capacitor: specifications & applications, Electrolytic capacitor: constructional diagram & working : Variable capacitors: requirement of variable capacitor, construction, working, specification of air gang, PVC gang capacitor, trimmer capacitor, Coding of capacitors using numerals, color band system. **Inductor:** Introduction of magnetic materials- Ferromagnetic. B-H curve, hard & soft magnetic material, concept of Hysteresis, permeability, corecivity, reluctivity & losses in magnetic material. Faradays law of electromagnetic induction, self& mutual induced EMF.	8	14

			Induction - Definition & expression (with simple derivation) of self-inductance, mutual inductance, coefficient of coupling, Q factor, inductive reactance. Constructional diagram & application of Air core, iron core & ferrite core, inductor frequency range for- AF, RF, and IF Toro dial inductor. Working Principle of slug tuned inductor, Color coding of Inductor.		

2	**Diodes**	Student should be able to- • Interpret I-V graphs of semiconductors. • different semiconducting material • Discuss the types of diode	**P.N. Junction Diodes** Working principle & circuit diagram of characteristic of PN junction diode, Static & dynamic resistance, specification, forward voltage drop, maximum forward current power dissipation. **Zener diode :** Constructional diagram, symbol, circuit diagram and characteristics of Zener diode Specification: Zener voltage, power dissipation, dynamic resistance, Special Diodes, Construction, symbol & applications of PIN diode, Schottky diode, Tunnel diode **Optical diodes,** Construction, symbol, operating principle & applications of LED, IRLED, Photodiode, Laser diode	10	16
3	**Rectifiers And Filters**	Student should be able to- • draw and understand the use of diodes in half wave and full wave bridge rectifiers • Calculate the peak value of the output voltage of half wave and full wave rectifiers given the rms input voltage. • Determination of output voltages and currents. • Analyze the operation of rectifier circuit with capacitor filter	Need of rectifiers. Types of rectifiers: HWR,FWR (bridge and center tap) circuit operation I/O waveforms for voltage & current Parameters of rectifier (without derivation) Average DC value of current & voltage, ripple factor, ripple frequency, PIV of diode, TUF, efficiency of rectifier Comparison of three types of rectifiers Need of filters Circuit diagrams, operation and input-output waveforms filter, types of filter.	12	16
4	**Transistors**	• Understand the Different type of configuration of transistors • Discuss the importance of parameter of the transistor while using in the circuit	Transistors, Introduction to Unipolar and Bipolar junction Transistors, Bipolar junction Transistors, Definition, Types (PNP, NPN) Symbol, Working Principle of NPN transistor, Types of Transistor, Configuration – CE, CB, CC (Only circuit Diagrams), Characteristics of CE configuration – Input /Output	10	14

		• Describe the characteristics of JFET ,BJT,FET	Characteristics. Identification of Cut off, Active and Saturation Region, Input resistance, Output resistance , Current gain (α and β), Relation between α and β,Transistor Biasing- Need for biasing, DC load line, Q-point, Types of biasing – Voltage divider bias, Field Effect Transistor, Types (JFET and MOSFET), JFET- N Channel and P channel – Symbol, Construction, and working principle. Characteristics of JFET – Drain and Transfer Characteristics, FET parameters – DC Drain Resistance, AC drain Resistance, Trans conductance, Amplification Factor, Input Resistance, Comparison of JFET and BJT MOSFET, Types, Symbol, working principle. Applications of BJT, FET and MOSFET.		

VI. LIST OF PRACTICAL EXPERIENCES

1	Study various measuring instruments like Voltmeter, Ammeter & Multimeter
2	Study different types of resistors, capacitors & inductors.
3	To find the value of resistor by color coding method & verify it using multimeter.
4	To study forward characteristics of PN junction diode.
5	To study reverse characteristics of PN junction diode.
6	To study forward characteristics of Zener junction diode.
7	To study reverse characteristics of Zener junction diode.
8	To study operation & understand applications of LED & photo diode.
9	To study the operation of Half wave rectifier & verify its I/O waveforms.
10	To study the operation of Full wave Centre tap rectifier & verify its I/O waveforms.
11	To study the operation of Full wave Bridge rectifier & verify its I/O waveforms.
12	To study the operation of Inductor Filter & verify its I/O waveforms.
13	To study the operation of Capacitor Filter & verify its I/O waveforms.
14	To study the operation of Inductor-Capacitor Filter & verify its I/O waveforms.

VII. REFERENCE BOOKS

Sr. No.	Author	Title	Publication
1	R. S. SEDHA	APPLIED ELECTRONICS	S. CHAND
2	Patil,R.N	Elements Of Electronics And Instrumentation Engineering	Chhaya Pub. House
3	Kumar, Sunil	Industrial Electronics And Instrumentation	S.K.Kataria & Sons
4	Khobare, V. K.	Basic Electronics And Mechatronics	Nirali Prakashan

M2 – 06: BASICS OF MECHANICAL ENGINEERING SYSTEMS & AUTOMATION

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	6	3	60	60	40	40	200

II. COURSE RATIONALE:

The engineering field requires an understanding of core concepts including mechanics, kinematics, thermodynamics, materials science, structural analysis, and electricity. Mechanical engineers use these core principles along with tools like computer-aided engineering, and product lifecycle management to design and analyse manufacturing plants, industrial equipment and machinery, heating and cooling systems, transport systems, aircraft, watercraft, robotics, medical devices, weapons, and others

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

Students will be able
To understand various method of manufacturing method to use in a company
To understand the concept of heat treatment
To understand the transmission elements
To select right type of bearing and it's lubricate

IV. COURSE OUTCOMES

Students will be able
To understand various method of manufacturing method to use in a company
To understand the concept of heat treatment
To understand the transmission elements
To select right type of bearing and it's lubricate

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	CONTENTS	TEACHING HOURS	MARKS
1	**Manufacturing Method**	Introduction to various method of the manufacturing like forming, machining, joining methods Forming process- an over view of casting, forging, rolling, drawing, press work, powder material tech etc. Joining method- temporary joints like screws, bolt, rivets- type and types of rivet joint, soldering, brazing, arc and gas welding	4	6
2	**Heat Treatment**	Principal of heat treatment, phase transformation in steel during heating. Heat treatment process- annealing, normalizing, hardening, vacuum, hardening and induction hardening defect in hardening.	4	8
3	**Transmission Of The Power**	Belt drivers- types like flat, "v", timing belt, poly v belt rope way and there designation and application slip and creep in belt, use of idler and jockey pulleys, fast and loose pulleys, stepping pulley, Chain drives - types and application, power transmitted by chains, Gear and gear drives-type like spur, helical, double helical, spiral, worm and worm gear, bevel gear, rack and pinion and their application, center distance, Speed ratio, simple problems.	4	6
4	**Bearing Material And Antifriction Bearing**	Introduction of bearings, characteristics, types, composition of 2 common bearing material like white metal, bronze, brass, cadmium, alloys etc. bimetal and tri metal bearing. Types of antifriction bearing, designation of each type, ball bearing, roller bearing and needle bearing, preloading of angular contact bearing	3	4
5	**Lubrication**	Characteristic of lubrication, type of lubricant. Method of lubrication- self lubrication, manual feed, auto feed and aerosol lubrication, auto lubrication system	3	4

6	**An Over View On Steam Turbines, 1c Engines,**	Working principal of the boiler and turbines, types of 1C engines construction classification-two stroke and four stroke petrol and diesel engines, thermal efficiency and mechanical efficiency	3	6
7	**Jigs & Fixture**	Introduction To Jigs & Fixture And Advantages, Planes of the movement and degree of freedom, Method of location, different types of clamp and clamping devices drill bush and support. Types of jigs & fixture, Types of location and location method, Jigs & fixture design	4	6
8	**Information On Non-Conventional Machine**	Chemical etching, ultrasonic machining, electrochemical machine, Electrical discharge machine, wire cut EDM, Plasma arc machine, laser beam, machining, water jet machining	5	8
9	**Clutching And Couplings**	Working principal of single and multi-plate clutch. Clutching line 1 material. Types of coupling and there app.	5	4
10	**Fundamentals Of Mechatronics & Automation**	Concept of mechatronics, basic elements of mechatronics, Overview of mechatronics design process Basic elements of automated system, advanced automation Functions, levels of automation.	5	8

VI. LIST OF PRACTICAL EXPERIENCES

1) Visit to CNC machine Shop and discuss their working.
2) Visit production shop to observe casting, forging, press work etc.
3) Visit and demonstrate joining methods like Brazing, Soldering, welding
4) Visit Heat Treatment shop and discuss.
5) Draw 2 application of each, Belt drive, Rope Drive, chain Drive
6) Draw a sheet for drill Jig
7) Draw a sheet for Milling Fixture
8) Visit CNC shop and understand the function and working of CNC EDM
9) Visit CNC shop and understand the function and working of CNC W EDM

VII. REFERENCE BOOKS

Sr. No.	Author	Title	Publication
1	Parmar,M.S.	Mechanical Engineering	Satya Prakashan
2	Handa D.	Mechanical Engineering (Objective Type)	Satya Prakashan
3	Gupta,R.C.	Mechanical Engineering Materials	Asian Publishers
4	International Labour Organisation	Mechanical Engineering Turning Identifying Self Cantering Chuks And Their Uses	International Labour Organisation
5	International Labour Organisation	Mechanical Engineering Turning Identifying Lathe Centres And Their Uses	International Labour Organisation

M2-07: COMMUNICATION SKILL – II

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	2	3	60	-	40	-	100

II. COURSE RATIONALE

The most commonly used medium to express oneself is language. English, being a global language, is used in all the spheres of human life i.e., personal, professional and social. A diploma student is expected to be proficient in English language and pursue the existing course of study to handle the future jobs. The content of the text includes the aspects related to language skills.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVE

Students will be able to:
1. Develop vocabulary.
2. Apply the rules of grammar.
3. Comprehend the given unseen passage.

IV. COURSE OUTCOMES

Students will be able to construct the sentence in English. Students can apply grammar rules in sentence building. Understand the different types of paragraph. Comprehend main ideas and reproduce them. Describe an object, process or procedure.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1. VERBAL COMMUNICATION	PRINCIPALS OF WRITTEN COMMUNICATION	students should be able to- • Writing of message with capitalization spelling and punctuations. • Writing of paragraph, drafting circulars and notice. • Write and communication with presentation. • Preparation and presentation for formal speech. • Better oral communication skill with intelligibility.	**Contents**: The Process of formal written communication Designing a message, deciding purpose, analyzing audience, organizing selecting, arranging ideas and preparing outlines. The qualities of good writing, attitude clarity, conciseness, preciseness, style, flow, accuracy readability. Principles of message organization, topic transitional and concluding sentences, levels of meaning conceptual prepositional, contextual and programmatic meaning, Independent function sentences defining, classifying, etc. text depending sentences exp exemplifying and interaction. Features of technical writing : Problem solving situation, collaboration and sub technical vocabulary functional language objective use of verbal's, use of formats.1) Structure of typical science and technology paragraph 2) Mechanics of writing - Spacing and identitation use of equation, abbreviation, numerals reference and access devices, capitalization spelling and punctuations.	10	15
	WRITING SKILL		Writing General function paragraph Writing Specific function paragraph The following forms of Communication Office Drafting, Circulars, Notices, Memorandum and telex manage, Business letters - application and resume sales, enquiry, order, complain, Reports - Investigation, Progress, Appraisals and trouble	8	12
	PRINCIPAL OF ORAL COMMUNICATION		Principles of formal oral communication. The process of formal oral communication	4	6

			Designing oral messages, Analyzing audience selecting method presentation for from impropty, memorized, read and extemporaneous, speech, preparation and Presentation of formal speech.		
	ORAL SKILLS		Oral Skills - Phonic System of English language speech sounds hovel and consonants diphthong syllable and word accent. Connected speech rhythm pitch, Improving intelligibility of spoken language Writing transcription of words International Phonetic Association Notation	4	6
2. NON VERBAL COMMUNICATION	NON VERBAL COMMUNICATION	students should be able to- • Students Will understand nonverbal communication with sign, text and body language	Principles of Non-verbal Communication Illustrating text with figures and diagram body language	2	3
3.COMMUNICATION IN ORGANIZATION	NATURE OF ORGANISATION	students should be able to- • Nature of organization about communication. • Vertical and horizontal communication. • Up word and down word communication. • Dialog communication, formal and informal communication. • Able handle problem solving situation	Business and Industry as an organization communication activities in educational and industrial organization, communication, Diagonal, Vertical, Horizontal Upward, downward, Diagonal formal and informal routes of communication	4	6
	COMMUNICATION ROUTES AND NET WORK		Vertical and horizontal communication Upward and downward Communication Diagonal Communication Formal and Informal Communication	2	3
	EQUIPMENTS FOR COMMUNICATION		Non-Technical Information Only	2	3
	FEATURES OF TECHNICAL COMMUNICATION		Problem Solving Situation, Collaboration	2	3

4. PROFESSIONAL COMMUNICATION	PRINCIPAL OF EFFECTIVE PROFESSIONAL COMMUNICATION	students should be able to- • Students will understand principle of effective professional communication. • Able to modern communication equipment used in office	Modern Communication equipment used in offices	2	3

VI. LIST OF TUTORIAL

1) Describe an object, process or procedure. Prepare list of various communication activities carried out in your institute.
2) Study of word formation.
3) Identify sentence elements.
4) Draw the diagram of communication cycle for given situation. State the type and elements of communication involved in it.
5) Role play: Teacher should form the group of students based on no. of characters in the situation. Students should develop the conversation and act out their roles.
6) Collect five pictures depicting aspects of body language from different sources such as magazines, newspapers, internet etc. State the type and meaning of the pictures.

VII. REFERENCE BOOKS

Sr. No.	Author	Title	Publication
1	Raju Shetty	Effective Communication	Satya Prakashan
2	B. V. Pathak	Communication Skills	Satya Prakashan
3	Board of Editors	Written & Spoken Communication in English	Board of Editors

MSME TECHNOLOGY CENTRE BHOPAL

(A Government of India Society under Ministry of Micro, small and medium enterprises)

THIRD SEMESTER: COURSE DETAILS

DIPLOMA IN MECHATRONICS

M3 – 01: STRENGTH OF MATERIALS

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	2	3	60	-	40	-	100

II. COURSE RATIONALE

The study of strength of materials often refers to various methods of calculating the stresses and strains in structural members, such as beams, columns, and shafts. The methods employed to predict the response of a structure under loading and its susceptibility to various failure modes takes into account the properties of the materials such as its yield strength, ultimate strength, Young's modulus, and Poisson's ratio; in addition the mechanical element's macroscopic properties (geometric properties), such as it length, width, thickness, boundary constraints and abrupt changes in geometry such as holes are considered.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

The Student will be able to:

1. Understand the fundamentals of solid mechanics.
2. Acquire elementary knowledge of stresses, strains & material properties.
3. Understand & analyse the basic principles involved in the behaviour of machine parts under load in the Context of designing it.
5. Understand & analyse the mechanical properties of the various materials.

IV. COURSE OUTCOMES

After completion of this course the Student will be able to:

1. Understand the fundamentals of solid mechanics.
2. Acquire elementary knowledge of stresses, strains & material properties.
3. Understand & analyse the basic principles involved in the behaviour of machine parts under load in the Context of designing it.
4. Understand & analyse the mechanical properties of the various materials.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	**Simple Stresses & Strains**	Students should be able to- • Understand the concept of stress and strain. • Understand the definition explanation calculation. • Understand the concept of stress and strain diagram. • Understand the modulus of elasticity.	Stress strain types, definition explanation calculations, Hooke's law, principle of super position. Stress-strain diagram for tensile & brittle materials, important points on the stress- strain diagram, Modulus of elasticity	8	12
2	**Principal stresses and planes.**	Students should be able to- • Understand the concept of principal stresses and principal planes. • Describe about direct stresses. • Understand to describe direct and shear stress on one plane, on mutually, perpendicular plane. • State Mohr's circle method.	Concept of Principal stresses and Principal planes. Stresses on an oblique section of a body subjected to Direct stresses on one plane, Direct stresses on mutually perpendicular planes. Direct and Shear stress on one plane, Direct and Shear stress on mutually, Perpendicular plane (No derivations). Mohr's circle method for finding principle stresses and planes (only simple numerical).	8	12
3	**Bending Moment & Shear Force**	Students should be able to- • Able to understand the concept and definition of shear force and bending moment. • Understand the concept of shear force and bending moment diagram for cantilevers. • Understand about over hanging beam subjected to point load and also uniformly distributed load	Concept & definition of Shear force & bending moment Relation between rates of loading, shear force & bending moment. Shear force & bending moment diagrams for cantilevers, simply supported beam & over hanging beam subjected to point load[1]; & uniformly distributed load. Location of point of contra flexure	4	8

5	**Moment of Inertia**	Students should be able to- • Able to understand the concept and definition of moment of inertia, parallel and perpendicular axes theorem. • Understand about the square rectangular, circular, semi-circular, triangular hollow sections. • Moment of inertia of angle section ,channel section ,tee section, I section about centroidal axis	Concept & definition of Moment of inertia, Parallel & perpendicular axes theorem. (No derivation). Moment of inertia of solid sections-square, rectangular, circular, semi-circular, Triangular Hollow sections- square, rectangular & circular cross sections only. Moment of Inertia of angle section, Channel section, Tee- section, I -section about centroidal axis & any other axis parallel to centroidal axis. Polar moment of inertia.	8	14
6	**Bending** **Stresses**	Students should be able to- • Able to know about the theory of simple bending. • Briefly know about the assumptions in the theory of bending and moment of resistance. • Understand about section modulus, neutral axis. • Understand about equation of bending.	Theory of simple bending, Assumptions in the theory of bending, moment of resistance, section modulus, neutral axis. Equation of bending (Simple numerical based on formula)	6	8
7	**Torsion**	Students should be able to- • Able to know about the concept of pure torsion. • Understand about the assumptions in theory of pure torsion. • Torsion equation for solid and hollow circular shafts. • Understand about power transmitted by a shaft. • Understand about solid hollow shaft subjected to pure torsion	Concept of Pure Torsion, Assumptions in theory of pure Torsion, Torsion equation for solid and hollow circular shafts, Power transmitted by a shaft. Comparison between Solid and Hollow Shafts subjected to pure torsion (no problem on composite and non-homogeneous shaft)	6	6

VI. LIST OF PRACTICAL EXPERIENCES

1. Know your laboratory to understand the difference Machines / their components and purpose.
2. Understand different components, their purpose and operations of "Universal Testing Machines" by conducting a trial on sample test specimen.
3. Understand different components, their purpose and operations of Extensometer by conducting a trial on sample test specimen.
4. Tension test on mild steel and aluminium specimen by using Universal Testing Machine (UTM) to Calculate yield stress, ultimate stress, breaking stress, percentage elongation and moduli of Elasticity.
5. Compression test on cast iron specimen by using "Universal Testing Machine".
6. Determine the shear strength of mild steel bar in single and double shear by using "Universal Testing Machine"
7. Determine the Brunel hardness number of mild steel specimen and also its equivalent by the other method.
8. Izod or charpy test on M.S., copper, aluminium and brass specimen to calculate energy absorbed.
9. Conduct torsion test on mild steel bar and find breaking torsional shear strength and stiffness.
10. To calculate and draw the S. F. D. and B. M. D. for cantilever, simply supported And Overhang beams.
11. To determine principal stresses and to locate principal planes for a given loading by analytical and Graphical (Mohr's circle) methods.

VII. TEXT BOOKS

Sr.No.	Author	Title	Publication
1	Khurmi,R.S.	Strength Of Materials (MKS And Si Units)	S.Chand & Co. Ltd
2	Rajput,R.K.	Strength Of Materials In Si Units	S.Chand
3	Malhotra, D.R. Gupta,H.C.	The Strength Of Materials (Si Units)	Satya Prakashan
4	S. Ramamrutam	Strength Of Materials	Dhanpat Rai Publications

M3-02: CONTROL SYSTEM

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	4	3	60	60	40	40	200

II. COURSE RATIONALE

This course is essential for a student to define problems, to plan solutions, design a system for own requirements and upgrading that system and checking its efficiency.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

1. Understand various design of control system.
2. Apply acquired knowledge effectively and efficiently to all work in the field of engineering.
3. MATLAB helps to understand the behaviour of the system.
4. Give knowledge about various types of control system and its behaviour.

IV. COURSE OUTCOMES

Students should be able to:

1. Identify the basic elements and structures of feedback control systems.
2. Know importance of transfer function and its advantages in control system.
3. Understand importance of locus and different plots in checking stability of a good control system.
4. Observe, measure and the design and conduct the experiments through practical experience in the laboratory.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHIG HOURS	MARKS
1	**Introduction to Control system**	Student should be able to • Define the system. • Understand the input and output of the system. • Define Control System. • Differentiate between open loop and closed loop control system. • Describe the advantages and disadvantages of Control System.	What is Control system? Basic definition, System, Commands, input, output. Open loop and Closed loop system Definition and Block diagram of open and closed loop control system, examples, advantages and disadvantages, effects of feedback. Manual and Automatic control system Basic elements of servo mechanism, examples of automatic control system. Linear and Non-linear Control system Additive property, homogeneous property, examples of level, flow, temperature control system	8	10
2	**Control system Representation**	Student should be able to • Calculate olve the Laplace Transform, Inverse Laplace Transform. • Define Transfer function of the system and its importance. • Describe the advantages of Transfer Function (T.F). • Define the poles, zeros of the T.F • List the rules for the Block diagram reduction technique to find the T.F • Understand the Mason's gain formula to find the Transfer Function.	Transfer function Laplace transform, Inverse Laplace transform, Properties of T.F, advantages and disadvantages of T.F, Poles and Zeros of a T.F. Block diagram reduction Definition of basic elements of block diagram, Rules and procedure of block diagram reduction. Mason's Gain formula and Signal Flow Graph Basic definition in SFG, Rules for SFG, Properties of SFG, Mason's Gain formula.	12	16
3	**Times Response Analysis**	Student should be able to • Understand mathematically the various standard test signals which can be used as input to the system.	Standard test signals, Step, Ramp, Parabolic, and impulse function. Times response of control system. Classification of time response, Analysis of First order and second order control system, effect of ω on second order system.	10	16

		• Describe the time response analysis of control system for first order and second order system. • Summaries the effect of various values of damping ratio (ξ) on the second order system. • Understand the time constant and steady state error.	Time constant and Steady state error, Analysis of steady-state error and its type. Advantages and disadvantages of static error coefficient.		
4	**Locus and Plots Analysis**	Student should be able to • Define stability of the system. • Understand the stability of the system by using the Routh's Hurwitz criterion concept. • Describe effects of poles on stability when the poles lies in right hand side of S plane. • Draw the Root Locus diagram to find the closed loop system stability. • Plot the Bode plot.	Locus of Transfer function Fundamental of root-locus., Relation between poles and zeros, steps for solving problems. Stability, Effects of poles on stability, Routh-Hurwitz Criterion for checking stability of a system. Different types of plots, Bode plot, Resultant curve, Advantages of a Bode plot, Phase and Gain margin, stability.	10	18

VI. LIST OF PRACTICAL EXPERIMENTS

1. Introduction to MATLAB

a) Create a variable in MATLAB.

b) Write the command to clear the command window and workspace window.

c) Create two variables in MATLAB and perform on them different arithmetic operations.

2. Matrix generation

a) Create a 2*2, 3*3 Matrix.

b) Given below two square matrices, add them, multiply, subtract, take transpose of each resultant matrices.

c) Extracts a 3×4 sub matrix starting at row 2 and column 3 and ending at row 4 and 6 column from the matrix given Below. a=[1 2 3 4 5 6;5 6 7 8 9 3;7 8 9 5 6 3;8 2 9 4 6 4]

d) Find the inverse of the matrix

e) Find the determinant of the matrix

3. Introduction to 2-d plotting and different toolboxes in MATLAB

a) Creates a 2-D line plot of the data in y versus the corresponding values in x.

b) Define x as 100 linearly spaced values between -2*pi and 2*pi. Define y1 and y2 as sine and cosine values of x. Create A line plot of both sets of data.

c) Plot three sine curves with a small phase shift between each line. Use the default line style for the first line. Specify A dashed line style for the second line and a dotted line style for the third line.

d) Plot a circle centered at the point (4, 3) with a radius equal to 2. Use axis equal to use equal data units along each Coordinate direction.

e) Plot three sine curves with a small phase shift between each line. Use a green line with no markers for the first sine Curve. Use a blue dashed line with circle markers for the second sine curve. Use only cyan star markers for the third Sine curve.

4. Plot the pole-zero configuration in s-plane for the given transfer function.

a) How to write transfer function in MATLAB for the given transfer function. $2s^2+5s+1/s^2+2s+3$

b) Locate the poles and zeros for the transfer function. . $2s^2+5s+1/s^2+2s+3$

c) Obtain the transfer function from poles and zeros.

d) Create a transfer function model that represents a second order system. With known natural Frequency and damping ratio. H(s) = (w0^2)/(s^2+2Ew0s+w0^2).

e) Given damping ratio=zeta=E=0.25, w0=3 rad/sec.

5. Determine the transfer function for given closed loop system in block diagram representation.

6. Plot unit step response of given transfer function and find peak overshoot, peak time. H(s) = (w0^2)/(s^2+2Ew0s+w0^2). Given damping ratio=zeta=E=0.25, w0=3 rad/sec.

7. **Plot unit step response of given transfer function and find rise time, delay time. H(s) = (w0^2)/(s^2+2Ew0s+w0^2). Given damping ratio=zeta=E=0.25, w0=3 rad/sec.**
8. **Plot root locus of given transfer function. $2s+4/2s^2+3s+1$**
9. **Plot bode plot of given transfer function and find gain and phase margins. $2s+4/2s^2+3s+1$**
10. **Plot nyquist plot of given transfer function and find gain and phase margins. $2s+4/2s^2+3s+1$**

VII. REFERENCE BOOKS

Sr.No.	Author	Title	Publication
1	Bolton, W.	Mechatronics : Electronic Control Systems In Mechanical And Electrical Engineering	Pearson Education
2	Tripathi,S.M.	Modern Control Systems An Introduction	Firewall Media
3	Palani,S	Control Systems Engineering	McGraw Hill
4	Gopal,M	Control Systems : Principles And Design	McGraw Hill
5	Sataynarayan, P.S	Control System Engineering	Scintificint
6	Bhattacharya, S.K	Control System Engineering	Pearson Education
7	Salivahanan, S	Control System Engineering	Pearson Education

M3-03: DIGITAL ELECTRONICS

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	4	3	60	60	40	40	200

II. COURSE RATIONALE

Digital electronics, or digital (electronic) circuits, represent signals by discrete bands of Analog levels, rather than by a continuous range.
All levels within a band represent the same signal state. Relatively small changes to the Analog signal levels due to manufacturing tolerance, signal attenuation or parasitic noise do not leave the discrete envelope, and as a result are ignored by signal state sensing circuitry.
In most cases the number of these states is two, and they are represented by two voltage bands: one near a reference value (typically termed as "ground" or zero volts), and the other a value near the supply voltage.
These correspond to the "false" ("0"), and "true" ("1"), values of the Boolean domain, respectively.
Digital techniques are useful because it is easier to get an electronic device to switch into one of a number of known states than to accurately reproduce a continuous range of values.
Digital electronic circuits are usually made from large assemblies of logic gates, simple electronic representations of Boolean logic functions

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

1. Understand basic digital circuits.
2. Understand conversion of number systems.
3. Implement combinational and sequential circuits.
4. Understand logic families, data converters

IV. COURSE OUTCOMES

Students should be able to:

1. Understand basic digital circuits.
2. Understand conversion of number systems.
3. Implement combinational and sequential circuits.
4. Understand logic families, data converters.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOME	CONTENTS	TEACHING HOURS	MARKS
1	**NUMBER SYSTEM**	Students should be able to • Write the 1's & 2's complement of a binary number. • Understand the different codes like BCD, gray, excess-3, etc. • Convert a number from one number system to other.	**Introduction to digital signal, Advantages of Digital System over Analog systems.** Number Systems: Different types of number systems (Binary, Octal And Hexadecimal), conversion of number systems, Binary arithmetic: Addition, Subtraction, Multiplication, And Division. Subtraction using 1's complement and 2's complement. **Codes .**Codes -BCD, Gray Code, Excess-3, ASCII code**,** BCD addition, BCD subtraction using 9's and 10' complement	6	10
2	**Logic gates and introduction to logic families**	Students should be able to • Describe different logic gates. • Explain Boolean laws & de-Morgan's theorems. • Solve numerical based on logic equation.	**Logic gates.** Basic gates and Derived Gates, NAND and NOR as Universal gates. Boolean Algebra: Fundamentals of Boolean laws. Duality Theorem, De Morgan's theorems. (numerical based on simplification of logic equations) **Logic Families.** Characteristics of logic families & Comparison between different logic families. Logic families such as TTL, CMOS, ECL. TTL NAND gate - Totem pole output, open collector, CMOS Inverter	8	16
3	**Combinational Logic Circuits**	Students should be able to • Understand basic idea of logic development. • Describe logical expression with the help of k-map. • Understand the working of adder & subtractor circuit.	**Introduction.** Standard representation of canonical forms (SOP & POS), Maxterm & Minterm), conversion between SOP and POS forms. K-map reduction technique up to 4 variables. (SOP & POS form), Design of half and full Adder, half and Full Subtracter using K-map, Code Converter using K-map: Gray to Binary to Gray Code Converter (up to 4-bit) 1C 7447 as BCD to 7 segment decoder – driver 1C 7483 as Adder & Subtracter, 1 digit BCD adder. Block Schematic of ALU 1C 74181 and 1C 74381. **Necessity, Applications and realization of following.** Multiplexed MUX): MUX tree. Demultiplexers (DEMUX): Demux tree, Demux as decoder. Study of 1C 74151, 1C 74155,	8	14

			Priority Encoder 8:3, Decimal to BCD Encoder. Tristate logic, Unidirectional & bidirectional buffer ICs: 1C 74244 and 1C 74245.		
4	**Sequential Logic Circuit**	Students should be able to • Analyze the different logic circuits. • Classify types of shift registers. • Understand flip-flops.	**Sequential circuits:** Comparison between Combinational & Sequential circuits, One bit memory cell -RS latch- using NAND& NOR. Triggering Methods (Edge and level trigger) Flip Flops - S R Flip flop, Clocked SR flip flop with preset and clear, Drawbacks of SR Flip flop. Clocked JK Flip flop with preset & clear, Race around condition in JK flip flop, Master slave JK flip flop. D and T type flip flop. Excitation table of flip flops. Block schematic and function table of IC-7474, 7475,74373	8	10
			Study of Counters: Counter: Modulus of counter, their types as Asynchronous and Synchronous counter. Asynchronous counter: (Ripple counter , 4 bit up/down Counter Synchronous counter: Excitation table of flip flops, implementation of 3 bit synchronous counter, its truth table and waveforms. Block schematic and waveform , 1C 7490 as MOD-N Counter		
			Shift Register: logic diagram, Truth Table and waveforms of: 4-bit Shift registers (SISO, SIPO, PISO, PIPO) 4 Bit Universal Shift register. Applications of Shift Register (Logic Diagram with waveforms) of: Ring counter , Twisted ring counter		
5	**Data Converters**	Students should be able to • Analyze the different data converters. • Understand the importance of code converters.	**Introduction and Necessity of Code Convertors.** DAC Types and comparison of Weighted resistor method (Mathematical derivation) and R-2R Method (Mathematical derivation up to 3 variable).	6	6
			ADC Types and their comparison. Block Diagram and working of following ADCs. Single slope ADC, Dual slope ADC, SAR ADC, IC PCF 8591 : 8 BIT ADC-DAC		
6	**Memories**	Students should be able to • Classify the different types of memories. • Understand the principle of operation of memories.	Principle of operation and classification of memory. Organization of memories, RAM (Static, Dynamic), Volatile and Non-Volatile, ROM (PROM, EPROM, EEPROM), Flash memory. Comparison between EPROM and Flash , Study of memory ICs	4	4

VI. LIST OF PRACTICAL EXPERIMENTS

SR. NO.	TITLE OF EXPERIMENT
1	Verify the truth table of basic logic gates.
2	Verify De Morgan's theorem.
3	To study universal logic gates.
4	To study NOR gate and NAND gate as universal logic gate.
5	To study Half Adder.
6	To study Full Adder.
7	To study Half subtractor
8	To study Full subtractor
9	To study the operation of Multiplexer. (software)
10	To study the operation of De-Multiplexer. (software)
11	Design MUX & De-MUX tree. (software)
12	Study the 1-bit memory cell. (software)
13	Study the R-S flip flop. (software)
14	Study the J-K flip flop. (software)
15	Study the T & D flip flop. (software)
16	Study the shift register & universal shift register. (software)
17	Study the Up & Down Counters. (software)

VII. REFERENCE BOOKS

Sr.No.	Author	Title	Publication
1	Gothmann, William	Digital Electronics (An Introduction To Theory & Practice)	Prentic Hall Of India Ltd.
2	Jain,R.P.	Modern Digital Electronics	Tata McGraw Hill Pub. Co. Ltd.
3	Gaur, R.K.	Digital Electronics And Micro Computers	Dhanpat Rai & Sons
4	Jain, R. P.	Modern Digital Electronics	Tata McGraw Hill Pub. Co. Ltd.
5	Maini, Anil, K.	Digital Electronics : Principles & Integrated Circuits	Wiley India
6	Gaur, R. K.	Digital Electronics & Micro - Computers	Dhanpat Rai & Co.
7	Tokheim, Roger L.	Digital Electronics: Principles And Applications	Tata McGraw Hill Pub. Co. Ltd.

M3-04: ELECTRICAL CIRCUITS AND PANELLING

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	4	3	60	60	40	40	200

II. COURSE RATIONALE

Electrical Circuits and panelling is the heart of industrial electrical wiring system. This subject will provide knowledge on designing, maintenance and troubleshooting of industrial electrical panels.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

1. Student will be acquainted with the facts of electrical circuits, magnetic circuits, circuit elements, tools, Equipment, type of circuits, sources etc.
2. Student will know the basic concept of control panel designing parameters which is very important for Mechatronics.

IV. COURSE OUTCOMES

After learning the subject the students will know how to design, maintain, and troubleshoot industrial electrical panels.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
Unit I	**Introduction**	students should be able to- • Understand the need & importance of Electrical panel • Describe types of electrical panel • Draw the symbols used in electrical engineering • Discuss properties of electromagnetic circuit	Need & importance of Electrical panel, category/type of electrical panel, Control parameters, Symbols used in field of electrical engineering, Concept of circuits, properties of electromagnetic and electro static fields, a. c. quantities. Electrical circuits, magnetic circuits, circuit elements	8	15
Unit II	**Type of Circuits & Electrical layouts**	students should be able to- • Understand & draw various drawing used in electrical engineering field • Analysis of circuit • Draw electrical layout of room • Understand & draw single line diagram • List the types of wire • Describe wire insulation material	Study of different panel in practice, Type of circuits, sources etc. Analysis of circuits and type of circuits, The Electrical layout as shop floor, Single line diagram of supply system, Wire types, Wire insulation materials, Wire gauges and specifications, Wire Preparation	12	12
Unit III	**Panel Design & Drawing**	students should be able to- • Calculate voltage & current ratings for the system • Understand the use of panel accessories • Understand the panel design problem • Read & understand electrical connection diagram	Calculation of voltage, current, ratings, power supply for the system/product, Over-current protection devices, Tools, equipment used in Panel, Electrical panel system –component, product, processes and system, Panel Design & Drawing, Panel board. Types of panel board, Panel board construction, Panel design problems on – Product , process, system, Manufacturing Electrical panels, Panel board mains configurations	8	14
Unit IV	**Control Circuits and Panel Design**	students should be able to- • Draw control circuit for forward & Reverse direction for DC motor • Demonstrate quality control policies for electrical accessories • Understand the panel maintenance procedure	Control circuit for forward and reverse direction for a d.c. shunt motor, Control circuit of different input, output devices. Panel Management parameters, Inspection and quality control, Panel maintenance	6	13

Unit V	**Hardware Components Earthing, Screening &PLC Wiring**	students should be able to- • List the different hardware used in panel • Describe the use of earthing • Draw PLC wiring connections • Understand the troubleshooting of PLC hardware	Hardware components used in the panel, Earthing the protective bonding circuit, Screen connections and system earth terminals, Installation of PLC, Power supply wiring and earthing, Wiring inputs and earthing	6	6

VI. LIST OF PRACTICAL EXPERIMENTS

1. To draw various symbols used in field of electrical engineering.
2. Introduction to single line diagram for different electrical circuits.
3. Demonstrate use of NO/NC contacts in control circuit of different input, output Devices.
4. Develop a control circuit for Start Stop logic of a motor.
5. Develop a control circuit for forward and reverse logic of a motor.
6. Introduction to EPLAN Education Software.
7. Electrical System Design for Start Stop logic of a motor.
8. Electrical System Design for forward and reverse logic of a motor.
9. Electrical System Design for Starting Methods for Induction Motors:-

   1) DOL Starter (Direct Online Starter)

   2) Star-Delta Starter

   3) Auto Transformer Starter

10. General arrangement of components in Panel

VII. REFERENCE BOOKS

Sr.No.	Author	Title	Publication
1	Uppal, S. L.	Electrical Wiring: Estimating & Costing	Khanna Publishers
2	Raina, K. B.	Electrical Design: Estimating And Costing	New Age Int.

M3-05: INTRODUCTION TO ELECTRO-MECHANIC SENSORS & ACTUATORS

[MECHATRONICS SYSTEM]

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	4	3	60	60	40	40	200

II. COURSE RATIONALE

Sensors and Actuators are very important to know about Mechatronics. Without the knowledge of these input and output components Mechatronics would be incomplete.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

1. Student will be acquainted with the types Transformers, Semiconductors, types of diodes, rectifiers, Transistors, and basics of integrated circuits.
2. Student will know the basic concept of many types of sensors and transducers, Mechanical Actuation system, Electrical actuation system and interfacing with different components.

IV. COURSE OUTCOMES

After learning the Sensors and Actuators Students can easily and clearly get the whole knowledge on where and how the sensors and actuators are to be interfaced to run a process automation.

V. CONTENTS

UNIT NO.	TOPIC/SUB TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	**Introduction**	Student should be able to - • Define scope of Mechatronics Measurement systems. • Understand various control system • List the requirements and selection parameters of sensors.	Need, scope and importance of Mechatronics in industries. Systems, measurement systems and control systems. Sensors – Basic requirements of a sensors- Selection Parameters of sensors- Classification of sensors. Static and Dynamic characteristics of sensors. Basic elements of close loop control systems.	4	6
2	**Signal Conditioning Elements**	Student should be able to- • Summarize need of signal conditioning. • Understand the types of operational amplifiers and comparators.	Amplifiers:-Operational amplifiers, Inverting & Non-inverting amplifiers. Comparators.	6	8
3	**Displacement Measurement Sensor**	• Student should be able to- • Understand displacement sensors like potentiometers, LVDT. • Understand capacitive and inductive types of sensors as a displacement sensors. • Describe optical encoder and hall effect sensors	Displacement Sensors- Linear and Rotary displacement sensors-Potentiometer, Capacitive and Inductive type displacement sensor -LVDT – RVDT. Position sensors- Optical encoder, Hall Effect Sensor.	8	12
4	**Measurement of Proximity, Force and Pressure**	Student should be able to- • Working and applications of proximity sensor • Describe the application of inductive and capacitive proximity sensors in real application. • Understand the physical principles and operation of pressure sensor. • Describe various pressure measurement methods.	Principle, working and applications of-, Proximity sensor- Inductive Proximity sensor- Capacitive Proximity sensor - Proximity Switches- Contact and Noncontact type – Wheatstone bridge -Strain Gauge. Diaphragm Pressure Sensor- Manometer Pressure Sensor- Bourdon tube pressure sensor Piezoelectric Sensor.	6	10

5	**Temperature Measurement Sensors**	Student should be able to- • Classify temperature sensors. • Select appropriate temperature sensor for the given process. • Understand use and installation problem of thermocouple during temperature measurement.	Temperature Scales- Principle, working and applications of- Thermistors- Resistance Temperature Detector(RTD)- Thermocouples:-Laws-characteristics, installation problems, cold junction compensation. IC temperature sensors, Bimetallic Strip.	8	12
6	**Mechanical Actuation Systems**	Student should be able to- • Understand mechanical actuation system and types of motion. • Explain cam and follower system.	Basics of mechanical actuation systems: types of motion, kinematic chains, cams, gear trains, belt and chain drives, bearing fundamentals, arrangements/working, and applications.	8	12

VI. LIST OF PRACTICAL EXPERIENCES

1. Study of Sensor Lab.
2. Study of Sensors.
3. Study of amplifiers.
4. Study of Slide Potentiometric Displacement Sensor.
5. Study of Rotary Potentiometric Displacement Sensor.
6. Study of Capacitive Displacement Sensor.
7. Study of Galvanic Skin Response Sensor.
8. Testing of Transistor Transistors.
9. Study of LVDT.
10. Study of Inductive proximity sensor.
11. Study of Capacitive Proximity Sensor.
12. Study of Strain measurement using strain gauges and cantilever assembly.
13. Characteristics of Temperature Sensor (RTD).
14. Study of Relay.
15. Study of different types of liner Actuators.

VII. REFERENCE BOOKS

Sr.No.	Author	Title	Publication
1	Soloman,Sabrie	Sensors And Control Systems In Manufacturing	McGraw Hill Inc.
2	Ghosh, M. K.	Optoelectronics: Sensors And Instrumentation	Scientific Int. Ltd.
3	Brooker,Graham	Introduction To Sensors For Ranging And Imaging	Yesdee
4	Ghosh,M.K	Optoelectronics: Sensors And Instrumentation	Medtec
5	Fraden, Jacob	Handbook Of Modern Sensors: Physics Designs And Applications (R)	Springer

M3 – 06: THERMODYNAMICS & HEAT TRANSFER

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	2	3	60	-	40	-	100

II. COURSE RATIONALE

Mechanical Engineers have to work with various power producing & power absorbing devices like Boilers, Turbines, Compressor, I.C. Engines, and Pumps etc. In order to understand the principles, construction and working of the devices, it is essential to understand the concept of energy, work, heat and conversion between them. The subject is a related to Power Engineering and other related subjects in which the application of fundamental concepts of Thermal Engineering are included.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES :

Students will be able to

1. Understand fundamental concepts of thermodynamics to thermodynamic systems.
2. Use various laws of thermodynamics.
3. Apply various gas laws and ideal gas processes to various thermodynamic systems.
4. Understand construction and working of boilers, turbines & condensers.
5. Find properties of two phase system from steam table / mollier charts
6. Know various modes of heat transfer.

IV. COURSE OUTCOMES

After completion of this course Skills to be developed:

1. Understand various concepts and fundamentals of thermodynamics.
2. Understand vapour processes, principle of working of steam boilers and function of different mountings and Accessories.
3. Understand construction and working of steam turbines and condensers.
4. Understand modes of heat transfer and concept of heat exchanges.
5. Interpret steam tables, Mollier chart and relationship between different thermodynamic properties.
6. Understand different sources of energy and their applications

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	**Fundamentals of Thermodynamics**	student should be able to - • Define thermodynamics. • Understand Extensive and intensive properties with units and conversion like P, V, R and temperature, point and path function. • Differentiate between work and heat. • Define Energy, concepts of enthalpy and entropy. • Describe Laws of thermodynamics- zeroth law, principle of law of conservation of energy First law of thermodynamics, second law of thermodynamics. • List the Applications of laws of thermodynamics.	Concepts of pure substance, types of systems, properties of systems- Extensive and Intensive properties with units and conversion like P, V, R and Temperature, Point and path function. Work and Energy. Thermodynamic definition of work & heat, Difference between heat and work. Energy -Potential Energy, Kinetic Energy, Internal Energy, Flow Work, concepts of enthalpy & entropy. Laws of Thermodynamics- Zeroth Law, principle of law of conservation of energy First law of Thermodynamics, Second Law of Thermodynamics- Kelvin Planks, Clausius statements and their equivalence, Clausius inequality, Concept of perpetual motion machine of first and second kind. Application of Laws of Thermodynamic -Steady Flow Energy equation and its application to boilers, engine, nozzle, turbine, compressor & condenser. Application of Second law of Thermodynamics to Heat Engine, Heat Pump and Refrigerator	10	10
2	**Ideal Gases**	student should be able to - • Understand the Concept of ideal gas. • Describe the Ideal gas processes. • Understand P-V and T-S diagram P-V and T-S diagram	Concept of Ideal gas- Charle's law, Boyle's law, Avogadro's law, equation of state, characteristic gas constant and universal gas constant. Ideal gas processes: - Isobaric, Isochoric, Isothermal, Isentropic, Polytrophic, and their representation on P-V and T-S diagram (only simple numerical based on above)	6	12
3	**Steam and Steam Boiler**	student should be able to - • Understand Generation of steam. • Describe Properties and use of steam table. • Understand Steam boilers, classifications, construction and its working	Generation of steam at constant pressure with representation on various charts such as T-S, H-S. Properties of steam and use of steam table, Dry ness fraction, Degree of superheat, Vapour processes: - Constant pressure, constant volume, constant enthalpy, constant entropy process (numerical using Mollier chart), Rankine Cycle. Steam Boilers: - Classification, Construction and working of- Cochran, Babcock and Wilcox, La-mont and Loeffler boiler. Boiler draught. Indian Boiler Regulation (IBR), Boiler mountings and accessories	8	14

4	**Steam Nozzles and Turbines**	student should be able to – • Understand the Concept of steam nozzles. • List the Types of nozzles. • Describe Concept of turbines. • Classify turbines, construction and its working. • Understand Concept of condensers, classification, construction and its working • Understand the concept of condenser efficiency and vacuum efficiency. • Describe cooling tower construction and understand the working of forced.	Steam nozzle: -Continuity equation, types of nozzles, concept of Mach number, critical pressure, application of steam nozzles. Steam turbine: -Classification of turbines, Construction and working of Impulse and Reaction turbine. Compounding of turbines and its types, Regenerative feed heating, bleeding of steam, governing & its types, losses in steam turbines. Dalton's law of partial pressure, function and classification of condensers, construction and working of surface condensers. Sources of air leakage and its effect, concept of condenser efficiency, vacuum efficiency (Simple numerical). Cooling Towers.-Construction and working of forced, natural and induced draught cooling tower.	8	14
5	**Heat Transfer**	student should be able to – • Understand the concept of heat transfer. • Derive relation between conduction and convection and radiation. • Describe the Fourier's law. • Understand the concept of thermal conductivity. • Define absorptivity, transmissivity, and reflectivity. • Understand black and gray bodies. • Understand the actual concept of Stefan Boltzman. • Understand the concept of construction and working of shell and tube.	Modes of heat transfer: - Conduction, convection and radiation. Conduction:-Fourier's law, thermal conductivity, conduction through cylinder, thermal resistance, composite walls (Simple numerical) Radiation: -Thermal Radiation, Absorptivity, Transmissivity, Reflectivity, Emissivity, black and gray bodies, Stefan-Boltzman law. Heat Exchangers: -Classification, Construction and working of Shell and tube, shell and coil and pipe in pipe type, plate type heat exchanger and its applications.	8	10

VI. LIST OF PRACTICALS

1. Trace and draw the path of flue gases and water-steam circuit with the help of boiler model.
2. Study and draw various types of Boiler mountings and Accessories.
3. Prepare a report on a visit to sugar factory / Dairy / steam power plant, with specifications of boiler and list Of mountings and accessories.
4. Draw the sketches of impulse and reaction turbine ,describe their working
5. Study and draw jet condensers.
6. Calculation of thermal conductivity of a solid metallic rod.
7. Enlist the heat exchangers available in the laboratory. Classify them.

VII. REFERENCE BOOKS

Sr. No.	Author	Title	Publication
1	Nag,P.K	Basic And Applied Thermodynamics	Mcgraw Hill
3	Chattopadhyay, P.	Engineering Thermodynamics	Oxford University Press
4	Nag,P.K	Engineering Thermodynamics	Mcgraw Hill
6	Sonntag, R. E. Borgnakke, C.	Fundamentals Of Thermodynamics	Wiley India P. Ltd
7	Sears, F. W. Salinger, G. L.	Thermodynamics, Kinetic Theory And Statistical Thermodynamics	Narosa Publishing House

MSME TECHNOLOGY CENTRE BHOPAL

(A Government of India Society under Ministry of Micro, small and medium enterprises)

FOURTH SEMESTER: COURSE DETAILS

DIPLOMA IN MECHATRONICS

M4 – 01: MANUFACURING PROCESS & MECHATRONICS FUNDAMENTALS

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	4	3	60	-	40	50	150

II. COURSE RATIONALE

Diploma technician often comes across various types of basic manufacturing processes. He/she is required to select, operate and control the appropriate processes for specific applications. He/she is also required to know about various cutting tools, latest improvements in manufacturing processes. This is a core technology subject. The diploma technician should know how the raw material gets processed through various processes and ultimately results into finished goods. Hence it is essential that, he has understanding of basic manufacturing processes, machines, tools and equipment. With sound knowledge of this subject, the diploma technician will be able to handle and control practical situations more effectively and confidently

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

The student will be able to:

1) Use the basic machine tools like lathe and drilling.
2) Produce and inspect the job as per specified dimensions.
3) Select the specific manufacturing processes for the desired output
4) Adopt safety practices while working on various machines.
5) Understand and select plastic moulding processes
6) Know and identify basic manufacturing process for different components to be machined.

IV. COURSE OUTCOMES

Skills should be developed after completion of this course

1. Identify basic manufacturing processes like forging, rolling and extrusion, for required component.
2. Specify need of pattern allowances.
3. Decide process parameters for different operations.
4. Decide tools required for a manufacturing process.
5. Identify a joining method for fabrication.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	**Forming Processes**	students should be able to- • Understand the techniques used in metal forming processes. • Understand drop forging and its types. • List the Applications of forging. • List the Advantages and disadvantages of forging. • Understand Defects and remedies of forging.	Drop forging: Grain Structure, Upset forging, press forging(die forging),open die & closed die forging, forging operations, Forging die features, Hammers and press forging machines, Application of forging, advantages and disadvantages of forging, defects and remedies of forging. Forming processes, Definition, Types, bulk deformation.	2	4
2	**Press working**	students should be able to- • Understand sheet metal and its types of working operations. • Describe the press working and its types of working operations. • Understand shearing and non-shearing operation. • Describe about dies and types of dies.	Sheet Metal working, Blanking & Piercing, other types of sheet metal working. Sheet metal Cutting stages. Press classification, press operations like punching /piercing, blanking, notching, lancing, Die set components and types of dies, Forming Operations : Bending, drawing	4	8
3	**Casting Processes:**	students should be able to- • Understand the casting operations. • Describe the Types of casting. • Understand Moulding and type of moulding sands, properties of sand, moulding methods, cores and core prints, elements of gating system, bench moulding, floor moulding ,pit moulding, machine moulding.	Pattern making: Basic steps in making casting, Pattern: types, material and allowances, tools, colour coding of patterns. Moulding : Type of moulding sands, properties of sand, moulding methods, cores and core prints, elements of gating system, bench moulding, floor moulding, pit moulding, machine moulding. Casting: Casting Process. Types of Patterns and their materials, Methods & applications of – Centrifugal casting, shell moulding, investment casting. Hot chamber and cold chamber die casting, Die casting	8	10

4	**Welding**	students should be able to- • Understand the Welding process. • Classify welding processes. • Describe the Soldering and brazing. • Understand Heating methods and applications.	Introduction & classification of welding processes - Gas welding, carbon arc welding, shielded metal arc welding, TIG welding, MIG welding, plasma arc welding, resistance welding types-spot, seam projection. Electron beam welding, laser beam welding, welding defects. Introduction to soldering and brazing, Process, fillers, heating methods & applications. Brazing, Soldering, Filler material, advantages, Process, fillers, heating methods & applications	8	10
5	**Machining Operations**	students should be able to- • Understand various techniques used in machining operation. • Describe Lathe, milling and drilling.	Introduction, classification and basic parts of lathe & their functions, Lathe operations like facing, plain turning, taper turning, thread cutting, chamfering, grooving, knurling. Cutting tool nomenclature & tool signature, cutting parameters. Milling machine, Milling machine principles, Up and Down milling, Mechanism and attachments Work and Tool holding devices. Drilling Machine Introduction, classification, basic parts of radial drilling machine and their functions, twist drill nomenclature, drilling machine operations like drilling, reaming, boring, counter sinking, counter boring, spot facing, cutting parameters.	4	8
6	**Plastic Moulding**	students should be able to- • Understand the Plastic moulding. • List the Types of plastic moulding material. • Describe the Properties and applications of plastic material. • Understand the Plastic moulding process. • Describe the Types of ejection system	Types of plastic moulding material, properties of plastic material, application of plastic material, plastic moulding process, plastic moulding machines, injection system for plastic moulding, runner system, types of gating, types of ejection system,	4	8

7	**Mechatronics fundamentals**	students should be able to- • Understand the Mechatronics system. • Describe the Building blocks of mechatronics systems. • List the Advantages of mechatronics. • Understand the Machines in mechatronics. • List the Applications of mechatronics.	Introduction to mechatronics systems. Basic building blocks of mechatronic Systems. Mechatronics key elements, Mechatronics in home, office and industry automation, Scope of Mechatronics. Advantages of Mechatronics. Mechanical Engineering and Machines in Mechatronics. Mechatronic systems applications in Manufacturing, smart robotics.	10	12

VI. LIST OF PRACTICAL EXERCISES

1) Discuss Forging and rolling methods with the help of Videos.
2) Visit and discuss about press tools in press shop.
3) Discuss and demonstrate working of Blanking, Piercing tools
4) Draw a sheet for Blanking and Piercing Tools
5) Discuss and demonstrate working of Moulds
6) Draw a drawing sheet for hand mould.
7) Visit injection Moulding Shop to understand working of Injection Mould.
8) Demonstration of five axis robot.

VII. REFERENCE BOOKS

Sr.No.	Author	Title	Publication
1	Hajara Choudhury, S.K. Hajara Choudhury,A.K.	Elements Of Workshop Technology Vol I : Manufacturing Process	Media Promoters & Pub.Ltd.
2	Duvall,Barry	Contemporary Manufacturing Processes	The Good Heart Willcox Co.
3	Raghuwanshi,B.S.	A Course In Workshop Technology Vol 1 : Manufacturing Processes	Dhanpat Rai & Sons
4	Mahajan, M.S. Matani,A.G.	Advance Manufacturing Process (With CNC Machine)	Vrinda Publication
5	Khobare, V. K.	Basic Electronics And Mechatronics	Nirali Prakashan
6	Bolton, W.	Mechatronics : Electronic Control Systems In Mechanical And Electrical Engineering	Pearson Education

M4-02: POWER ELECTRONICS

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	4	3	60	60	40	40	200

II. COURSE RATIONALE

To enhance knowledge and understanding of power electronic converter and their application in power electronics system. To provide students with the skill and techniques necessary to analyse and synthesise power electronic circuits. Applications include electronics power supplies, aerospace and vehicular power system, and renewable energy system

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

Students will be able to:

1. Understand construction and operating principle of various power electronic devices.
2. 2. Study construction and operation of controlled rectifiers, choppers, inverter, and industrial control circuits.

IV. COURSE OUTCOMES

1. Student should be able to identify various power electronics component
2. Student should understand construction and working principle of various power electronics component

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	Power electronics	Student should be able to • Understand about power electronics concept. • Analyze about various power electronics component • Understand for operating principle of MOSFET, IGBT and other power devices	Introduction to power electronics. Power transistor: Construction, Operating Principle, V-I characteristics and Uses of power transistors. Power MOSFET- Construction, Operating Principle, V-I characteristics and Uses of Depletion and Enhancement type power MOSFET. IGBT-Construction, Operating Principle, V-I characteristics and Uses of IGBT.	8	8
2	Thyristor Family Devices	Student should be able to • Analyze thyristor family devices • Understand the working principle, V-I characteristics of thyristor family component. • Understand application of SCR, LASCR, SCS, GTO & TRIAC	SCR: Construction, Operating Principle with Two transistor analogy, V-I characteristics, Latching Current (It) and Holding Current (I_H). Thyristor family devices LASCR, SCS, GTO and TRIAC: Construction, Operating Principle, V-I characteristics and applications. Triggering Devices-Construction, Operating Principle, V-I characteristics and applications of UJT, PUT, SUS, SBS and DIAC. Applications of SCR, LASCR, SCS, GTO and TRIAC.	8	10
3	Turn ON and Turn OFF methods of SCR	Student should be able to • Understand the turn ON mechanism of SCR. • Analyze triggering in SCR • Understand the turn OFF mechanism of SCR, by using class-A, class-B, class-C commutation circuit.	Concept of Turn ON mechanism of SCR: High Voltage triggering, thermal triggering, Illumination triggering, dv/dt triggering Gate triggering of SCR. Gate trigger circuits - Resistance triggering circuit, Resistance Capacitance triggering circuit (Operation, applications and limitations) SCR triggering using UJT, PUT-Relaxation Oscillator circuit and Synchronized UJT triggering circuit: (Operation and applications). Pulse transformer used in triggering circuit (Operation and applications). Concept of Turn OFF mechanism and methods of - Class A-Series resonant commutation circuit, Class B-Shunt resonant commutation circuit, Class C Complimentary Symmetry commutation circuit	8	12

4	Phase controlled Rectifiers	Student should be able to • Understand concept of phase control • Analyze rectifier. • Understand concept freewheeling DIODE.	Concept of phase control. (Firing Angle and conduction angle). Circuit diagram, working, equations for and Waveforms of V_{DC} of following rectifiers. Single phase half wave controlled rectifier with R, RL load. Effect of freewheeling diode. Single phase centre tapped full wave controlled rectifier with R, RL load. Effect of freewheeling diode. Single phase Bridge type full wave controlled rectifier with R, RL load. Effect of freewheeling diode. Basic three phase half wave uncontrolled and controlled rectifier. Need and Uses of Polyphase rectifier.	6	16
5	Converters	Student should be able to • Understand concept of chopper • Analyzes working of INVERTER with its application. • Understand classification of INVERTER.	Concept of Choppers, Chopper: basic circuit and its operation using MOSFET, Step Up and Step down Chopper using MOSFET basic circuits. Inverters-Need of an inverter, Classification of inverters important applications of inverter. Working principle of single phase half bridge inverter. Definitions of performance parameters of inverter.	6	8
6	Industrial Control Circuits.	Student should be able to • Understand concept of industrial control circuit. • Describe low power DC flasher.	Low power DC flasher. Light dimmer circuit using DIAC-TRIAC. Electronic timer using SCR. UPS, SMPS, Battery charging ckt.	4	6

VI. LIST OF PRACTICAL EXPERIENCES

1. Study and Plot V-I characteristics of MOSFET.
2. Study and plot V-I characteristics of SCR.
3. Determine latching current and holding current using V-I characteristics of SCR.
4. To study the V-I characteristics of DIAC with positive and negative biasing and plot the curve between V and I.
5. To study the V-I characteristics of TRIAC with positive and negative biasing and plot the curve between V and I.
6. Study of the characteristics of JFET in common source configuration and evaluate.
7. Draw the output waveform of half wave controlled rectifier with resistive load and determine load voltage.
8. Study of STEP-UP CHOPPER with resistive load.
9. Study of STEP-DOWN CHOPPER with resistive load.

VII. REFERENCE BOOKS

Sr.No.	Author	Title	Publication
1	Bose, B. K.	Modern Power Electronics : Evolution, Technology & Application	Jiaco
2	Moorthi,V.R	Power Electronics : Devices Circuits And Industrial Application	Oxford University Press
3	Rashid.Muhammadh	Power Electronics : Devices Circuits And Application	Pearson Education
4	Agrawal,Jai.P	Power Electronic Systems : Theroy And Design	Pearson
5	Erickson,Robert.W Makesimovic,Dragan	Fundamental Of Power Electronics	Springer
6	Bossche,Alex Van Den	Introduction And Transformers For Power Electronics	Taylor & Francis
7	Kassakian,John G Schlecht, Martin	Principles Of Power Electronics	Pearson Education

M4-03: MICROCONTROLLER PROGRAMMING

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	6	3	60	60	40	40	200

II. COURSE RATIONALE

Knowledge in the field of microcontrollers very essential for the students of this branch. This course covers programming and application of 8051 microcontroller

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

Students will be able to:

1. Understand the execution of instructions and addressing modes.
2. Write syntax of given instructions.
3. Apply instructions in Assembly Language Program for different problem statements.
4. Write programs in embedded c.

IV. COURSE OUTCOMES

Students will be able to:

1. Understand working of microcontroller
2. Understand the execution of instructions and addressing modes.
3. Write syntax of given instructions.
4. Apply instructions in Assembly Language Program for different problem statements.
5. Write programs in embedded c.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
UNIT NO-1	Introduction to Microcontroller	Student should be able to • Define Microcontroller. • differentiate between Microcontroller and Microprocessor • Describe the internal architecture of 8051 Microcontroller, Block diagram of 8051 and pin diagram of 8051 Microcontroller. • Understand the importance of signed and unsigned number concept. • Understand the Arithmetic operation instruction, logic and compare instruction, Jump instruction and call instruction.	Basic of Microcontroller Introduction to microcontroller 8051 Arithmetic instruction Signed number concept and arithmetic operation Logic and compare instruction Jump loop and call instruction	12	20
UNIT NO-2	Addressing modes and assembly language programming	Student should be able to • Understand the operand, opcodes, assembler and assembly language programming. • Describe the data types in 8051 and directives.	Introduction to 8051 assembly programming Assembling and running an 8051 program 8051 data types and directives Flag bits and PSW register Addressing modes	10	15

		• Draw program status word register (PSW) and must explain the flag bits in PSW. • Understand the importance of flag bits in the PSW register for the conditional execution instruction. • Describe the different addressing modes in 8051. • Write the program in assembly language.	I/O programming of 8051		
UNIT NO-3	Programming in embedded C	Student should be able to • Write the program in embedded c • Define the ports of 8051 and how to make it input and output port. • Develop the program for various peripheral devices such as LED, Seven Segment Display, LCD etc.	Data types and time delay in 8051C I/O programming of 8051C Logic operation in 8051C Data conversion programs in 8051c	6	10
UNIT NO -4	Peripheral of 8051	Student should be able to • Develop the program for timer in assembly language and embedded c. • Develop the program for serial port programming in assembly and embedded c. • Understand interrupts in 8051 Microcontroller.	Timer programming in assembly and c Serial port programming in assembly and c Interrupts in 8051	12	15

VI. LIST OF PRACTICAL EXPERIENCES

1. TASK FOR SIMULATION

a) Write an instruction to copy 41h to accumulator register.
b) Write a program to copy the content of accumulator into R0 register
c) Write a program to add two 8 bit numbers.
d) Write a program to subtract 18H from 47H.

2. TASK ON LED'S

ASSEMBLY LANGUAGE PROGRAM

a) Write an assembly language program to on all 8 LED's continuously by using port0.
b) Write an assembly language program for on/off all 8 LED's continuously.
c) Write an assembly language program to on off alternative LED's continuously.

3. TASK ON SEVEN SEGMENTS

ASSEMBLY LANGUAGE PROGRAM

a) Write an assembly language program for display 0 to 9 numbers on seven segment display (up counter).
b) Write an assembly language program for display 9 to 0 numbers on seven segment display (down counter).
c) Write an assembly language program for display 1234 constantly at 4 seven segments.
d) Write an assembly language program for interface led's and seven segment display. Take led's as our output Machine and seven segment for display the how much machines are on. If 1st led is on then seven segment Display one, when two LEDS are on the two will be display at seven segment and so on.

4. TASK ON LCD DISPLAY

ASSEMBLY LANGUAGE PROGRAM

a) Write an assembly language program for display "AB" at first line of LCD.
b) Write an assembly language program for display "12" at second line of LCD

c) Write an assembly language program for display “MSME” at first line and “BHOPAL” at second line of LCD.

5. TASK ON SWITCHES

ASSEMBLY LANGUAGE PROGRAM

a) Write an assembly language program to interface “no” switch with microcontroller, when we press no switch All LEDs will be glow and stay on. (Latching)
b) Write an assembly language program to interface “no” switch with microcontroller, when we press no switch All LEDS will be glow and after releasing it will off. (Etching)
c) Write an assembly language program to interface “NC” switch, when we press “NC” switch all LEDs will be glow And stay on. (Latching)

6. TASKS ON C PROGRAMMING

LEDS PROGRAM
EMBEDDED C LANGUAGE PROGRAM

a) Write an embedded c program to on all 8 LEDS continuously by using port0.
b) Write an embedded c program for on/off all 8 LEDS continuously
c) Write an embedded c program to on off alternative LEDS continuously.

7. SEVEN SEGMENTS PROGRAM

EMBEDDED C LANGUAGE PROGRAM

a) Write an Embedded C program for display 0 to 9 numbers on seven segment display (up counter).
b) Write an Embedded C program for display 9 to 0 numbers on seven segment display (down counter).
c) Write an Embedded C program for display 1234 constantly at 4 seven segments.
d) Write an Embedded C program for interface LEDS and seven segment display. Take LEDS as an output machine And seven segment for display the how much machines are on. If 1st led is on then seven segment display one, When two LEDS are on the two will be display at seven segment and so on.

8. LCD PROGRAM

EMBEDDED C LANGUAGE PROGRAM

a) Write an Embedded C program for display “AB” at first line of LCD.

b) write an Embedded C program for display “12” at second line of LCD

c) Write an Embedded C program for display “MSME” at first line and “BHOPAL” at second line of LCD.

9. HEX KEYPAD PROGRAM

EMBEDDED C LANGUAGE PROGRAM

a) Write a program to interface Hex keypad with LED’s using Microcontroller 8051.

b) Write a program to interface Hex keypad with SEVENSEGMENT’s using Microcontroller 8051.

10. TIMER PROGRAM

EMBEDDED C LANGUAGE PROGRAM

a) Write a C program to On/Off all eight LEDs after the delay of 1 second.

b) Write a C program to interface no switch, led and LCD. When you press NO switch led L1 glow and stay on for 3 Second and after 3 second LCD display that “your Output is off.

11. 11. UART

EMBEDDED C LANGUAGE PROGRAM

a) Write an Embedded C program for UART, to Receive Data from PC to microcontroller and transfer data from Microcontroller to PC.

VII. REFERENCE BOOKS

Sr.No.	Author	Title	Publication
1	Mazidi, Muhammad Ali Mckinlay, Rolind, D.	The 8051 Microcontroller And Embedded Systems Using Assembly And C	Pearson
2	Ayala, Kenneth	The 8051 Microcontroller	Cengage Learning- I Pvt Ltd
3	Kothari, D. P. Vasudevan, S. K.	Analysis Of Microcontrollers	Scientific Int. Ltd.
4	Bakwad, K. M.	Advanced Processors & 8051 Microcontroller	Nikita Publication
5	Kothari, D. P.	Analysis Of Microcontrollers	Medtec
6	Ghoshal, Subrata	8051 Microcontroller	Pearson Education
7	Mazidi, Muhammad Ali Mickinay, Rolind.D	PIC Microcontroller And Embedded Systems: Using Assembly And C For PIC 18	Pearson Education

M4-04: METROLOGY & QUALITY CONTROL

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARK
2	2	3	60	-	40	50	150

II. COURSE RATIONALE

Metrology & quality control Strength of Material is a core technology subject. It aims at enabling the student to understand & analyse various types appropriate instrument/s for specific measurement. It includes the topics Metrology Basics, Standards and Comparators, Limits, Fits ,Tolerances and Gauges, Angular Measurement, Screw thread Measurements, Gear Measurement and Testing, Measurement of surface finish, Machine tool testing, Quality Control Quality , Total Quality Management, ISO 9000 Series &other standards, Statistical Quality Control, Acceptance Sampling. Understanding measurement quality control will help in the good measurement, quality control for various engineering applications.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

- Define accuracy, precision, calibration, sensitivity, repeatability and such relevant terms in metrology.
- Select appropriate instrument/s for specific measurement.
- Analyse and interpret the data obtained from the different measurements processes and present it in the Graphical form, statistical form.
- Construct and draw the control charts.
- Understand ISO certification procedure and quality system.

IV. COURSE OUTCOMES

Student will able learn how to define accuracy, precision, calibration, sensitivity, repeatability and such relevant terms in metrology. Measurement is the most important in the field of engineering they will get a good knowledge of appropriate instrument/s for specific measurement & Analyse and interpret the data obtained from the different measurements processes and present it in the graphical form, statistical form. Student also get idea about ISO certification procedure and quality system.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	**Metrology Basics**	Student should be able to • Describe need of inspection • Define Precision, Accuracy, Sensitivity • Understand the precaution taken while using an instruments	**Definition of metrology**, Categories of metrology, Scientific metrology, Industrial metrology, Legal metrology, Need of inspection, Revision of (no questions be set) - Precision, Accuracy, Sensitivity, Readability, Calibration, Traceability, Reproducibility, Sources of errors, Factors affecting accuracy, Selection of instrument, Precautions while using an instruments for getting higher precision and accuracy.	4	8
2	**Standards and Comparators**	Student should be able to • Describe and explain line standards. • Explain use and manufacturing of Slip gauges • Demonstrate and use of Slip gauges • Explain and demonstrate various gauges • Calibrate and explain Calibration of line standards • Understand and demonstrate comparators like multi angle, sigma comparators	**Definition and introduction to line standard**, end standard, Wavelength standard, Slip gauge and its accessories, Length bars. Definition, Requirement of good comparator, Classification, use of comparators, Working principle of comparators, Dial indicator, Sigma comparator, Pneumatic comparator, Electrical, Electronic, Relative, advantages and disadvantages.	6	8
3	**Limits, Fits ,Tolerances and Gauges**	Student should be able to • Understand Concept of limits • Understand Taylor's principles of gauge design • Demonstrate and use of Ring gauges • Explain and demonstrate multi gauging and inspection	**Concept of Limits, Fits, And Tolerances,** Selective Assembly, Interchangeability, Hole And Shaft Basis System, Taylor's Principle, Design of Plug, Ring Gauges, 1S919-1993 (Limits, Fits & Tolerances, Gauges IS 3477-1973, concept of multi gauging and inspection.	4	8

4 5	**Angular Measurement**	Student should be able to • Understand Concept of Angular, Measurements • Understand Working And Use of Universal Bevel Protractor Demonstrate and use of Ring gauges	**Concept, Instruments For Angular, Measurements**, Working And Use of Universal Bevel Protractor, Sine Bar, Spirit Level, Principle of Working of Clinometers, Angle Gauges (With Numerical on Setting of Angle Gauges).	4	8
	Screw thread Measurements & Gear Measurement and Testing	Student should be able to • Evaluate and do analysis of parameters of screw threads • Identify and understand pitch errors • Determine and describe various methods of measurements of gear terminology	ISO grade and fits of thread, Errors in threads, Pitch errors, Measurement of different elements such as major diameter, minor diameter, effective diameter, pitch, Two wire method, Thread gauge micrometer, Working principle of floating carriage dial micrometer. Analytical and functional inspection, Rolling test, Measurement of tooth thickness (constant chord method), gear tooth Vernier, Errors in gears.	8	10
6	**Quality Control & Total Quality Management**	Student should be able to • Define and describe Quality Characteristics • Explain concept of Reliability • Understand and differentiate the function of QA , QC • Perform Quality audit	Definitions, meaning of quality of product &services, Quality characteristics, Quality of design, Quality of conformance, Quality of performance, Concept of reliability, Cost, Quantity assurance, Cost of rework &repair, Quality &Inspection, Inspection stages. Principles and concept of total quantity management Quality Audit: Concept of audit practices, lead assessor certification. Six sigma: Statistical meaning, methodology of system Improvement.	8	10
7	**ISO 9000 Series &other standards**	Student should be able to • Explain ISO quality series • Describe Elementary statistics	Concept, ISO 9000 series quality standards, QS14000, Standards in general, Its evaluation & Implications, necessity of ISO certification, other Quality systems. Elementary Statistics & it's application in quality control	6	8

VI. LIST OF PRACTICAL EXERCISE

Experiment No. 1	Standard use of basic measuring instruments. Surface plate, v-block, sprit level, combination set, filler gauge, screw pitch gauge, radius gauge, Vernier caliper, micrometer and slip gauges to measure dimension of given jobs.
Experiment No. 2	To find unknown angle of component using sine bar and slip gauges.
Experiment No. 3	Study and use of optical flat for flatness testing.
Experiment No. 4	Measurement of screw thread elements by using screw thread micrometer, screw pitch gauge.
Experiment No. 5	Study and use of dial indicator as a mechanical comparator for run out measurement, roundness comparison.
Experiment No. 6	Measurement of gear tooth elements by using gear tooth venire caliper and verification of gear tooth profile using profile projector.
Experiment No. 7	Testing of machine / machine tool for flatness, parallelism, perpendicularity by Dial indicator.
Experiment No. 8	Draw the frequency histogram, frequency polygon for given samples (min 5o readings) and find mean, mode, median.
Experiment No. 9	To draw the normal distribution curve and find standard deviation, variance, and range.
Experiment No. 10	To draw and interpret the control limit for variable measurement (X - bar and R -chart).

VII. REFERENCE BOOKS

Sr.No.	Author	Title	Publication
1	Jain,R.P.	Engineering Metrology	Khanna Publishers
2	Mahajan,R.D.	Metrology And Quality Control	Nirali Prakashan
3	Dotson, Connie	Fundamentals Of Dimensional Metrology	Thomson
4	Bucher Jay	A Laboratory Manual For Metrology And Quality Control	MSBTE
5	Narayan K.L	Metal Working And Metrology	Sci-Tech Publication

M4 – 05: C PROGRAMMING

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARK
2	6	3	60	60	40	40	200

II. COURSE RATIONALE

C Programming is basic computer programming. It includes the topics Operators, if statement, Loop Control, Arrays, string, Basics of a function, Structures, Graphics introduction. C's compactness and coherence is mainly due to the fact that it's a one man language. C's known as middle level language .It was designed to have both: a relatively good programming efficiency (as compared to Machine oriented languages) and a relatively good machine efficiency (as compared to problem oriented languages).

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

Students will able to.

- Learn programming concepts and methodology
- Learn standard, sequential, decision and iterative structures of programming language
- Write, debug, compile and execute the programs -
- Write programs for hardware interfacing.
- Design graphics using standard geometrical shapes and graphic functions
- Handle text and binary files for real life applications

IV. COURSE OUTCOMES

Students will able to learn programming concepts and methodology of C programming. Learn standard, sequential, decision and iterative structures of programming language. Also learn how to debug, compile and execute the programs write programs for hardware interfacing. Design graphics using standard geometrical shapes and graphic functions & handle text and binary files for real life applications.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	**Getting Started with C**	Student should be able to • Understand history of c language. • Describe the concept of Keywords, constant, • Variable & character set. • Describe Concept of C Operators. • Learn programming concept and methodology of C programming.	**History of C,** Features of 'C', advantages of 'C', assembler, compiler, interpreter, structure of' C' program **Character set, keywords**, **constants, variables**, rules of variables, data type-declarations, initializations, assignments, memory sizes, formatting characters and minimum/maximum values for each data types, type modifiers, type conversion **Operators** (arithmetic, Logical, assignment, relational, increment and decrement, conditional, bit wise, special operators) precedence, expressions, formatted input and output statements.	12	15
2	**The Decision Control Structure**	Student should be able to • Describe function of loops & decision making statements. • Choose the loops and decision making statements to solve the problems.	**Decision making and branching: if statement** (if, if-else, if-else-if ladder, nested if-else), switch statement. **Loop Control**: What is loop, why to use loops, pre-test and post-test loops, while, do-while and for loops, nested loops, break and continue statement	6	10
3	**Arrays & Strings**	Student should be able to • Explain Declaration of array, size of array. • Describe initialization one dimensional, two dimensional arrays. • Implement different operation on array. • Describe string initialization functions & implement different standard library of strings function.	**Arrays:** Declaration, initialization of one dimensional, two dimensional arrays, size of array, memory allocation of array, accessing array elements using index. Operations such as searching and sorting of array. **Declaration and initialization of string variables**, string handling functions from standard library (strlen (), strcpy (), strcat (), strcmp ()).	6	10

4	**Function & Structures**	Student should be able to • Explain Function definition, uses of functions & variables. • Describe function call, passing arguments to functions, different between call by value & call by reference. • Use function to solve the given problems. • Describe pointer, Structures & unions.	**Basics of a function**, Need of functions, How function works, Function definition, internal and external variables, scope and lifetime of variables, function call, passing arguments to functions (call by value, call by reference), return values, storage classes, category of function , Library functions Introduction to pointer, Pointer notation. Recursion, recursion and stack, Programs on pointers **Structures**: Defining structure, declaring and accessing structure members, initialization of structure, arrays of structure.	6	10
5	**Graphics & files**	Student should be able to • Describe initialization of graphics, Basic graphic functions • Describe fonts, patterns, colures & styles of graphics. • Use graphics function solve the given problems. • Explain basic concept of file functions, application of files. • Explain types of flies- text and binary, flies operations- read, write, open, close. • Implement file operation in c programming for a given application.	**Graphics introduction**, Initialization of graphics, using fonts, patterns, colours, styles, filling. Basic graphic functions **Why to use file**, file types-text and binary, file handling-sequential and random, file operations- read, write, open, close, append, basic file functions	10	15

VI. LIST OF PRACTICAL:

(ANY TEN FORM FOLLOWING**)**

EXPERIMENT-1:- Write a C program to print your Name at Screen.

EXPERIMENT-2:- Write a C program to display “MSME” at first line and “Bhopal” at second line of output screen.

EXPERIMENT-3:- Write a program to display Yours Name in double inverted comma.

EXPERIMENT-4:- Print the following output in the middle of the screen.

(Use only \n and \t in printf statement don't use spaces)

```
        *
      * * *
    * * * * *
  * * * * * * *
```

EXPERIMENT-5:- Write a program addition of two numbers.

EXPERIMENT-6:- Take two variables and swap their contents using third temporary variable.

EXPERIMENT-7:- Take two variables and swap their contents without using third temporary variable

EXPERIMENT-8:- Take a four digit number from the user print its reverse

EXPERIMENT-9:- Take a four digit number from the user and print the sum of the digits.

EXPERIMENT-10:- Take a three digit number from the user and print the sum of first and last digit.

EXPERIMENT-11:- Take the marks of five subjects and calculate the total and the average and print it.

EXPERIMENT-12:- Take the radius of the circle and calculate the area of the circle.

EXPERIMENT-13:- Write a C program to check whether given number is even or odd.

EXPERIMENT-14:- Write a C program to check whether given number is positive or negative.

EXPERIMENT-15:- Find out the Largest among three numbers without using the logical operators.

EXPERIMENT-16:- Find out the largest among three numbers using the logical operator.

EXPERIMENT-17:- Take number of items and the price per item from the user and calculate the bill, if total amount is more than 1000 then give 10% discount else no discount, Display the bill.

EXPERIMENT-18:- Take the character from the user and print whether the entered character is vowel or consonant. (Program should be Applicable for both the cases i.e. Upper and Lower case);

EXPERIMENT-19:- Take the basic salary from the user if basic salary is less than or equal to 2000 then

DA=40% and HRA is 20%

If basic salary is greater than 2000 then

DA=60% and HRA is 40%,

Calculate the gross salary.

EXPERIMENT-20:- Take the number from the user up to 10 and print it in words.

EXPERIMENT-21:- Take two numbers from the user and show him the menu of the operations to be performed on these two numbers and ask his choice, operate and display the result. Which has following options:

1. Addition.
2. Subtraction.
3. Average
4. Exit

EXPERIMENT-22:- Calculate the total electricity bill Take number of units consumed from the user.

UNITS	RATE
0-100	2.25
101-500	5.65
501-1000	7.85
1001 onwards	9.30

EXPERIMENT-23:- write a c program for the display first 10 natural numbers using while loop.

EXPERIMENT-24:- Print the sum of first 10 natural numbers.

EXPERIMENT-25:- Take the number from the user and generate the table of given number.

EXPERIMENT-26:- Take the number from the user and print the sum of the digits.

EXPERIMENT-27:- Take the number from the user and print it in reverse order.

EXPERIMENT-28:- write a program to print the all even numbers from 0 to 30.

EXPERIMENT-29:- Print the sum of first 100 even numbers.

EXPERIMENT-30:- Take the number from the user and check whether the entered number is prime or not.

EXPERIMENT-31:- Print the Fibonacci series.

EXPERIMENT-32:- Take the number from the user and reverse it and check whether it is same as the number.

EXPERIMENT-33:- Print the series of numbers up to 10000 whose sum and the product of the digits is same.

EXPERIMENT-34:- Take the input of 10 numbers from the user and print those numbers in the reverse order.

EXPERIMENT-35:- Take the input of 10 numbers from the user and print square of the numbers in the same array.

EXPERIMENT-36:- Take the input of 10 numbers from the user finds the smallest and the largest number among these numbers.

EXPERIMENT-37:- Take the input of 10 numbers from the user and print how many positive, negative, even and odd numbers are present in the given array.

EXPERIMENT-38:- Take the input of 10 numbers from the user and print those numbers in the ascending order.

EXPERIMENT-39:- write a program to enter elements for 3x3 matrix and display them.

EXPERIMENT-40:- Take two 2D-arrays from the user and subtract them and store the result in the third array.

EXPERIMENT-41:- Take two 2D-arrays from the user and add them and store the result in the third array.

EXPERIMENT-42:- write a program for calculating the multiplication of 2 dimensional Array.

EXPERIMENT-43:- Take two matrices of 3 x 3 order and multiply them and store in the third matrix.

EXPERIMENT-44:- Take one matrix of 3 x 3 order and print it in the ascending order.

EXPERIMENT-45:- write a c program to enter roll number and total mark of 5 students and on the basis of roll number of any student print mark of respective entered roll number student (by using 2 Dimensional Array)

EXPERIMENT-46:- Write a program to find the frequency of characters in a string. (Enter any string and checks how many times a character is repeated in the string)

EXPERIMENT-47:-Write a program that converts all lowercase characters in a given string to its equivalent uppercase character.

EXPERIMENT-48:- Write a program to determine the length of string enter though keyboard.

EXPERIMENT-49:- Write a program to exchange the content of two strings.

EXPERIMENT-50:- take two strings from keyboard and copy second string at the end of first string.

EXPERIMENT-51:- Take one string from the user and check whether the given string is palindrome or not.

EXPERIMENT-52:- Take two strings and check whether they are of equal length or not.

EXPERIMENT-53:- Send the number into the function and print the Cube of a number in the function itself.

EXPERIMENT-54:- Send the number into the function and print the Cube of a number in the main function.

EXPERIMENT-55:- A four digit positive integer is entered through keyboard, write a function to calculate sum of the digit.

EXPERIMENT-56:- Write a function to calculate factorial of a number.

EXPERIMENT-57:- Send the radius of 5 circles in the function and print the area of those circle in the main function.

EXPERIMENT-58:- Create a variable and assign it some value then print the value address of that variable and the value at that address.

EXPERIMENT-59:- Take two numbers from the user and add them using the pointers and print the result. (Don't use name of variables even in scanf and printf statements only use pointers.)

EXPERIMENT-60:- Take two numbers from the user and swap them using the pointers.

EXPERIMENT-61:- write a program to generate the table of any given number by using function call by reference.

EXPERIMENT-62:-write a program for swapping the contents of two variable by using function call by reference.

EXPERIMENT-63:- take 5 number from keyboard and calculate the square of those number.

EXPERIMENT-64:- take any two number from keyboard and display the GCD number of those number.

EXPERIMENT-65:- take any digit number form keyboard and display the reverse number of entered number.

EXPERIMENT-66:- Create a structure of an employee having the name, code, designation and the basic salary.

EXPERIMENT-67:- In the above program list all the employees whose basic salary is more than 5000.

EXPERIMENT-68:- For the above program take the name of employee from the user and check whether the given employee is present in the list or not, if present display all the details, else give message employee not present.

EXPERIMENT-69:- Create a structure to specify data on students given below:

Roll number, Name, Year of joining

Assume that there are not more than 8 students in the class.

(a) Write a function to print names of all students.

(b) Write a function to print the data of a student whose roll number is given.

EXPERIMENT-70:- Create a structure to specify data of customers in a bank.

The data to be stored is:

Account number, Name, Balance in account.

Assume maximum of 10 customers in the bank.

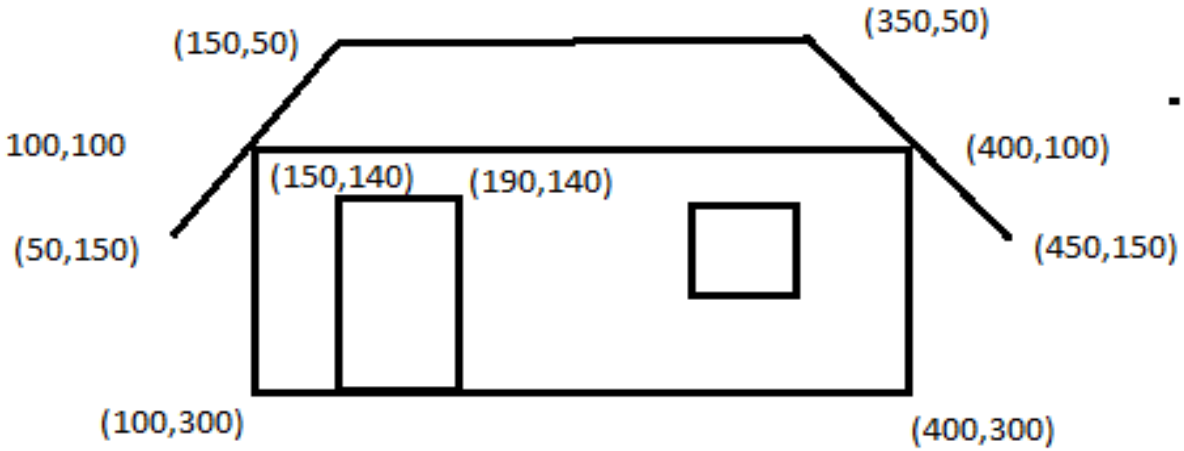
Write a function to print the Account number and name of each customer with balance below Rs. 100.

EXPERIMENT-71:- write a C program to draw a line parallel to x-axis.

EXPERIMENT-72:- write a C program to draw circle with center coordinates (100,100) and radius 80.

EXPERIMENT-73:- write a C program to draw cylinder at output screen.

EXPERIMENT-74:- write a C program to draw following graph at output screen.



EXPERIMENT-75:- Create a file on the DOS using dos commands and write few lines in that file. Read the file through a C program.

EXPERIMENT-76:- Create a file with the C program and read the contents with the help of C program.

EXPERIMENT-77:- Create a file, write few lines in the file and the contents into another file.

EXPERIMENT-78:- Generate a table of the given number and store it in the file and read it with the help of C program.

VII. REFERENCE BOOKS

Sr.No.	Author	Title	Publication
1	Yashavant Kanetkar	Let US C	BPB Publications
2	E Balgurusamy	Programming in ANSI C	Mc Graw Hill
3	Dixit, J.B.	Mastering C Programs	Fire Wall Media

M4 – 06: PROFESSIONAL PRACTICES & MINI PROJECT

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARK
-	8	-	-	-	-	100	100

II. COURSE RATIONALE

The purpose of introducing Professional practices is to fulfil the need of students to stand in today's global market with knowledge and confidence. Practical aspects of engineering can be learned through industrial visits, industry expert lectures, seminars, searching alternative solutions and validation of the selected alternatives. Subject like professional practices allow the students to think independently using integrated knowledge of various subjects and give opportunity of working with their own hands. The exercises included in this subject are useful to create social awareness and developing them into good citizens of tomorrow.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

Student will be able to:

1. Acquire information from different sources.
2. Prepare notes for given topics
3. Present seminar using power projection system.
4. Interact with peers to share thoughts.
5. Work in a team and develop team spirit.

IV. COURSE OUTCOMES

Practical aspects of engineering can be learned through industrial visits, industry expert lectures, seminars, searching alternative solutions and validation of the selected alternatives. Subject like professional practices allow the students to think independently using integrated knowledge of various subjects and give opportunity of working with their own hands.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	Information search	Students should be able to • Identify the use of technology in the market. • Learn to do team work. • Communicate with the traders, supplies, and etc.	1. Information search: Information search be made through manufacturers catalogues, suppliers, traders, workshops, journals & websites etc. and submit a report on given topic in a group of 3 to 4 students. Report size shall be around 7 – 10 pages.	8	100
2	Lectures by professionals / industry experts	Students should be able to • Understand the working of an organization. • Explain the importance of mechatronics diploma engineers. • Visualize growing industries in India and opportunities in the field of mechatronics	2. Lectures by professionals / industry experts Two lectures of 2 hour duration are arranged on any two topics suggested below or any other suitable topics so that the students get oriented to the industrial environment & Working. Students are required to prepare a brief report of each lecture as a part of their Term work. i) Organizational structure, various functional departments & their inter relations, types of products manufactured or services provided. ii) Role of mechatronics diploma engineers in an organization, responsibilities to be taken and future scope. iii) Work culture iv) Industrial growth in India and new opportunities & avenues available to mechatronics diploma engineers. v) Time management vi) Developing product quality & reliability vii) Creative & innovative thinking approach viii) Personality Development ix) Interview technique / group discussion technique x) E – banking – credit card, debit card, ATM operation	8	

			Any suitable as per recent trends in technology.		
3	Group Discussion	Students should be able to • Gain confidence and courage to speak in front of group. • Aware current social conditions. • Understand the need of friendly solution to social issues.	3. Group Discussion – One exercise Group discussions on any one of the following topics are suggested or any other general / social /educational / technology related topics. Group size - divide practical batch into Groups of 7 to 10 students, time for group discussion 15 to 20 minutes. i) Current topics from news papers / T.V. news related to social, education & technology Students should prepare a report on salient points discussed on the topic & summarize Concluding remarks.	48	
4	Seminar	• Gain confidence and courage to speak in front of group.	4. Seminar Seminar on any one topic specified in the list given below or any topic suggested Under information search & expert lecture. Time for presentation – 10 minutes per group of 2 to 3 students, Prepare power point presentation and submit seminar notes not more than 10 pages Mentioning source of information – books, magazines, journals, websites, surveys, etc. Topics – recent trends in mechatronics and automation technology.	48	
5	Industrial Visits	Students should be able to • Know the industrial environment and organizational structure. • Identify materials used and the process in the manufacturing products. List the material and equipment required.	5. Industrial Visits Structured industrial visits are arranged and report of the same be submitted by the individual student to form a part of the term work. No of visits – at least one Scale of industry – Small scale unit, medium scale unit Group size – practical batch containing not more than 20-25 students, Report 2 to 5 pages.	8	

			Purpose – a. Get familiar with industry environment b. Know the organizational structure c. Working of functional departments & their inter relation d. Products manufactured, services provided e. Identification of materials used and material flow from raw materials to finished products f. Study the production processes & types of machines used g. Layout of machinery & equipment's in general h. List of material handling equipment		
6	Individual Assignments & mini project	Students should be able to • Importance of topics studied in different subjects. • Explain the application of subjects so far studied.	6. Individual Assignments & mini project Any two assignments from the list suggested based on the subjects in the 4th semester (Any other suitable assignments may be chosen) Mini project.	24	
7	Socially Relevant activities	Students should be able to • Give seminar presentation. • Understand the use of different sources of information.	7. Socially Relevant activities Conduct **any one activity** through active participation of students & write the report Group of students – maximum 4 Report – not more than 6 pages List of suggested activities – (Activities may be thought in terms of campus) i) Go green movement ii) Literacy camps iii) Building ethical & moral values iv) Conservation of electrical energy v) Water conservation vi) Clean campus / city vii) Awareness to avoid use of plastic carry bags viii) Educating students / people about firefighting equipment ix) Rain water harvesting x) Traffic management within campus / city.	16	

MSME TECHNOLOGY CENTRE BHOPAL

(A Government of India Society under Ministry of Micro, small and medium enterprises)

FIFTH SEMESTER: COURSE DETAILS

DIPLOMA IN MECHATRONICS

M5-01: CNC PROGRAMMING & MACHINING

I. SCHEME OF TEACHING & EVALUATION:

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	6	3	60	60	40	40	200

II. COURSE RATIONALE :

People working in the production field require specialized technical skills and knowledge which combine some hand skills and an understanding of machining processes with more intensive production methods, greater control over the accuracy of dimensions and the maintenance of quality standards. CNC technology is one of the leading technologies in mechanical processing of metals and non-metals. CNC stands for Computer Numerical Control and it means a computerized guidance of the machine system. The prerequisite for computer control of a CNC machine is a program that can be programmed in several ways.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES :

Students will be able

- To have a knowledge of NC & CNC
- To know the principal of NC&CNC
- To know the knowledge of design of CNC machine structure and feedback devices, axes identification.
- To have a knowledge of different types of cutting tool materials, holders, ATC.
- To have knowledge of CNC manual programming, job planning, cut planning.

IV. COURSE OUTCOMES :

Students will be able

- To have a knowledge of NC & CNC
- To know the principal of NC&CNC
- To know the knowledge of design of CNC machine structure and feedback devices, axes identification.
- To have a knowledge of different types of cutting tool materials, holders, ATC.
- To have knowledge of CNC manual programming, job planning, cut planning.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	**INTRODUCTION TO COMPUTER NUMERICAL CONTROL**	Student should be able to:- • Define NC & CNC. • Write about Historical development of CNC technology & classification. • Explain uses of CNC machine tool. • Write down Advantages & Disadvantages of conventional, NC & CNC. • Identification Axis & Classification of NC system	Introduction, History of CNC Machine, Elements of CNC Machine, Scope & Need of CNC, Advantages & Disadvantages of CNC, Objective of CNC, Diff. Between Conventional NC & CNC, Numerical control, Numerical control modes, Numerical control elements, NC machine tools	4	4
2	**CNC lathe**	Student should be able to:_ • Write the Procedure of start the lathe machine. • Explain about the control panel. • Define the axes principle of lathe machine. • Propose of using Hand wheel function. • Write the procedure of Work holding device, tool holding device, work piece references. • What do you understand homing process. • Describe the homing process in different modes. • Understand the tool selection & how to set the tool. • Need of cutter compensation. • Prepare the part programming by using G & M codes.	Introduction Of Cartesian Coordinate System, Types of positioning Reference point system, Types of Motor, Circulating Ball Screws Mechanism, CNC Machınes Feedback Devıces, Meaning of G-codes & M-codes in CNC Lathe Machine & its use, Introduction of CNC Lathe, Principle Of Lathe Machine, Different Types of Operation, Types of CNC Lathe, Description, Main parts and Function of Machine, Work holding Devices used On CNC Lathe, Tool holding Devices used On CNC Lathe. Types of Cutting Tool Holders, Classification Cutting Tool Holder & its use, Specification Of Cutting Tool Holder, Explain Different Types of Carbide Cutting Tools & Its Material, Specification Of Cutting Insert & its use, Define Cutting Speed, Feed, Depth of cut, Calculation of machine parameter and Cutting parameters, Concept of Tool Radius Compensation, Explain Different types of Geometrical Symbols, Machine Symbols used in Drawing Take Safety	6	10

		• Different types of cycle. • Calculate the RPM for the various materials. • Different errors while programming & machining. • Write safety precaution for machining.	Precautions During work on Machine/CNC Shop floor		
3	**CNC HARDWARE BASICS**	Student should be able to:_ • Understand Structure of CNC machine tool • Describe Spindle design • Understand actuation system.	Structure of CNC machine tools, Spindle design, Drives, Actuation systems, Feedback devices	4	4
4	**CNC TOOLING**	Student should be able to:_ • Understand Cutting tool materials • Describe Milling tooling systems • Explain Automatic tool Changer • Differentiate between ball mill cutter & bull mil cutter • Calculate machine parameter and cutting parameter	Cutting tool materials, Turning tool geometry, Milling tooling systems, Automatic tool changers, Cutting parameters for different types of tools. Explain Difference types of Cutters Used on CNC Milling Machine, Explain Difference Between Ball mill cutter & Bull mill Cutter, Factors for Selection of Carbide Cutter on CNC Milling, Specification Of Cutting Insert & its use, Define Cutting Speed, Feed, Depth of cut, Calculation of machine parameter and Cutting parameters. Concept of Tool Radius Compensation, Explain Different types of	4	8

			Geometrical Symbols used in Drawing, Explain Different Types of zero and reference points on CNC Machine, Take Safety Precautions During work on Machine/CNC Shop floor		
5	**CNC MACHINE TOOLS & CONTROL SYSTEMS**	Student should be able to:_ • Understand High speed machine tools • Describe Machine control units • Explain Touch trigger probes	High speed machine tools, Machine control units, Support systems, Touch trigger probes	2	6
6	**CNC PROGRAMMING**	Student should be able to:_ • Understand Part programming fundamentals • Describe Preparatory functions • Simulate the program	Part programming fundamentals, Manual part programming methods, Preparatory functions, Miscellaneous functions, Program number, Tool length compensation, Canned cycles, Cutter radius compensation, Practice of all programs on the computer using simulation software	6	8
7	**ADVANCED PART PROGRAMMING METHODS**	Student should be able to:_ • Understand Polar co-ordinates • Describe scaling and rotating • Simulate the program • Understand CAD/CAM and its application	Polar co-ordinates, Parameters, Looping and jumping, Subroutines, Mirror imaging, scaling and rotating. Canned cycles, Practice of all programs on the computer using simulation software, CAD CAM and its application.	4	8
8	**CNC Milling**	Student should be able to: • Write the Procedure of start the milling machine. • Explain about the control panel. • Define the axes principle of lathe machine. • Propose of using Remote control function. • Write the procedure of Work holding device, tool holding device, work piece references. • What do you understand homing process.	Meaning of G-codes & M-codes in CNC Milling Machine & its use, Introduction Of Cartesian Coordinate System, Types of positioning Reference point system, Difference Between Absolute mode & Incremental mode, Introduction of CNC Milling, Principle Of Milling Machine, Different Types of Operation, Types of CNC Milling, Description, Main parts and Function of Machine, Work holding Devices used On CNC Milling Tool holding Devices used On CNC Milling Cutter Nomenclature	6	8

		• Describe the homing process in different modes. • Understand the tool selection & how to set the tool. • Need of cutter compensation. • Prepare the part programming by using G & M codes. • Different types of cycle. • Calculate the RPM for the various materials. • Different errors while programming & machining. • Write safety precaution for machining.			
9	**CNC Machine Maintenance**	Student should be able to: • Understand preventive & Breakdown maintenance of CNC machine.	Preventive & Breakdown maintenance of CNC lathe & milling machines, Common problems & its remedies	4	4

VI. LIST OF PRACTCAL EXERSIZES

1. Visit CNC Shop and discuss difference in NC DNC & CNC
2. Demonstrate working of PRE axial and Post axial machining
3. Perform CNC programming on EMCO software for Turning Operation for LATHE
4. Perform CNC programming on EMCO software for Grooving Operation LATHE
5. Perform CNC programming on EMCO software for Threading Operation LATHE
6. Perform CNC programming on EMCO software for Core Machining Operation Milling.
7. Perform CNC programming on EMCO software for Cavity Machining Operation Milling.
8. Perform CNC programming on EMCO software for Peck Drilling Operation Milling.

VII. REFERENCE BOOKS :

Sr. No.	Author	Title	Publication
1	Pabla, B.S.	CNC Machines	Wiley Eastern Ltd.
2	Krar,Steve	CNC Technology And Programming	McGraw-Hill Inc.
3	Pabla, B.S.	CNC Machines	New Age Int. P. Ltd Publishers
4	Bhashyam, A.T.	Introduction To CNC And Ems	All India Council Of Tech. Education
5	Pabla, B.S.	CNC Machines	All India Council Of Tech. Education
6	Jain, R.P.	NC / CNC Machine Tools	All India Council Of Tech. Education
7	Raj,Tilak	CNC Machines And Programming	All India Council Of Tech. Education
8	Biswas, P.K.	CNC	All India Council Of Tech. Education
9	IGTR	CNC Technology (Lathe & Milling)	IGTR

M5-02 INDUSTRIAL HYDRAULICS & PNEUMATIC

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	6	3	60	60	40	40	200

II. COURSE RATIONALE

The concepts of hydraulics and pneumatics are important and indispensable tools in the innovation, circuit design and improvement of engineering processes and devices. Different types of power sources, valves and actuators are essential elements in all the manufacturing industries. This course is designed to develop underpinning knowledge of hydraulic and pneumatic systems which are widely used in machine tools, material handling, automobile, marine, elevators, mining, metal processing equipment and other fields. This course also enable the diploma students to operate and troubleshoot different types of hydraulic and pneumatic systems in industries.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

The student will be able to.

- Identify various components of hydraulic & pneumatic systems.
- Know the working principle of various components used for hydraulic & pneumatic systems.
- Select appropriate components required for simple hydraulic and pneumatic circuits.
- List probable causes of faults or defects in the components of hydraulic & pneumatic circuits.

IV. COURSE OUTCOMES

The student will be able to.

- Identify various components of hydraulic & pneumatic systems.
- Know the working principle of various components used for hydraulic & pneumatic systems.
- Select appropriate components required for simple hydraulic and pneumatic circuits.
- List probable causes of faults or defects in the components of hydraulic & pneumatic circuits.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	Introduction to oil hydraulic systems	Student should be able to • Understand practical application of hydraulic system • Understand structure of hydraulics system • Describe the properties of hydraulics	Introduction to oil hydraulic systems, Practical applications of hydraulic systems. General layout of oil hydraulic systems. Merits and limitations of oil hydraulic systems. Properties of hydraulic fluid -viscosity, demulsibility, lubricity etc.	4	6
2	Components of Hydraulic systems	Student should be able to • List different energy supply elements relate to hydraulics. • Identify the hydraulics power system elements. • Select appropriate elements / components / symbols for the given process. • Select different standard elements • Describe the functioning of different elements, systems • Understand the actuators and its types • Identify different hydraulics accessories	Components of Hydraulic systems Pumps - Vane pump, gear pump, Gyrator pump, screw pump, piston pump Valves - Construction, working and symbols of Pressure control valves - pressure relief valve, pressure reducing, pressure unloading Direction control valves - Poppet valve, spool valve, 3/2, 4/2 D.C. valves, Sequence valves. Flow control valves - pressure compensated, non-pressure compensated flow control valve. Actuators- Construction, working and symbols of Rotary Actuators - Hydraulic motors Linear Actuators - Cylinders - single acting, double acting. Accessories - Pipes, Hoses, fittings, Oil filters, Seals and gaskets, Accumulators. (Types, construction, working principle and symbols of all components)	10	16

3	Hydraulic Circuits	Student should be able to • Design the conceptual circuit diagram. • Simulate the circuit diagrams. • Identify different electrical, pneumatic, hydraulic elements • Understand sequencing circuit of hydraulics	Hydraulic Circuits Meter in, Meter out circuits Bleed off circuit Sequencing circuit - travel dependent, pressure dependent Hydraulic circuits for Milling machine, Shaper machine, Motion synchronization circuit.	8	8
4	Introduction to pneumatic Systems	Student should be able to • Understand the pneumatics system • List the applications of pneumatics system • Describe structure of pneumatics system	Introduction to pneumatic Systems Applications of pneumatic system General layout of pneumatic system Merits and limitations of pneumatic systems	4	6
5	Components of pneumatic system	Student should be able to • List different energy supply elements relate to Pneumatics. • Select appropriate elements / components / symbols for the given process. • Select different standard elements • Describe the functioning of different elements, systems • Understand the actuators and its types • Identify different Pneumatics accessories	Components of pneumatic system Compressor - Reciprocating & Rotary compressors. Control Valves – Pressure regulating valves, Flow Control valves, Direction Control Valves. Actuators- Rotary - Air motors, Types, construction, Service unit. working principle Linear- Cylinders- Types, construction & working principle Accessories - Pipes, Hoses, Fittings, FRL unit (Types, construction, working principle and symbols of all components), Pneumatic Circuits Speed control circuits — for double acting cylinder ~ for bidirectional air motor Sequencing circuits -- Position based sequencing circuit	14	24

VI. LIST OF PRACTICAL EXPERIENCES

Sr.NO	NAME OF EXPERIMENT PNEUMATICS
EXPT-1 to 7	Logic gates basics pneumatics.
EXPT-8 to 10	Draw sequential circuit
EXPT-11	Experiment on pin feeding device
EXPT-12	Experiment on bending device
EXPT-13	Experiment on separating product from a magazine
EXPT-14	Experiment on control of a casting ladle
EXPT-15	Experiment on distribution of billiard balls
EXPT-16	Experiment on distribution of parcels
EXPT-17	Experiment on clamping of work piece
EXPT-18	Experiment on stamping of badges
EXPT-19 to 25	Logic gates electro pneumatics
EXPT-26 to 28	Draw electro sequential circuit.

Sr.NO	NAME OF EXPERIMENT HYDRAULICS
EXPT-1 to 7	Logic gates basics hydraulics.
EXPT-8 to 10	Draw sequential circuit.
EXPT-11	Experiment on cover of hardening furnace
EXPT-12	Experiment on open & closed of furnace door
EXPT-13	Experiment on parts are fed through a drying oven
EXPT-14	Experiment on surface grinding machine
EXPT-15	Experiment on a heavy cold store door
EXPT-16	Experiment on emboss graphics symbols on metal foil
EXPT-17	Experiment on open & closed of bulkhead door
EXPT-18	Experiment on a drilling machine
EXPT-19 to 25	Logic gates electro hydraulics
EXPT-26 to 28	Draw electro sequential circuit.
EXPT-29	Experiment on sorting device
EXPT-30	Experiment on component selection on conveyor belt

EXPT-31 EXPT-32	Experiment on lifting station Experiment on bending device
EXPT-33	Experiment on press-fitting
EXPT-34	Experiment on stamping machine
EXPT-35	Experiment on door control

VII. TEXT BOOKS

Sr. No.	Author	Title	Publication
1	Parr, Andrew	Hydraulics And Pneumatics : A Technician's & Engineering Guide	Jaico Bks.
2	Parr Andrew	Hydraulics And Pneumatics: Atech.And Engineers Guide	Dremtech I.P. Ltd.
3	Ilango,S, S.	Introduction To Hydraulics And Pneumatics	Phi
4	Igtr,Ahm	Pneumatics & Hydraulics	Indo-German Tool Room
5	Khurmi, R.S.	A Text Book Of Hydraulics, Fluid Mechanics And Hydraulic Machines	S.Chand
6	Nimbarte, M.K.	Pneumatic And Hydraulics Fluid Power System	Skill Today Publication
7	Turner,Ian	Engineering Applications Of Pneumatics And Hydraulics	Arnold

M5 – 03: THEORY OF MACHINE & PROCESS SYSTEM ANALYSIS

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	4	3	60	-	40	-	100

II. COURSE RATIONALE

It is a core technology subject in Mechanical Engineering Discipline. Mechanical Engineers often come across various machines in practice. They should be able to identify and interpret various elements of machines in day to day life. In maintaining various machines, a diploma engineer should have sound knowledge of fundamentals of machine and mechanism. It will be helpful for them to understand the mechanisms from operational point of view in a better way. This subject imparts the kinematics involved in different machine elements and mechanisms like gear,
Cam-follower, follower, belt-pulley, flywheel, brake, dynamometer, clutch, etc.
Detailed knowledge of these aspects with deep insight into the practical applications develops a professional confidence in them to become successful Engineer.
This subject serves as a prerequisite for subjects like Machine Design to be learned in higher semester.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES :

The student will be able to be:

1. Understand different machine elements and mechanisms.
2. Understand Kinematics and Dynamics of different machines and mechanisms.
3. Draw cam profile suitable to various displacement diagram.
4. Select Suitable Drives and Mechanisms for a particular application
5. Understand the function, operation and application of flywheel and governor.
6. Understand the function, operation and application of brake, dynamometer, clutch and bearing
7. Find magnitude and plane of unbalanced forces.

IV. COURSE OUTCOMES

After studied about TOM a student should be able to identify and interpret various elements of machines in day to day life. TOM is a core technology subject in Mechanical Engineering Discipline. Detailed knowledge of these aspects with deep insight into the practical applications develops a professional confidence in them to become successful Engineer.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HRS/UNIT	MARKS
1	**Fundamentals and type of Mechanisms**	Student should be able to • Understand Kinematics, Dynamics, Statics • Describe kinematics pair & its type. • Understand inversion of four bar chain • Define inversion • Understand Oldham's coupling	**Kinematics of Machines:-** Definition of Kinematics, Dynamics, statics, Kinetics, Kinematics link, Kinematics pair and its types, constrained motion and its types, Kinematic chain and its types, Mechanism, inversion, machine and structure. **Inversion of Kinematic Chain:-** Inversion of four bar chain, coupled wheels of Locomotive, Beam engine, Pantograph. Inversion of single slider Crank chain -Pendulum pump, Rotary I. C. Engines mechanism, Oscillating cylinder engine, Introduction & Definition Inversion Whitworth mechanism. Quick return mechanism of shaper, Inversion of Double Slider Crank Chain- Scotch Yoke Mechanism Elliptical trammel, Oldham's Coupling.	12	12
2	**Velocity and Acceleration in Mechanisms**	Student should be able to • Analyse the velocity and acceleration of mechanisms Describe kinematics pair & its type. • Differentiate between Velocity & acceleration • Understand velocity and acceleration diagram	Concept of relative velocity and relative acceleration of a point on a link, angular acceleration, inter-relation between linear and angular velocity and acceleration. Difference between Velocity & acceleration **Drawing** of velocity and acceleration diagram of a given configuration, diagrams of simple Mechanism. Determination of velocity and acceleration of point on link by relative velocity method.	6	15
3	**Cams and Followers**	Student should be able to • List applications of Cams and Followers • Classify Cams and Followers • Understand simple harmonic motion • Draw profile of radial cam with knife-edge and roller follower	Concept, definition and applications of Cams and Followers. Cam terminology, Classification of Cams and Followers. Different follower motions and their displacement diagrams -Uniform velocity, Simple harmonic motion, Uniform acceleration and Retardation. Drawing of profile of radial cam with knife-edge and roller follower.		

				6	15
4	**Power Transmission**	Student should be able to • Describe power transmission systems. • Understand types of belt drive • Determine velocity ratio • Describe centrifugal tension and initial tension • Understand types of chain drive • Understand types of gear drive	**Belt Drives**- flat belt, V-belt & its applications, Material for flat and V-belt.. Selection of belts, angle lap, Length of belt, Slip and creep. Determination of velocity ratio, of tight side and slack side tension, centrifugal tension and initial tension, condition for maximum power transmission (Simple numerical). **Chain Drives**- Types of chains and sprockets, velocity ratio. Advantages & Disadvantages of chain drive over other drives, Selection of Chain & Sprocket wheels, methods of lubrication. **Gear Drives** - Classification of gears, Law of gearing, gear terminology. Types of gear trains, their selection for different applications. Train value velocity ratio for simple, compound, reverted and epicyclical gear trains.	6	9
5	**Flywheel and Governors**	Student should be able to • Describe the operation and perform basic analysis of flywheel and governors. • Differentiate between flywheel and governor	Flywheel -Concept, function and application Governors- Types, concept, function Comparison between Flywheel and Governor.	4	3
6	**Brakes and Dynamometers**	Student should be able to • Describe the function of break and dynamometers • Understand types of brakes and dynamometers • Understand construction and working of rope brake dynamometer	Function of 'brakes and Dynamometers, Type of brakes & Dynamometers, comparison between brakes & Dynamometer. Construction and working- shoe brake, Band brake, Internal expending shoe brake, Disc Brake Construction and working of Rope brake Dynamometer, Hydraulic Dynamometer, and Eddy current Dynamometer.	6	6

VI. LIST OF PRACTICAL EXERCISES

1) Sketch and describe Working of quick return mechanism for a shaper. Find the ratio of time of cutting stroke to the time Of return stroke for the same
2) Sketch and explain the working of the following mechanisms
   a) Bicycle free wheel sprocket mechanism
   b) Geneva mechanism
   c) Ackerman's steering gear mechanism
   d) Foot operated air pump mechanism (Evaluate the effort at pedal for a given pump pressure)
3) Determine velocity and acceleration of various links of the given two mechanisms, by relative velocity method. (Any two mechanism)
4) Determine velocity and acceleration of piston of an I. C. engine's Slider Crank mechanism by Klein's construction
5) Describe the working and function of flywheel. Determine the coefficient of fluctuation of speed for a given Turning moment diagram.
6) Draw a schematic diagram of Hartnell governor (or any other governor) and describe it's working. Draw a graph Between radiuses of rotation versus speed of the governor.
7) Sketch the two wheeler braking system and identify the functions of various components. Dismantle and Assemble mechanically operated braking mechanism of two wheelers.
8) Dismantle and assemble multi-plate clutch of two-wheeler. Draw neat sketch and state the functions of various Components
9) Determine graphically counterbalance mass and its direction for completely balancing a system of several Masses rotating In a single plane

VII. REFERENCES

Sr. No.	Author	Title	Publication
1	Khurmi, R.S.	Theory Of Machines	S.Chand
2	Singhal, B.L.	A Text Book Of Mechanisms (Theory Of Machines)	Nirali Prakashan
3	Rattan, S.S.	Theory Of Machines	Tata McGraw Hill
4	Ambatkar, S.D.	Theory Of Machines And Mechanisms	Tech-Max Publication
5	Bevan, Thomas	Theory Of Machines	Pearson
6	Singh, Sadhu	Theory Of Machines :Kinematics And Dynamics	Pearson
7	Bevan, Thomas	Theory Of Machines	Pearson

M5-04: PLC PROGRAMMING

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARK
2	6	3	60	60	40	40	200

II. COURSE RATIONALE

To work in any automation industry, a mechatronics engineer must have knowledge of PLC programming. Student should understand the need of organization and should able to solve it. The Programmable Logic Controllers (PLC) Technician program addresses the needs of employers who require a highly skilled technical workforce and those of students who need cost-effective, high-quality, fully accredited technical training.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

Students will able to.

- To know the various components of electrical hardware
- To understand the method of switching and develop one line diagram
- To study One Line Diagram and connect circuit according to it.
- To develop ladder logic for programming and automate working process.
- To know different modes of communication between PLC and PC.
- To troubleshoot a problem and develop solution according to it.

IV. COURSE OUTCOMES

Students will able to
Learn programming concepts and different methods of handling a project. They will be able to understand the problem faced while automating a given process and debug it. After debugging they should be able to develop an efficient solution for the problem. They should be able to handle PLC along with various methods of interfacing/ communication.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	**PLC BASICS**	Students should be able to- • Understand the concept of industrial automation. • List the advantages and disadvantages of automation. • Understand the working of field input and output devices.	PLC Basics, Evolution of PLC in automation, Need and benefits of PLC in Automation, PLC components, Overall look inside PLC. General PLC programming procedure and I/O devices	4	8
2	**BASIC PROGRAMMING**	students should be able to- • Describe ladder rules. • Develop program for controller. • Simulate the developed program. • Compare the output with requirement. • Understand different logic operations. • Apply logic and to develop solutions for logical problems.	Discrete input/output modules, Block diagram, typical wiring details and specifications of AC input modules & DC input module. Sinking and sourcing concept in DC input modules. Analog input and output modules, Block diagram, typical wiring details and specifications. Special input and output modules, I/O addressing of PLC, Basics of PLC Programming, Programming Languages, Basic Programming Components, Logic functions (Logic Gates)	8	12
3	**BASIC FUNCTIONS**	students should be able to- • Understand different types of registers. • Understand different types of timers & counters. • Understand the use of timers & counters in PLC ladder logics with their functions.	Registers basics, Timer functions, Counter functions	8	12
4	**INTERMEDIATE FUNCTIONS**	Students should be able to- • Understand the arithmetic function, data handling function. • Use of comparators and number conversion function in building logic of programming.	Arithmetic functions, Data Handling Function, Number comparison functions.(comparators), Number conversion functions. Analog PLC operations and PID control.	12	16

		• Describe Analog PLC operation and use of PID control.			
5	**NETWORKING PLC AND TROUBLESHOOTING PLC**	Students should be able to- • Demonstrate the networking of the PLC. • Use the different internal peripherals of PLC. • Use of different protocols for communication	Networking PLC and troubleshooting PLC, Installation, Troubleshooting, PLC Enclosures, Electrical Noise, Leaky Inputs and Outputs, Grounding, Voltage Variations and Surges, Preventive Maintenance, Troubleshooting, Data Communications, Serial Communication, Device net, Control Net, Ethernet/IP, Modbus, Fieldbus, PROFIBUS-DP	8	12

VI. LIST OF PRACTICAL

1. Design a Ladder logic for NO-NC contact.(Switch ON- Light OFF, Switch OFF- Light OFF)
2. Design a Ladder logic for SPDT Switch. (EX-OR,EX-NOR logic gate)
3. Design a Ladder logic for Latching. (Forward-Reverse-Stop with manual interlock)
4. Design a Ladder logic for Memory bit.
5. Design a Ladder logic using comparator with MOVE Operation.
6. Design a Ladder logic using Timer.
7. Design a Ladder logic for flasher technique using Timer.
8. Design a Ladder logic for counter(Up counter, Down counter and Up-Down counter)
9. Design a Program logic for Analog control.
10. Design a PLC Program in FBD (Functional Block Diagram) Language.
11. Design a PLC Program in STL (Statement List) Language.

VII. REFERENCE BOOKS

Sr. No.	Author	Title	Publication
1	W. BOLTON	PROGRAMMABLE LOGIC CONTROLLERS	NEWNES
2	JOHN HACKWORTH	PROGRAMMABLE LOGIC CONTROLLERS: PROGRAMMING METHODS AND APPLICATIONS	PEARSON
3	CTTC	COURCE MATERIALS FOR INDUSTRIAL AUTOMATION (PLC)	CTTC
4	KANDRAY, DANIEL E.	PROGRAMMABLE AUTOMATION TECHNOLOGIES: AN INTRODUCTION TO CNC ROBOTICS AND PLCs	INDUSTRIAL PRESS
5	MAZIDI, MUHAMMAD ALI	PLC MICROCONTROLLER AND EMBEDDED SYSTEMS: USING ASSEMBLY AND C FOR PLC 18	PEARSON EDUCATION

M5 – 05: BEST MANUFACTURING PROCESS

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARK
2	-	3	60	-	40	-	100

II. COURSE RATIONALE

Manufacturing industries are a vital component of all modern economies and all of them require employees who are skilled - in and knowledgeable about - manufacturing processes. This Introduction to Manufacturing Processes will give students a detailed understanding of processes such as casting, forming, cutting and joining.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

Students will able to.

- To know the definitions and levels of management
- To understand the meaning of productivity
- To study the importance of quality circle
- To highlight the modern production management system
- To know the definition of TQM/TPM
- To understand the industrial and factories act

IV. COURSE OUTCOMES

Students will able to learn programming concepts and methodology of management. They will be able to understand the meaning of productivity and its importance in quality cycle. Understanding about the subject should in such a fashion that the students will be able to highlight the modern production management system. After the completion of study, students should be able to know the definition of TQM/TPM and understand the industrial and factories act.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	**Evaluation and nature of management.**	Students should be able to- • Understand levels of management • Describe role and responsibilities of member • Understand organization structure and its function	Management as function/ discipline management and administration, Levels of management, role and responsibility, Organization structure and its functions	4	8
2	**Production and productivity**	Students should be able to- • Understand production and productivity • Describe productivity inspection and quality control • Understand SQC and SPC	Production and productivity understanding, measuring to increase productivity Inspection and quality control, Quality control inspection and quality control, , SQC and SPC	8	10
3	**Modern production management system**	Students should be able to- • Understand operation of KAIZEN • Understand 5S responsibilities • Describe concept of industry 4.0 • Describe POKA-YOKA	7 QC tools, KAIZEN understanding, objectives, responsibilities, operation of KAIZEN. 5s understanding, steps of 5 S responsibilities. KANBAN- JIT management system, introduction, production management system KANBAN philosophy and application, POKA- YOKA mistake proofing principle steps/ application, case studies. Business Reengineering and process Reengineering principle, top management involvement, steps/ application, cause and effect diagram. Concept of Industry 4.0- history, evolution, principle and current trends.	10	14
4	**TQM/TPM**	Students should be able to- • Understand TPM Importance and implementation • Describe Quality standard and its clauses	TQM overview and history of TQM contribution of quality gurus. Juran's quality, TPM importance and implementation. Quality standards definition, ISO 9000 and QS 9000 quality standards its clauses, steps to implement	6	8

5	**Estimation and costing**	Students should be able to- • Understand importance estimation and costing • Define source of errors • Estimate of cost of direct materials, indirect material	Importance of estimation and costing, definition sources of errors, costing definition importance. Estimation of cost direct materials, indirect material, direct labour, indirect labour, other expenses, components of cost prime cost, factory cost selling price problems. Estimation methods of complete projects case studies. Numerical on costing.	8	12
6	**Industrial relations and acts**	Students should be able to- • Understand Employees welfare facilities • Describe discipline, safety • Understand trade union act right and liabilities • Describe Indian factories act	Employee's welfare facilities, labour participation in management, discipline, safety, committee, Industrial relations, industrial disputes, trade union act right and liabilities, payment of wages act. Indian factories and definition, health provision, safety provision, welfare provision working hours, accidents, penalties, miscellaneous provision	4	8

VI. REFERENCE BOOKS

Sr. No.	Author	Title	Publication
1	Amstead, B.H.	Manufacturing Processes	John & Wiley & Sons
2	Duvall,Barry	Contemporary Manufacturing Processes	The Good Heart Willcox Co.
3	Raghuwanshi,B.S, B.S.	A Course In Workshop Technology Vol 1 : Manufacturing Processes	Dhanpat Rai & Sons
4	Sharma, P.C.	A Text Book Of Production Technology (Manufacturing Processes)	S.Chand
5	Khurmi, R.S.	A Text Book Of Workshop Technology (Manufacturing Processes)	S.Chand
6	Beddoes, J.	Principles Of Metal Manufacturing Processes	Viva Books Pvt. Ltd.
7	Sing Rajender	Introduction To Basic Manufacturing Processes And Workshop Technology	New Age International Publishers Ltd.
8	Ambadekar, P.K.	A Text Book Of Manufacturing Processes	Nirali Prakashan
9	Todd, Robert. H.	Fundamental Principles Of Manufacturing Processes	Industrial Press

M5-06: ELECTRICAL DRIVES AND CONTROL

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARK
2	6	3	60	-	40	50	150

II. COURSE RATIONALE

Technological development in all sectors has caused imbalance in energy generation and it's consumption. Energy conservation is a scientific tool provided to minimize the energy imbalance. This is one of the rapid emerging field in the area of electrical engineering hence this has been included as core technology subject.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

The contents on energy conservation techniques in lighting systems, motors, transformers and transmission - distribution lines will be useful to reduce energy losses and wastage in residential, commercial and industrial sectors.

IV. COURSE OUTCOMES

Energy conservation is a scientific tool provided to minimize the energy imbalance. This is one of the rapid emerging field in the area of electrical engineering hence this has been included as core technology subject.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	Electric Drives: Introduction:	Students should be able to • Understand the concept of electric drive. • List the advantage and disadvantage of electric drive. • Classify the different type of electric drive. • Describe the speed-torque characteristics of the electric motor.	Drives – definition, block diagram, concept. Drives – Mechanical Drive and Electric Drive. Advantages and Disadvantages of Electric Drive. Factors Governing Selection of Electric Motors. Nature of Electric Supply: 3 phase and 1 phase AC and DC. Type of Drive: Group Drive & Individual Drive. Nature of Load: Nature of the Mechanical Load, Matching of the Speed Torque Characteristics of the Motor with that of the Load, and Starting Conditions of the Load.	12	16
2	Electrical Characteristics:	Students should be able to • Classify the different type of AC & DC motor. • Understand the different speed control methods of electric motor. • Describe the different characteristics of electric motor. • Understand the braking methods of electric motors. • List the application of different AC & DC motors.	- Electrical Characteristics: (Only DC Series, Three Phase and Single Phase Induction Motors) - Running Characteristics: Three Typical Speed Torque Characteristics – Inverse, Constant Speed and Drooping. - Starting Characteristics: Starting Torque only. (No Starters). Speed Control: Suitability to Economic and Efficient	12	20

			Speed Control Methods (Above and Below Normal Speed). Braking Characteristics: Plugging, Rheostatic Braking and Regenerative Braking, as Applied to DC Series and Three Phase Induction Motor. characteristics and applications of following motors D.C. Series ,1phase A.C. Series, 1phase I.M., 3phase I.M., Universal motor, Stepper motor.		
3	**Motor specification**	Students Should be able to • Summarize the specification of different electric motor. • Understand the load cycle of electric motor. • Differentiate the estimation and costing of electric motor. • Describe the construction parts of electric motors.	Size and Rating of Motor: Load Cycles for – Continuous Loads, Short Time Loads, Intermittent Loads, Continuous Operation with Short Time Loads and Continuous Operation with Intermittent Loads. Duty Cycles. Standard Ratings for Motors as per ISS. Estimation of Rating of a Motor. Load Equalization. (No Calculations) Cost: Capital Cost Running Cost (Losses, p.f., Maintenance) Mechanical Features: Type of Enclosure as per IS Type of Bearings Type of Transmission for Drive Noise Level.	10	14
4	**Application of drive**	Students should be able to • Understand the industrial application of electric motor.	Requirements of Motors used in following applications, stone crushing, textile industry, Paper manufacturing industry, rolling mill, chemical industry.	6	10

VI. LIST OF PRACTICAL EXPERIMENTS

ELECTRICAL DRIVES AND CONTROL

a) Study of a Single Phase Induction Motor.
b) Study of the Running and Reversing of single Phase Induction Motor.
c) Study of no load test of a single phase induction motor.
d) Study of load test of a single phase induction motor.
e) Study of the Running and Reversing of Three Phase Induction Motor.
f) Study of No Load Test in a Three Phase Induction Motor.
g) Study and Measurement of slip in Three Phase Induction Motor.
h) Study of Speed-Torque Characteristics of Three Phase Induction Motor.
i) Introduction to drives software (SINAMICS STARTER V4.4).
j) Reversible and non-reversible uncontrolled constant speed.
k) Reversible and non-reversible step speed control.
l) Variable position control.

VII. REFERENCE BOOKS

Sr. No.	Author	Title	Publication
1	SARKAR, B.N.	FUNDAMENTALS OF INDUSTRIAL DRIVES	PHI
2	KRISHNAN R.	ELECTRIC MOTOR DRIVES : MODELINGS, AND CONTROL	PEARSON EDUCATION
3	WILDI, THEODORE	ELECTRICAL MACHINES, DRIVES AND POWER SYSTEMS	PEARSON EDUCATION

MSME TECHNOLOGY CENTRE BHOPAL

(A Government of India Society under Ministry of Micro, small and medium enterprises)

SIXTH SEMESTER: COURSE DETAILS

DIPLOMA IN MECHATRONICS

M6-01: EMBEDDED SYSTEM DESIGN

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	6	3	60	60	40	40	200

II. COURSE RATIONALE

This subject comes under technology area. The subject is an extension of concept covered in digital technique. Embedded system is a heart of all domestic, industrial, consumer goods, and high end products. Automation in every field of life is being used and controlled by embedded system.
The student will gain knowledge of peripheral interfacing and programming. This subject will help the students to understand the design and working of microcontroller.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

The student will be able to

1. Access embedded systems hardware units like processor, I/O device, On-chip, and Off-chip device, Power supply etc.
2. Interface various devices using ports. .
3. Write embedded program.
4. Develop programmable interrupt controller.
5. Perform software analysis, design, implementation, testing, debugging for embedded systems.

IV. COURSE OUTCOMES

The student will be able to

1. Interface various devices using ports. .
2. Write embedded program.
3. Develop programmable interrupt controller.
4. Perform software analysis, design, implementation, testing, debugging for embedded systems.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	Embedded system	Students should be able to- • Understand internal architecture of ARM • Describe ARM Resistor set • List ARM processor families • Understand the instruction set	• Introduction • Architecture of Arm7 TDMI Processor. • Introduction to LPC2148 • Block diagram, pin diagram • Register Set • Instruction set • Peripheral & Interrupt handling • Advanced Serial and Parallel High Speed Bus	12	20
2	Introduction to Communication Protocol And Introduction to ARM7-TDMI	Students should be able to- • Understand internal peripherals of LPC2148 • Develop a program using internal peripheral	• Internal Peripherals of LPC2148 ○ PLL ○ Timer ○ Counter ○ ADC ○ DAC ○ Serial protocol ○ I2C, CAN, SPI	10	14
3	Embedded System Tools	Students should be able to- • Understand different hardware units, advantages and its applications. • Use of Software and hardware development tool, complier, debugger and programming	Introduction • Introduction, different Hardware Units, advantages like Reliability, efficiency and cost, Applications. Tools • Software & Hardware development tools , IDE, Compiler, Debugger, Simulator, Emulator, In circuit Emulator(ICE),Target Board, Device Programmer • Embedded software development cycle; Software Embedded in System Concept of Device Driver	10	14

4	RTOS & Inter-process Communication	Students should be able to- • Understand the fundamental concepts of real-time operating systems • Describe the use of multitasking techniques in real-time systems • Describe the design cycle of real-time applications • Understand design applications based on real-time operating systems.	• Concepts of RTOS • Requirement, Need, Specification of RTOS in Embedded systems • Multitasking • ask synchronization & Mutual Exclusion • Starvation, Deadlock, Multiple process • Inter-process Communication	8	12

VI. LIST OF PRACTICAL EXERCISES

1. Development and execution of the program for sending data on port lines.
2. Development and execution of the program for arithmetic operation and time delay.
3. Development and execution of the program for input and output operation.
4. Development and execution of the program for interface LEDs to particular port,
5. Development and execution of the program to generate a square wave on port.
6. Development and execution of the program for logical operators and data conversion.
7. Development and execution of the program PWM waveform generation.
8. Development and execution of the program to display "MSME" message on LCD (16x2).
9. To write C program to send "WELCOME" on serial port continuously.
10. Interface Stepper Motor to Microcontroller 8051 and development and execution of the program to run stepper Motor.
11. Interface ADC to Microcontroller and development and execution of the program to display digital equivalent of Analog input
12. Interface DAC to Microcontroller and development and execution of the program to generate specified voltage.

VII. REFERENCE BOOK

Sr. No.	Author	Title	Publication
1	KAMAL, RAJ.	EMBEDDED SYSTEMS : ARCHITECTURE PROGRAMMING & DESIGN	McGraw HILL INT ED.
2	DAS, LYLA, B.	EMBEDDED SYSTEMS : AN INTEGRATED APPROACH	PEARSON
3	RAO, B. KANTA.	EMBEDDED SYSTEMS	PHI
4	KOTHARI, D. P.	EMBEDDED SYSTEMS	NEW AGE. INT. PUB
5	HEALTH,STEVE	EMBEDDED SYSTEMS DESIGN	ELSEVIER
6	SHIBU,K.V	INTRODUCTION TO EMBEDDED SYSTEMS	MCGRAW HILL
7	KAMAL,RAJ	EMBEDDED SYSTEMS : ARCHITECTURE PROGRAMMING & DESIGN	MCGRAW HILL
8	HUANG, HAN-WAY	EMBEDDED SYSTEM DESIGN USING C8051	CENGAGE LEARNING
9	GANSSLE, JACK	EMBEDDED SYSTEMS : WORLD CLASS DESIGN	ELSEVIER

M6-02: MECHATRONICS SYSTEM DESIGN

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	6	3	60	-	40	100	200

II. COURSE RATIONALE

The mechatronics is newly born subject combination of different subjects.
The student can learn the various control system and system design parameters.
Mechatronics engineer must have too familiar with mechanical system design.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

- To understand the mechanical system design
- To understand principles of modelling and simulation
- To know modelling and simulation of physical systems
- To build system models
- To know the advance applications in mechatronics
- To build models foe simulations using bond graphs 20 – SIM

IV. COURSE OUTCOMES

Students got familiar with mechatronics system design .which is important part of mechatronics. And also simulation methods of various control system

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	**SYSTEMS AND DESIGN**	Students should be able to- • Understand integrated designs. • Understand the concepts of mechatronics. • Describe the purpose of mechatronics system design.	Mechatronic systems – Integrated design issue in mechatronic – mechatronic key element, mechatronic approach –Design process – Type of design – Integrated product design – Mechanism, load condition, design and flexibility – structures – man machine Interface, industrial design and ergonomics, information transfer, safety.	8	12
2	**CONTROL AND DRIVES**	Students should be able to- • Understand the working of different types of drives • Understand the use of drives. • Describe the principle of drives.	Control devices –electro pneumatic l controls – Rotational drives, swivel arm. – Pneumatic motors: continuous and limited rotation – solenoid valve, Motion convertors, fixed ratio, invariant motion profile.	8	15
3	**REAL TIME INTERFACING**	Students should be able to- • Understand the process of real time interfacing. • Understand the installation of application software. • Define the real time simulation process	Real time interface – Introduction, Elements of a PLC system, overview of I/O process, Installation of I/O card and software – Installation of the application software.	8	15
4	**CASE STUDIES – I**	Students should be able to- • Understand the working of output actuators. • Understand the different types of input devices.	study of input /outputs and tricks to find out the input /outputs, interface, study of LVDT, study of reference sensor, study of single acting cylinder and optical, capacitive, inductive sensor	8	9
5	**CASE STUDIES – II**	Students should be able to- • Understand the parameters of the robot. • Understand the rotary and linear motion drives	Introduction, study of input /outputs and tricks to find out the input /outputs, interface, study of limit switches. Set the parameters of linear and rotary drives by using configuration tool software, Study about all axis and robot parameters	8	9

VI. LIST OF PRACTICALS

Practice on Mechatronics systems kits

1. Distribution Station
2. Testing station
3. Processing Station
4. Handling Station
5. Assembly Station
6. Robot Station
7. Storing Station

VII. REFERENCE BOOKS

Sr. No.	Author	Title	Publication
1	MAHALIK, N.P.	MECHATRONICS; PRINCIPLES,CONCEPT AND	TMH
2	SHETTY, DEVDAS	MECHATRONICS SYSTEM DESIGN	CENGAGE LEARNING-1 PVT LTD
3	ALCIATORE, DAVID, G.	INTRODUCTION TO MECHATRONICS & MEASURMENT SYSTEMS	TMH
4	MAHALIK, N.P.	MECHATRONICS : PRINCIPLES, CONCEPTS & APPLICATIONS	TMH
5	BOLTON, W.	MECHATRONICS : ELECTRONICS CONTROL SYSTEMS IN MECHANICAL & ELETRICAL ENGINEERING	PEARSON
6	ALCIATORE, DAVID, G.	INTRODUCTION TO MECHATRONICS & MEASURMENT SYSTEMS	McGRAW HILL
7	KHOBARE, V. K.	BASIC ELECTRONICS AND MECHATRONICS	NIRALI PRAKASHAN

M6-03 ROBOTICS

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	4	3	60	-	40	100	200

II. COURSE RATIONALE

The concept of creating machines that can operate autonomously dates back to classical times, but research into the functionality and potential uses of robots did not grow substantially until the 20th century. Throughout history, robotics has been often seen to mimic human behaviour, and often manage tasks in a similar fashion. Today, robotics is a rapidly growing field, as technological advances continue; researching, designing, and building new robots serve various practical purposes, whether domestically, commercially, or militarily. Many robots do jobs that are hazardous to people such as defusing bombs, mines and exploring shipwrecks.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

- Familiarization to industrial robot and its application.
- To get knowledge about different types of manipulator and calculation.
- To get knowledge about machine vision, implementation principles and issues.
- To get knowledge about control (movement, force) of the manipulator.
- Familiarization to the robot programming language.
- Familiarization to the robot intelligence and task planning.

IV. COURSE OUTCOMES

Students will be able to
Understand industrial robot and its application.
To get knowledge about different types of manipulator and calculation.
To get knowledge about machine vision, implementation principles and issues.
To get knowledge about control (movement, force) of the manipulator.
Familiarization to the robot programming language.
Familiarization to the robot intelligence and task planning.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HRS	MARKS
1	Fundamentals of robotics	Student should be able to- • Understand the basic concepts of robotics and automation. • Understand robot drive systems. • Understand the programming of robot. • Define the robot specification. • Describe the configuration of the robot.	Robotics and Automation - Robot Definition, Classification of Robots, Robot System components, functions of Robot System, Specification of Robot System, Robot Drives and Power transmission systems, Remote centered, Compliance devices. Laws of robotics	12	18
2	Robotic sensors	Student should be able to- • Understand the uses of robotic sensors. • Understand the working of different types of sensors. • Describe the robotic sensors. • Identify the sensors.	Introduction to robotic sensors characteristics of sensing device, types of sensors position and displacement sensors, force / torque sensors, Robotic Sensory Devices, Non optical Position sensors, Optical position sensors, velocity sensors, Accelerometers, Proximity sensors, touch and Slip sensors,, Force and Torque sensors - Robot vision system. , Range sensors, selection of right sensor	12	18
3	Robot Programming	Student should be able to- • Understand the JOG methods. • Understand the structure of programming. • Understand the POSE teaching method. • Understand the MDI method. • Explain the programming of the robot.	Methods of Robot programming - Lead though programming methods - capabilities and limitations, Textual Robot languages - robot language structure - motion commands, end effectors and sensor commands, Robot programming functions, robot programming environment, On-Line and Off Line programming Languages.	6	9

4	Robot Work Volume	Student should be able to- • Understand the concept of robot work volume • Understand simulation process.	Robot cell layouts - multiple Robots and machine interface, consideration in work cell design, interlocks, error detection and recovery, Robot cycle time analysis, simulation of Robot work cells.	6	9
5	Robot Applications	Student should be able to- • Understand the applications of robot. • Understand the operation performed by robot.	Application of robots in material transfer, machine loading and unloading, welding, assembly and inspection, safety, training, maintenance and quality aspects, Economics and social aspects of robotics.	4	6

VI. LIST OF PRACTICAL EXPERIMENTS

Robot & assembly

Aim-assembly of the single acting cylinder precisely & place it to the storing station as per their color slots given on to storage.

- Move all the axis using teach pendant.
- Move all the axis of robot using all the jog feeds given below.

1. 1-joint
2. 2-tool
3. 3-xyz
4. 4- 3-xyz
5. 5-cylinder
6. 6-work

- Manual data input.
- Pose teaching method.
- Find out all the inputs and outputs using t/b (monitor).
- Programme on simple pick and place of the object using t/b.
- Programme on assemble the single acting cylinder using t/b.
- Interface with robot arm using software ciros 5.1.4 (communicated with Ethernet).

Assembly

- Programme on assembly station to assembled spring and cap of the cylinder.

Robotino

Aim-to moves the robot at its designated position.

- Forward direction
- reverse direction
- Collision protection
- time_out_with_bumper
- Reverse_with_time_out
- Forward_reverse_with_time_out
- omni_drive_forwad_direction
- omni_drive_reverse_direction
- omni_drive_45_forward
- omni_drive_diamond_shape
- Move_around_object
- Path_tracking_metal
- line_detector_with_camera

VII. REFERENCE BOOKS

Sr. No.	Author	Title	Publication
1	GROOVER,MIKELL P	INDUSTRIAL ROBOTICS;TECHNOLOGY	TATA MCHGRAW HILL
2	DEB,S.R.	ROBOTICS TECHNOLOGY AND FLEXIBLE	TATA MCHGRAW HILL
3	RAJPUT, R.K.	ROBOTICS AND INDUSTRIAL AUTOMATION	S.CHAND
4	SAHA, S. K.	INTRODUCTION TO ROBOTICS	TMH
5	MITTAL,RAKESH	ROBOTICS & CONTROL	McGRAW HILL INT ED.
6	MITTAL, R. K.	ROBOTICS & CONTROL	McGRAW HILL EDN
7	PURANIK, M. T.	ROBOTICS	NIRALI PRAKASHAN
8	CRAIG, JOHN, J.	INTRODUCTION TO ROBOTICS : MECHANICS	PEARSON
9	BBGTC	ROBOTICS	BBGTC
10	CRAIG, JOHN J.	INTRODUCTION TO ROBOTICS: MECHANICS	PEARSON EDUCATION
11	SAHA, S.K	INTRODUCTION TO ROBOTICS	MC-GRAW HILL

M6-05 PANEL ENGINEERING

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	4	3	60	-	40	50	150

II. COURSE RATIONALE

A control panel is a flat, often vertical, area where control or monitoring instruments are displayed. They are found in factories to monitor and control machines or production lines and in places such as nuclear power plants, ships, and aircraft and mainframe computers. Older control panels are most often equipped with push buttons and analog instruments, whereas today in many cases touchscreens are used for monitoring and control purposes.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

Students will be able to
Understand EMC rules of the electrical control panel.
Draw the layout of equipment in a panel.
Understand cable routing in the panel.
Installation of enclosure on panel.

IV. COURSE OUTCOMES

Students will be able to
Understand EMC rules of the electrical control panel.
Draw the layout of equipment in a panel.
Understand cable routing in the panel.
Installation of enclosure on panel.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	Panel Design in Accordance with EMC rules	Student should be able to- • Understand the Protection of low power signals. • Draw the Layout of an equipment in a panel	Electromagnetic compatibility (EMC) of the electrical control panel. Protection of low power signals. Filtering. Characteristics of an EMC- compliant panel. Layout of an equipment in a panel. Reference regulation and standards.	8	10
2	Assembly – panel wiring	Student should be able to- • Understand the panel assembly • Draw the Cable running in the panel • Understand Earth connection of shielding • Understand Earth connection of metal raceways	panel assembly Installation of enclosure receiving polluted lines. External routing of cables- entry into the panel. Cable running in the panel Earth connection of shielding Earth connection of metal raceways.	8	10
3	Guide for selection of EMC product	Student should be able to- • Identify the accessories of EMC • Understand the use of EMC Accessories	Enclosures and panel with strengthened Fans and accessories for strengthened EMC Accessories for strengthening EMC	8	10
4	Schematic projects using software	Student should be able to- • Draw power & control Circuit • Draw 2D & 3D Panel Design • Draw PLC Circuit • Generate Project report, Part list	Schematic of Power circuit Schematic of Control circuit 2D Panel Design 3D panel Design using E-Plan PLC Circuit Design, Project report generation, Part list, Estimate cost, connection list, Manufacturing List	16	30

VI. LIST OF PRACTICAL EXPERIMENTS

1. To Draw various symbols used in the field of electrical engineering
2. Introduction to single line diagram for different electrical circuits
3. Demonstrate use of NO/NC contacts in control circuit of different input, output devices.
4. Draw the single line diagram using Relay, Contactor, and Proximity Sensors.
5. Develop a control circuit for Start Stop logic of a motor
6. Develop a control circuit for Forward & Reverse logic of a motor
7. Develop a control circuit for Star & Delta logic of a motor
8. Introduction to EPLAN Software
9. Electrical system design for Start Stop logic of a Motor
10. Electrical system design for Forward & Reverse logic of a Motor
11. Electrical system design for Starting Methods for induction Motors:
    - I) DOL Starter
    - II) Star-Delta Starter
    - III) Auto Transformer Starter
12. General Arrangement of components in Panel

VII. REFERENCE BOOKS

Sr. No.	Author	Title	Publication
1	GUPTA, P.P.	INSTALLATION, COMMISSIONING &	DHANPAT RAI & CO.
2	UPPAL, S. L.	ELECTRICAL WIRING: ESTIMATING & COSTING	KHANNA PUBLISHERS
3	PRASAD,RAJENDRA	ELECTRICAL MEASUREMENT AND MEASURING	KHANNA PUBLISHERS,
4	RAINA, K. B.	ELECTRICAL DESIGN: ESTIMATING AND COSTING	NEW AGE INT.
5	RAINA, K. B.	ELECTRICAL DESIGN: ESTIMATING AND COSTING	NEW DELHI: NEW AGE INT.LTD

M6-06 SCADA AND HMI

I. SCHEME OF TEACHING & EVALUATION

THEORY HRS/WEEK	PRACTICAL/ TUTORIAL HRS/WEEK	PROGRESSIVE TEST	END TERM EXAM. (TH)	END TERM EXAM. (PR)	TERM WORK (TH)	TERM WORK (PR)	TOTAL MARKS
2	4	3	-	60	50	40	150

II. COURSE RATIONALE

The concept of creating SCADA that can operate autonomously dates back to classical times, but research into the functionality and potential uses of AUTOMATION did not grow substantially until the 20th century. Throughout history, SCADA has been often seen to mimic human behaviour, and often manage tasks in a similar fashion. Today, SCADA AND HMI is a rapidly growing field, as technological advances continue; researching, designing, and building new robots serve various practical purposes, whether domestically, commercially.

III. COURSE OBJECTIVES/INSTRUCTIONAL OBJECTIVES

Familiarization to industrial AUTOMATION and its application.
To get knowledge about different types of manipulator and calculation.
To get knowledge about various supervisory control system.

IV. COURSE OUTCOMES

Students will be able to
Understand industrial automation and its application.
To get knowledge about different types of manipulator and calculation.
To get knowledge about machine vision, implementation principles and issues.
To get knowledge about control
Familiarization to the programming language.
Familiarization to the intelligence and planning.

V. CONTENTS

UNIT NO.	TOPIC/SUB-TOPIC NO.	OUTCOMES	CONTENTS	TEACHING HOURS	MARKS
1	Introduction to SCADA & HMI	Students should be able to- • List the application of automation. • Understand the Role of PLC, SCADA &HMI in industrial automation. • List need of SCADA & HMI system. • Understand the PLC and detail about addressing, input and output.	Introduction to SCADA what is automation and its advantages. Role of PLC & SCADA in industrial automation, Application of programmable logic controller. Need of SCADA system in automation. What is PLC and addressing details of input and output?	15	20
2	SCADA & HMI FUNCTIONING	students should be able to- • Install SCADA, HMI software. • Understand the communication of SCADA with PLC. • Understand the communication of HMI with PLC. • Understand activate and deactivate a project. • List the Application of standard object and control objects. • List the type of objects. • List out the Application of lad program on SCADA. • List out the Application of lad program on HMI. • Create different types of program on SCADA & HMI.	Installation of SCADA software and communication drivers, Communication of SCADA with plc. Creating a new SCADA application, Types of projects in SCADA. Activate and deactivate a project, Process screens, Working with graphic designer screen. Create and edit process picture. Use of object properties, Creating and editing graphic display with animation, Editing of static properties, style, flashing display, use of standard color palette. Database of Tags, Tag management and tag selection dialog box. Tags types. Details of process tag and internal tags, Process tag, internal tag and property setting of tags. Application of standard object and control objects,) Standard object, smart object, and window object. Application of LAD program on SCADA Use of lad program, input output memory tags.)Different types of programs done on SCADA using lad, Use of picture window, Creating a new picture window, multi-screen. Moving of graphic object, Alarm	15	20

			system, Alarm logging, principle of message system,) Archiving messages, display messages in runtime, Working with OLE control objects. Report generation and documentation. Creating an online trend, creating and accessing real time and historical time.		
3	CASE STUDY	Students should be able to- • Program on SCADA screen using lad. • Program on HMI screen using lad. • Create different programs to speed control, fan control, forward reverse circuit, demo board practice, sequential switching of motors, Bottle filling process & tank level control.	Different types of programs done on SCADA using lad, Start stop circuit, Deactivate push buttons, inch circuit, start stop inch, auto/manual circuit, fan control, speed control of fan, forward reverse circuit, Demo board practice, Sequential switching of motors. Rotor stator control of an induction motor. Fan control with speed regulation. Seven segment and tank level control.)Assignment on bottle filling process using moving properties.	10	20

VI. LIST OF PRACTICAL EXPERIMENTS

Sr. No.	Practical Name
1.	Start stop circuit, Deactivate push buttons, Inch circuit, start stop inch, auto/manual circuit.
2.	fan control, speed control of fan, forward reverse circuit,
3.	Sequential switching of motors. Rotor stator control of an induction motor. Fan control with speed regulation.
4.	Seven segment and tank level control
5.	Bottle filling process using moving properties.
6	Traffic light control & Parking

VII. REFERENCE BOOKS

Sr. No.	Author	Title	Publication
1	GROOVER,MIKELL P	INDUSTRIAL AUTOMATION ;TECHNOLOGY PROGRAMMING AND APLICATIONS	TMH
2	KANDRAY, DANIEL E.	PROGRAMMABLE AUTOMATION TECHNOLOGIES: AN INTRODUCTION TO CNC	INDUSTRIAL PRESS
3	GUPTA, A.K.	INDUSTRIAL AUTOMATION AND ROBOTICS	UNIVERSITY SCI.PRESS
4	BELLOUARD,YVES	MICROROBOTICS : METHODS AND PROCESS	CRC PRESS
5	DEB, S.R	ROBOTICS TECHNOLOGY AND FLEXIBLE AUTOMATION	MC-GRAW HILL