

# **AUTOMOTIVE MECHATRONICS SYLLABUS**

## **FIRST SEMESTER**

**SUBJECT: Fundamental of Computers**  
**CODE: ZBCE-101**  
**CATEGORY: General Education Component**

Credit	Hours	Marks		
		I	E	To
3	45	15	35	50

### Objectives

The syllabus introduces students to basic information and communication technology and proper paradigms that need to be implemented to develop any kind of computer applications. The course will help in developing the basic technical skills by hands on experience.

### Learning Outcomes

- Students will be able to the use the computer for basic purposes of preparing personnel/business letters, viewing information on Internet, sending mails, using internet banking services etc.
- Understand basic computer operations and ICT applications.
- Understand Network troubleshooting.
- Undertake data entry services

Unit	Topic	Key Learning
I	<b>Introduction to Computer System:</b>	<ul style="list-style-type: none"> <li>• What is Computer, Basic Applications of Computer; Block Diagram of Computer System</li> <li>• Input / Output Devices, Computer Memory, Concepts of Hardware and Software, Data and Information; Applications of IECT</li> <li>• Computer Virus: Definition, Types of viruses, Characteristics of viruses, Anti-virus software.</li> <li>• Introduction to number system.</li> </ul>
II	<b>Operating System:</b>	<ul style="list-style-type: none"> <li>• Overview of operating system: Definition, Functions of operating system, Need and its services, Types of operating system, Batch Processing, Spooling, Multiprocessing, Multiprogramming, Time-Sharing, On-Line Processing, Real-Time Processing Basics of window operating system, Comparison between DOS and windows, Switching between DOS and windows, Comparison between Unix and Windows.</li> </ul>
III	<b>Understanding Office Applications:</b>	<ul style="list-style-type: none"> <li>• Introduction to MS Word, Introduction to MS Excel and its applications, Introduction to MS PowerPoint, Menus, Shortcuts, Document types, Formatting documents, spread sheet and presentations, Working with Spreadsheets, Different templates, Macros, Mail merge.</li> </ul>
IV	<b>Networking</b>	<ul style="list-style-type: none"> <li>• Network Technologies, Introduction to Internet and protocols: TCP/ IP, Network connecting devices, Topologies, HTTP, HTTPS DNS, Hub, Switches, Router, Repeater, Firewalls, Digital Signature.</li> </ul>
V	<b>Introduction to World Wide Web:</b>	<ul style="list-style-type: none"> <li>• WWW and Web Browsers Introduction, Objectives, Concept of internet, Overview of search engines, popular search engines in use, Surfing the web and websites, Hosting your websites, Planning and Developing the websites, Internet service provider.</li> </ul>

## **Suggested Readings:**

### **Text Books**

- Computers and Beginners by Jain, V.K.;
- Computer Fundamentals by Anita Goel, Pearson.

### **Reference Books**

- Introduction to Information Technology, Leon Tech World by Leon and Leon
- Foundations of Computing, BPB Publication by Sinha, Kr. Pradeep and Preeti Sinha;
- Word Processing and Typing by Sharon Spencer, Heinemann.
- MS Office by S.S. Srivastava, Firewall Media.
- Microsoft Office 2010 by Bittu Kumar, V & S Publications
- Data Communication and Networking by Behrouz.A. Forouzan, McGraw Hill
- **Web Link**<http://cec.nic.in/E-Content/Pages/default.aspx>

**SUBJECT: Fundamental of Computers Lab**

**CODE: ZBCE-101P**

**CATEGORY: General Education Component**

<b>Credit</b>	<b>Hours</b>	<b>Marks</b>		
1	30	I	E	To
		35	15	50

**Objectives**

- The syllabus introduces students to basic information and communication technology and proper paradigms that need to be implemented to develop any kind of computer applications. The course will help in developing the basic technical skills by hands on experience

**Learning Outcomes**

- Able to do trouble shooting
- Able to do work on MS-Word and its applications
- Able to do work on Ms-Excel
- Able to make presentations in MS- Power Point.

**List of Practicals**

1. Troubleshooting
2. Practical based on to be exposed/shown various components and supposed how to switch on a computer.
3. Handling Boot Setup, Installation of Operating System, Connecting your client to server, User and Workgroup Handling, General Operating system handling and related topics.
4. WordPad, Notepad, Sticky Note, Snipping tool, Paint
5. M.S. Word
6. MS-Excel- Creating charts, Creating tables
7. MS-PowerPoint
8. MS-Outlook
9. Case study on Operating systems (Windows/ Ubuntu/ Android/IOS)
10. Networking
11. Software: Preparatory and open domain

**SUBJECT: Communication Skills****CODE: ZBSE-101****CATEGORY: General Education Component**

Credit	Hours	Marks		
		I	E	To
3	45	15	35	50

**Objectives**

- To inculcate in students professional and ethical attitude, effective communication skills, teamwork, skills, multidisciplinary approach and an ability to understand engineer's social responsibilities.
- To inculcate in students written communication skills.

**Learning Outcomes**

- The syllabus introduces students to have basic skill set of channelizing information, self-development, decision making and interpersonal skills.

Unit	Topic	Key Learning
I	<b>Communication:</b>	<ul style="list-style-type: none"> <li>Meaning of Communication, Importance of Communication, Types of communication. Process of communication, Communication network in an organization, Barriers to communication, Essentials of good communication.</li> </ul>
II	<b>Remedial English Grammar:</b>	<ul style="list-style-type: none"> <li>Articles, agreement between verb and subject, uses of tenses, Modal and their uses, Prepositions.</li> <li><b>Understanding and applying Vocabulary:</b> One word substitutes, Synonyms and Antonyms</li> <li>Word formation: -Prefixes, Bases and Suffixes.</li> </ul>
III	<b>Listening Skills:</b>	<ul style="list-style-type: none"> <li>The process of listening, Types of listening, Benefits of effective listening, Barriers to listening, listening to announcements at work place.</li> </ul>
IV	<b>Reading Skills:</b>	<ul style="list-style-type: none"> <li>Process and methodologies of reading, Skimming and scanning, Levels of reading, Proofreading, Summarizing, Precise writing, Unseen comprehension passage, Note taking and reviewing, convert the given information into charts and graphs.</li> </ul>
V	<b>Writing Skills:</b>	<ul style="list-style-type: none"> <li>Main Forms of Written Communication: Notices, Drafting an E-mail. Correspondence: Personal and Official, Notices, Technical Report Writing, Preparing agenda and minutes of meetings</li> </ul>

**Suggested Readings:**

- Sethi, J & et al. A Practice Course in English Pronunciation, Prentice Hall of India, New Delhi.
- Sen, Leena. Communication Skills, Prentice Hall of India, New Delhi.
- Prasad, P. Communication Skills, S.K. Kataria & Sons.
- Bansal, R.K. and J.B. Harrison. Spoken English, Orient Language.
- Roach Peter. English Phonetics and Phonology.
- A.S. Hornby's. Oxford Advanced Learners Dictionary of Current English, 7th Edition.
- Prasad, P. The Functional Aspects of Communication Skills, Delhi.
- McCarthy, Michael. English Vocabulary in Use, Cambridge University Press.
- Rajinder Pal and PremLata. English Grammar and Composition, Sultan Chand Publication.
- Idioms & Phrases (English-Hindi), Arihant Publication (India) Pvt. Ltd.
- One Word Substitution, Dr. Ashok Kumar Singh, Arihant Publications (India) Pvt, Ltd

**SUBJECT: Communication Skills Lab**  
**CODE: ZBSE-101P**  
**CATEGORY: General Education Component**

<b>Credit</b>	<b>Hours</b>	<b>Marks</b>		
1	30	I	E	To
		35	15	50

**Objectives**

- To inculcate in students professional and ethical attitude, effective communication skills, teamwork, skills, multidisciplinary approach and an ability to understand engineer's social responsibilities.

**Learning Outcomes**

- Able to communicate during conversation.
- Able to participate in group discussions.
- Able to participate in role plays
- Able to present PPTs

**List of Practicals**

1. Greeting and starting of conversation.
2. Nonverbal communication techniques during conversation.
3. Verbal communication techniques during conversation.
4. Group discussion.
5. Extempore public speaking.
6. Reading activity
7. Situational dialogues /Role play.
8. PPT presentation technique.

**SUBJECT: Fundamental of industrial Management****CODE: ZBME-101****CATEGORY: General Education Component**

Credit	Hours	Marks		
		I	E	To
3	45	15	35	50

**Objectives**

- Understanding the knowledge of Quality Control, inspection and quality assurance management used in the organization.
- Develop the skill for using tool and techniques for quality in Industry
- Apply elementary knowledge of quality concepts for quality assurance.

**Learning Outcomes**

- Students will be able to understand the daily management system related to Quality in the shop floor.
- Students will be able to understand all the required processes, ensuring implementation of the same and providing basic inputs for its improvement. Student will be able to ensure that the final products manufactured by is as per the quality norms set by the organization.
- Student will able to solve different type of problems in their manufacturing processes.
- Ensure implementation of 5S activities at the shop floor/ office area. Students will be able to analyse the root cause problems in the product & process by using different problem solving techniques
- Students will able to apply 5S and safety in their work place.

Unit	Topic	Key Learning
I	<b>Concept of Quality:</b>	<ul style="list-style-type: none"> <li>• Quality: Definition, History, Importance</li> <li>• Approaches to define Quality, Cost of Quality, Hierarchy of Quality Management</li> <li>• Introduction to Quality Control.</li> </ul>
II	<b>Organizational Aspects of Quality Assurance:</b>	<ul style="list-style-type: none"> <li>• Quality Assurance (QA): Introduction, Definition, Management principles in QA, QA in different stages, QualityPlanning.</li> <li>• ISO: Introduction, ISO 9000 series of standard, Benefits ofISO.</li> <li>• ISO 9001, Benefits of ISO 9001.</li> <li>• Quality survey: Scope, Types of audit, inspection methods, Quality budget, Vendor Quality Rating</li> </ul>
III	<b>Problem solving tools and techniques:</b>	<ul style="list-style-type: none"> <li>• Definition of a problem</li> <li>• Type of problems, classification of problems</li> <li>• What is problem solving, barriers to problem solving</li> <li>• Problem solving tools: Cause and effect diagram, Histogram, flow charts, Check sheets, Histogram, Brain-storming, Pareto charts, Control charts, Scatter Diagram</li> <li>3.5 Problem solving techniques: Brain storming, Flow diagram, PDCA Cycle etc</li> </ul>
IV	<b>Total Quality Management:</b>	<ul style="list-style-type: none"> <li>• Basic concept of TQM, features of TQM</li> <li>• principles of TQM</li> <li>• leadership concepts</li> <li>• Quality statements</li> <li>• Barriers to TQM implementation</li> <li>• Concept of TPM</li> <li>• Quality allied concept: KAIZEN, Poke yoke, JIT, KAPA</li> </ul>
V	<b>5 S and Safety:</b>	<ul style="list-style-type: none"> <li>• Detailed concept of 5S and safety used in Industries</li> <li>• Integrated Management system</li> </ul>

**Suggested Readings:**

- Total quality Management by L.Sganthi&Anand A. Samuel, PHI Publication.
- Total quality Management by Poornima M Charantimath, Pearson Publication.



**SUBJECT: Fundamental of industrial Management Lab**

**CODE: ZBME-101P**

**CATEGORY: General Education Component**

Credit	Hours	Marks		
		I	E	To
1	30	35	15	50

**Objectives**

- Understanding the knowledge of Quality Control, inspection and quality assurance management used in the organization.
- Develop the skill for using tool and techniques for quality in Industry
- Apply elementary knowledge of quality concepts for quality assurance.

**Learning Outcomes**

- Students will be able to understand the daily management system related to Quality in the shop floor.
- Students will be able to understand all the required processes, ensuring implementation of the same and providing basic inputs for its improvement. Student will be able to ensure that the final products manufactured by is as per the quality norms set by the organization.
- Student will able to solve different type of problems in their manufacturing processes.
- Ensure implementation of 5S activities at the shop floor/ office area. Students will be able to analyse the root cause problems in the product & process by using different problem solving techniques
- Students will able to apply 5S and safety in their work place.

**List of Practicals**

- 1. Draw and Demonstrate the process flow diagram**
- 2. Draw and demonstrate problem statement, target /Goal Setting**
- 3. Draw and demonstrate Pareto diagram**
- 4. Draw and Demonstrate cause and effect diagram**
- 5. Data validation and why –why Analysis**

**All these techniques applied can be used as a project to solve the problems in their workplace in OJT**

**SUBJECT: Manufacturing Technology**  
**CODE: BBME-101**  
**CATEGORY: Skill Education Component**

Credit	Hours	Marks		
2	30	I	E	To
		15	35	50

**Objectives**

- To make the students learn various techniques available to make shapes and designs in various materials
- To make students understand requirements and methodologies to be followed in casting, fabrication and forming of engineering materials

**Learning Outcomes**

- The graduates will be able to learn various techniques available to make shapes and designs in various materials. Students will understand the methodologies to be followed in casting, fabrication, machining, materials, metallurgy and forming of engineering materials.
- At the end of the course, students will be able to select and perform suitable method of producing a desirable component in industry.
- The graduates can become job-givers rather than just job-seekers
- Manufacturing a desirable component in industry.
- Knowledge of different component and product of shop floor and the process of manufacturing used.
- Ability to perform welding interdependently

Unit	Topic	Key Learning
I	<b>Metal casting processes:</b>	<ul style="list-style-type: none"> <li>• Introduction to Sand Casting: Sand Mould, Type of patterns, Pattern Materials, Pattern allowances.</li> <li>• Moulding sand Properties Moulding methods and processes-materials.</li> <li>• Moulding sand ingredients, essential requirements</li> </ul>
II	<b>Machining process:</b>	<ul style="list-style-type: none"> <li>• Cutting parameters: cutting speed, feed and depth of cut</li> <li>• Single and multi point cutting tool and its geometry</li> <li>• Introduction and working principle of lathe, shaper, planar, milling, grinding, broaching and CNC and conventional machine tools</li> <li>• Super finishing operations like honing, lapping, buffing, shaving etc.</li> </ul>
III	<b>Metal cutting:</b>	<ul style="list-style-type: none"> <li>• Cutting Tool Materials: Characteristics of tool materials, various types of cutting tool materials, coated tools, cutting tool selection.</li> <li>• Shapes and type of tools and its usage for specific applications and its nomenclature.</li> <li>• Types of tool wear, tool life, factors governing tool life</li> <li>• Purpose and types of cutting fluids, basic actions of cutting fluids, effect of cutting fluid on tool life, selections of cutting fluid.</li> </ul>
IV	<b>Metal Forming</b>	<ul style="list-style-type: none"> <li>• Introduction of metal forming processes.</li> <li>• Drawing, extrusion, forging, rolling and its types</li> <li>• Tools and Toolings: Varieties of Dies, punches etc</li> </ul>

		<ul style="list-style-type: none"> <li>• Machinery: Types of presses, hammers, extrusion machinery rolling mill etc.</li> </ul>
V	<b>Welding</b>	<ul style="list-style-type: none"> <li>• Introduction to welding: purpose of welding, methods of welding,</li> <li>• Welding parameters like temp, gas pressure, electrode distance, electric current, voltage etc</li> <li>• Types of welding: electric arc, spot, seam, gas, MIG, TIG, Robotic welding.</li> <li>• Soldering and Brazing</li> <li>• Types of electrodes for different metals, varieties of metals and according processes</li> <li>• Heat and distortion control</li> <li>• Fixtures and clamps</li> </ul>

### **Suggested Readings**

#### **Text Books-**

- Basic Manufacturing Processes- By VikasUpadhyay and Vikas Agarwal (Katson Publication-2016 Edition)
- Manufacturing Technology Volume 2(Metal cutting and Machine tools)- By P.N. Rao- McGraw Hill Education
- Manufacturing Technology Volume 1 (Foundry, Forming and Welding)-By P.N.Rao – McGraw Hill Education

#### **Reference Books-**

- Manufacturing Science- Amitabh Ghosh & A.K. Malik- Pearson India (2010)
- Manufacturing Processes for Engineering Material Si Edition- Kalpakjian- Pearson India (6th Edition)
- Manufacturing Processes and systems- Jairo Munoz Phillip F. Ostwald- Wiley (9th Edition)

**SUBJECT: Manufacturing Technology Lab**

**CODE: BBME-101P**

**CATEGORY: Skill Education Component**

Credit	Hours	Marks		
		I	E	To
2	60	35	15	50

**Objectives**

- To learn the use of basic hand tools
- To know the need for safety in work place
- To gain hands on experience on Fitting, welding and machine shop
- To have the basic knowledge on working of different machines in shop floor.

**Learning Outcomes**

- The graduates will become familiar with fundamentals of safety precautions, ability to perform work on conventional machines by their own
- Able to understand the various parts of the Machines used and thus acquire the capability to work on it.

**List of Practicals**

**Machine shop:**

1. To prepare a job on a lathe machine using right selection of tools (nose radius) and tooling.
2. To prepare a job involving side and face milling on a milling machine by using right cutter with right setting and right tools.
3. Determine the Tool Life while Milling a component on the Milling Machine and usage and setting of wiper insert.
4. Determine Tool Wear of a cutting tool while drilling on a Drilling Machine

**Welding Shop (mild steel)**

1. Exercise of Printed circuit board using soldering
2. To prepare a job by using electric arc welding.
3. Preparation of LAP/BUTT by using gas welding.
4. Preparation of job by using Brazing

**Fitting Shop:**

1. To study different types of hand cutting and fitting tools used in workshop
2. Exercise (Slide fit of square in square) with the help of files

**SUBJECT: Engineering Graphics and Drawing**  
**CODE: BBME-103P**  
**CATEGORY: Skill Education Component**

Credit	Hours	Marks		
		I	E	To
3	90	70	30	100

### Objectives

- Understand and appreciate the importance of Engineering Graphics in Engineering
- Understand the basic principles of Technical/Engineering Drawing
- Understand the different steps in producing drawings according to BIS conventions

### Learning Outcomes

- The student will become familiar with fundamentals of various science and technology subjects and thus acquire the capability to applying them
- The graduates will become familiar with fundamentals of engineering design. Understanding the concept generation, design optimization and evaluation.
- Students will be able to effectively design various engineering components and make process plan for the production.
- Projection of various components according to BIS specifications.
- Assembly of data and information of various components in visualized way
- Interpretation of technical graphics assemblies

### List of Practical's

## CONTENTS

### 1. Introduction to drawing, lines and lettering:

- 1.1. Definition and classification of drawing
- 1.2. Drawing instruments such as; drawing board, drawing sheets, drafter.
- 1.3. Types of pencils, sheets, eraseretc.
- 1.4. Different types of lines( Straight line, inclined line and curved lines)
- 1.5. Practice engineering style for letters and numbers as BIS: SP:46-2003

#### Hands on training:

- Prepare drawing sheet by using different types of lines
- Prepare drawing sheet by Bisection of line, angle, arc.

### 2. Dimensioning and scale:

- 2.1. Importance of dimensioning
- 2.2. Types (i.e. chain, parallel and progressive etc.) and methods of placing dimensioning (i.e. aligned and unidirectional)
- 2.3. Principles of dimensioning and practice dimensioning technique as BIS: SP: 46-2003.
- 2.4. Free hand sketching of straight lines, circle, square, Polygons

#### Hands on training:

- To divide line of length 120mm into 9 equal parts
- Divide a circle into 12 equal parts by using engineering compass
- Divide a circle into 8 equal parts by using set square

### **3. Introduction to Projection:**

- 3.1. Introduction to first and third angle projection
- 3.2. Introduction to projection of point, line and plane
- 3.3. Sectioning of solids

#### **Hands on training:**

- Practice for projection of point
- Practice for projection of line
- Practice for projection plane

### **4. Isometric and Orthographic projection**

- 1.1 Isometric drawing of simple geometric solids
- 1.2 Orthographic projection of simple geometric solids.

#### **Hands on training:**

- Prepare drawing sheet of orthographic projection
- Prepare drawing sheet of isometric projection.

### **5. Geometric and dimensioning Tolerance**

- 5.1 Component Drawing and interpretation
- 5.2 Geometric dimension and Tolerance
- 5.3 Introduction to software used in drawing

#### **Suggested Readings:**

- Engineering Drawing Plane and Solid Geometry : N.D. Bhatt and V.M. Panchal, Forty-Fourth Edition 2002, Charotar Publishing House.
- Engineering Drawing :Laxmi Narayan and Vaishwanar, Charotar Publishing House.
- Engineering Graphics and Drafting : P.S. Gill, Milenium Edition, S.K. Kataria and Sons.
- Engineering Graphics using AUTOCAD 2007 : T. Jeyapoovan,m First Edition 2002, Vikas Publishing House.

## **2<sup>nd</sup> semester Syllabus**

<b>Credit</b>	<b>Hours</b>	<b>Marks</b>
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**SUBJECT: Applied Physics**

**CODE: ZBSC-103**

**CATEGORY: General Education Component**

2	30	I	E	To
		15	35	50

**Objectives**

- The aim of this subject is to provide the students with the basic concepts of measurement, properties of fluid, laser and fibre optics, Nanoscience etc.

**Learning Outcomes**

- Able to explain different system of units used in measurement system.
- Able to explain different properties of fluid
- Able to explain simple and compound machines.
- Able to explain the properties of laser.
- Able to explain concept of photoconductivity

Unit	Topic	Key Learning
I	<b>Mechanical Measurement</b>	<ul style="list-style-type: none"><li>• Basics of Measurements: Introduction, General measurement system, systems of units (FPS, CGS and SI units), Thermometry: Thermoelectric temperature measurement, Resistance thermometry.</li></ul>
II	<b>Properties of Matter and Thermal Physics</b>	<ul style="list-style-type: none"><li>• Definition and types of stress and strain, Hooke's law, Fluid properties – density, Specific weight, Specific gravity, Surface tension, Viscosity, Pressure - atmospheric pressure, gauge pressure, absolute pressure, Pascal's law, buoyancy, Introduction to laminar and turbulent flow. Modes of heat transfer- thermal conductivity.</li></ul>
III	<b>Simple Machines</b>	<ul style="list-style-type: none"><li>• Definition of simple and compound machine (examples), definition of load, effort, velocity ratio, mechanical advantage and efficiency of a machine and their relationship, law of machines, definition of an ideal machine, reversible and self-locking machines. Working principle and application of simple screw jack and worm &amp; worm wheel.</li></ul>
IV	<b>Lasers and Fibre Optics</b>	<ul style="list-style-type: none"><li>• Characteristics of Lasers, Spontaneous and stimulated emission of radiation, Ruby laser, Helium-Neon Laser, Applications of lasers. Principle of optical fibre, Acceptance angle and acceptance cone - Numerical aperture - Types of optical fibres and refractive index profiles, Application of optical fibres</li></ul>
V	<b>Photoconductivity and Nanoscience</b>	<ul style="list-style-type: none"><li>• Photoconductivity &amp; Photovoltaics: application of photoconductivity, photovoltaic cells, solar cell and its characteristics. Introduction to Nano materials - Basic principles of Nanoscience &amp; Technology, applications of nanotechnology.</li></ul>



**Suggested Readings:**

- **Applied Physics Vol. I, TTTI Publication; Tata McGraw Hill, Delhi**
- **Basic Applied Physics by RK Gaur; Dhanpat Rai Publications**
- **Comprehensive Practical Physics - Volume I and II by JN Jaiswal; Laxmi Publishers**
- **Numerical Problems in Physics-Volume I and II by RS Bharaj; Tata McGraw Hill**
- **Simple Course in Electricity and Magnetism by CL Arora; S Chand and Co, New Delhi**
- **Fundamental Physics - Volume I and II by Gomber and Gogia; Pardeep Publications, Jalandhar**

**SUBJECT: Applied Physics Lab**  
**CODE: ZBSC-103P**  
**CATEGORY: General Education Component**

Credit	Hours	Marks		
2	60	I	E	To
		35	15	50

**Objectives**

- Students will be able to learn how physics and other disciplines have impacted and continue to impact each other and society.

**Learning Outcomes**

- Able to perform experiments of screw jack and worm and worm wheel.
- Able to determine force constant using Hooke's law
- Able to perform Bernoulli's theorem.

**List of Practicals**

1. To find the mechanical advantage, velocity ratio and efficiency of a screw jack.
2. To find the mechanical advantage, velocity ratio and efficiency of a worm and worm wheel.
3. To determine force constant of spring using Hooke's law
4. To determine the Moment of Inertia using a Flywheel.
5. To verify the Bernoulli's Theorem.
6. To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee's apparatus.
7. To study the characteristics of Cu-Fe thermo couple.
8. To find the value of Planck's constant by using a photo electric cell.
9. To determine the energy gap of a semiconductor diode.
10. Solar Cell: To study the V-I Characteristics of solar cell.
11. Light emitting diode: Plot V-I and P-I characteristics of light emitting diode.
12. Photoelectric effect: To determine work function of a given material.
13. LASER: To study the characteristics of LASER sources.
14. Optical fibre: To determine the bending losses of Optical fibres.

**SUBJECT: Applied Mathematic**  
**CODE: ZBSC-101**  
**CATEGORY: General Education Component**

Credit	Hours	Marks		
4	60	I	E	To
		30	70	100

**Objectives**

- Acquire knowledge in matrix theory, a part of linear algebra, which has wider application in engineering problems.
- To make the student knowledgeable in the area of Permutation and combination, trigonometric functions and to solve engineering problems based on the above concepts.
- To make the student knowledgeable with basic and applied mathematics for further application.

**Learning Outcomes**

- The graduates will become familiar with fundamentals of various Mathematical concepts.
- Students will be able to set up and solve linear systems/linear inequalities graphically/geometrically and algebraically
- Students will be able to formulate problems in the language of sets and perform set operations, and will be able apply the Fundamental Principle of Counting, Multiplication Principle.
- Solve equations and inequalities, both algebraically and graphically, and Solving and model applied problems.
- Acquire more knowledge in basic concepts of engineering mathematics.
- To improve problem evaluation technique.
- Choose an appropriate method to solve a practical problem.

Unit	Topic	Key Learning
I	<b>Algebra:</b>	<ul style="list-style-type: none"> <li>• Set theory</li> <li>• Permutation and Combination</li> <li>• Binomial theorem (expansion without proof)</li> <li>• Types of functions – linear, quadratic, polynomial, exponential and logarithmic</li> </ul>
II	<b>Trigonometric functions:</b>	<ul style="list-style-type: none"> <li>• Review of ratio of some standard angles (0, 30, 45, 60, 90 degrees)</li> <li>• Addition, subtraction and product formulae</li> <li>• Multiple and submultiples angles (2A, 3A, A/2)</li> <li>• Height and distance</li> </ul>
III	<b>Determinants and matrix:</b>	<ul style="list-style-type: none"> <li>• Introduction to Determinant and matrices</li> <li>• Algebra of matrices (up to third order)</li> <li>• Inverse of matrix by Adjoint method (up to second order)</li> <li>• Solution of system of linear equations by Cramer’s rule</li> </ul>
IV	<b>Differential calculus:</b>	<ul style="list-style-type: none"> <li>• Rules of differentiation – simple standard forms (involving one variable)</li> <li>• Derivatives of algebraic and trigonometric functions</li> <li>• Differentiation of function of a function Chain rule</li> </ul>
V	<b>Integral calculus:</b>	<ul style="list-style-type: none"> <li>• Integral of standard forms</li> <li>• Simple integration by substitution</li> <li>• Integration by parts and by fractions (for linear factor only)</li> <li>• Evaluation of definite integrals</li> </ul>

**Suggested Readings:**

- NCERT- 11<sup>th</sup> and 12<sup>th</sup> Mathematics.
- Advanced Engineering Mathematics, E. Kresyzig, John Wiley and Sons. (latest edition).
- Higher Engineering Mathematics, B.S. Grewal, Khanna Publications
- Advanced Engineering Mathematics, R.A Jain and S.R.K Iyengar. Narosa Publications.
- Engineering Mathematics, N.P Bali, Laxmi Publications.

**SUBJECT:Basics of Electrical& Electronics Engineering****CODE:ZBEE-104****CATEGORY:** General Education Component

Credit	Hours	Marks		
		I	E	To
2	30	15	35	50

**Objectives**

- To provide knowledge of Electrical Circuits.
- To provide knowledge of Electrical Protective Equipment's.
- To provide knowledge of Semiconductor and Applications.

**Learning Outcomes**

- Able to understand the concept of Current, Voltage and Power.
- Able to understand the concept of Transformers and Motor.
- Able to understand the concept of Relay and Circuit Breaker.
- Able to understand the concept of Semiconductor diodes & Bipolar Junction Transistor.

Unit	Topic	Key Learning
I	<b>D.C Circuits</b>	<ul style="list-style-type: none"> <li>• Definition of Voltage, Current, Power, Resistance, Inductance and Capacitance with their units, Ohm's law, Kirchhoff's Law, Series -Parallel Circuit, Conversion of Current and Voltage Source.</li> </ul>
II	<b>Three Phase A.C Circuits</b>	<ul style="list-style-type: none"> <li>• Generation of 3 phase E.M.F, Difference between three-phase and single-phase supply, Star connection, Delta Connection and its Conversion.</li> </ul>
III	<b>Electrical Machines</b>	<ul style="list-style-type: none"> <li>• Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Transformer, Induction Motor, Servo &amp; Stepper motors.</li> </ul>
IV	<b>Protective Devices &amp; Safety Precautions</b>	<ul style="list-style-type: none"> <li>• Introduction to PPE (Personal Protective Equipment) &amp; Safety Precautions, Introduction of Relays, Contactors, MCBs, ELCBs, Fuses, Concept of Neutral and Earthing.</li> </ul>
V	<b>Semiconductor Devices &amp; its Applications</b>	<ul style="list-style-type: none"> <li>• Basic idea of semiconductors – P and N type; diodes, zener diodes and their applications, transistor – PNP and NPN, symbols, identification of terminals of transistor, current flowing in a transistor, its characteristics and uses. Characteristics and applications of a thyristor.</li> </ul>

**Suggested Readings:****Text Books**

- Basic of Electrical and Electronics Engineering by S.k. Sahdev, Dhanpatrai Publications,2013.
- Text Book of Electrical Technology by B.L Theraja, S.Chand Publications,2014

**Reference Books**

- A Course in Electrical Technology by J.B Gupta, Katson Publications,2013
- Electrical Technology by J.S Katre, Techmax Publications, 2016

**SUBJECT:Basics of Electrical& Electronics  
Engineering Lab**

**CODE: ZBEE-104P**

**CATEGORY:** General Education Component

Credit	Hours	Marks		
		I	E	To
2	60	35	15	50

**Objectives**

- To provide knowledge of Electrical Circuits.
- To provide knowledge of Electrical Protective Equipment's.
- To provide knowledge of Semiconductor and Applications.

**Learning Outcomes**

- Able to identify tools used in the electrical
- Able to verify Kirchoff's law
- Able to perform DOL Starter
- Able to perform half wave and full wave rectifier

**List of Practicals**

1. Introduction of tools, symbols and abbreviations.
2. To verify Kirchoff's current & voltage law.
3. Construction & Working of DOL starter.
4. Construction & Working of Star-Delta starter.
5. Construction & Working of Distribution Board and Extension Board.
6. To perform open circuit test and short circuit test of a single-phase transformer.
7. Draw V-I characteristics of P-N junction diode.
8. Draw input and output characters of a transistor.
9. Draw reverse break down characteristics of a zener diode.
10. Construction & Working of Half Wave & Full Wave rectifier on bread board.

**SUBJECT: Basics of Mechatronics**  
**CODE: ABME-106**  
**CATEGORY: Skill Education Component**

Credit	Hours	Marks		
2	30	I	E	To
		15	35	50

**Objectives**

- Study of various mechatronics elements and their application.
- Study of means of measuring various physical variables.
- Study of different types of sensors and actuators

**Learning Outcomes**

- Illustrate how different elements are presented and illustrate their working principles.
- Illustrate issues of implementation of different sensors including calibration and error analysis
- Demonstrate different types of actuators and their implementation
- Demonstrate different types of mechatronics elements.
- Combined form of mechanical and electrical components.
- Basics of Automation
- Actuators and sensors.

Unit	Topic	Key Learning
I	<b>Introduction</b>	<ul style="list-style-type: none"> <li>• Introduction to Mechatronics –systems – concepts of Mechatronics approach</li> <li>• Need for Mechatronics</li> <li>• Emerging areas of Mechatronics</li> <li>• Classification of Mechatronic</li> </ul>
II	<b>Sensors</b>	<ul style="list-style-type: none"> <li>• Sensors and Transducers, Static &amp; Dynamic characteristics of sensors</li> <li>• Potentiometers, LVDT, Capacitance sensors</li> <li>• Strain gauges, Eddy current sensors, hall effect sensors,</li> <li>• Temperature sensors</li> <li>• Light Sensors</li> </ul>
III	<b>Basic Programmable Logic Controller (PLC) and its Components.</b>	<ul style="list-style-type: none"> <li>• Basic structure</li> <li>• Input and output processing</li> <li>• Programming</li> <li>• Timers, counters</li> <li>• Selection of PLC Introduction</li> <li>• Basic commands of PLC</li> </ul>
IV	<b>Stepper and Servo motors</b>	<ul style="list-style-type: none"> <li>• Basics of Stepper and Servo motors</li> <li>• Types of Stepper and servo motors</li> <li>• Construction, working, principle</li> <li>• Advantages and Disadvantages</li> </ul>
V	<b>Basic of Design of Mechatronics, Pneumatics &amp; Hydraulics system.</b>	<ul style="list-style-type: none"> <li>• Design Process</li> <li>• Stages of Design Process</li> <li>• Traditional &amp; Mechatronics Design concept</li> <li>• Basics of Pneumatics&amp; Hydraulics system</li> </ul>

**Suggested Readings:**

- System design – Devdas Shetty & Richard A.Kolk PWS Publication
- Mechatronics - Electronics control systems in Mechanical Engineering W.Bolton(Pearson)
- Mechatronics HMT (TMH)
- Mechatronics -- Prof.C.R.Venkataramana, Sapna Book House
- Mechatronics -- Electronics in product & process—Bradley, Dawson, Burd and Loader
- Introduction to mechatronics & measuring system.—Alciatore (TMH).
- Mechatronics Principles, concept & Applications—Mahalik (TMH).
- Pneumatic system principle & maintenance – Majumdar



**SUBJECT: Basics of Mechatronics Lab**  
**CODE: ABME-106P**  
**CATEGORY: Skill Education Component**

Credit	Hours	Marks		
1	30	I	E	To
		35	15	50

### Objectives

- To synergies the combination of mechanical, electronics, control engineering and computer.
- Providing a focused laboratory environment to the engineering students to apply and absorb Mechatronics concepts.
- To provide a common ground where students could perform experimental study regarding fundamental sequence control by utilizing various sensors and actuators.

### Learning Outcomes

- Practical application of Relay
- Various operations by Pneumatic and hydraulic.
- Operation of Displacement and temperature sensors
- Use of mechanical, electrical components in automation
- Various components of pneumatic and hydraulic operations.

### List of Practicals

1. Introduction to Mechatronic Lab, System & it different Components.
2. To study the Application of Electromagnetic relay (Holding the Push button).
3. Operation of Single acting Cylinder using Pneumatics.
4. Operation of Double acting Cylinder using Pneumatics.
5. Impulse Pilot operation using Double acting Cylinder.
6. Operation of Single Acting Cylinder Using Single Solenoid Valve.
7. Operation of Double Acting Cylinder Using Single Solenoid Valve.
8. Measurement of displacement using LVDT.
9. Measurement of temperature using thermocouple, thermistor and RTD
10. Introduction of PLC (programmable logic controller).

**SUBJECT: Measurement & Metrology**  
**CODE: BBME-106**  
**CATEGORY: Skill Education Component**

Credit	Hours	Marks		
2	30	I	E	To
		15	35	50

**Objectives**

- Understand metrology, its advancements & various measuring instruments
- To study the fundamentals of modern measurement tools and laid standard procedures.
- To study fundamentals of inspection methods and systems.
- To acquaint with operation of precision measurement tools and equipment

**Learning Outcomes**

- Explain different measuring instruments to measure the qualitative and quantitative characteristics of different mechanical components.
- Evaluate quality of job, machine and instruments.
- Perform calibration of measuring instruments.
- Analyze parts/instruments for dimensional accuracy and functionality.
- Describe functioning of force, torque, pressure, vibration and temperature measuring devices.
- Explain tolerance, limits of size, fits, geometric and position tolerances, gauges and their design.
- Understand the objectives of metrology, methods of measurement, selection of measuring instruments, standards of measurement and calibration of instruments.

Unit	Topic	Key Learning
I	<b>Introduction to Measurement</b>	<ul style="list-style-type: none"> <li>• Aim, Definition, types, need of inspection, terminologies, methods of measurements, units of measurement, selection of instruments, concept of error (systematic and random), sources of error, Measurement standards, calibration, statistical concepts in metrology.</li> </ul>
II	<b>Linear and Angular Measurements</b>	<ul style="list-style-type: none"> <li>• Linear instruments, Surface plates (size, accuracy and material), slip gauges, Length bars–Calibration of the slip gauges, dial indicator, micrometers. Bevel protractor, spirit levels, sine bar, angle Gauges. Comparators, their types, relative merits and limitation.</li> <li>• <b>Miscellaneous measurements:</b> Taper &amp; Radius measurement.</li> </ul>
III	<b>Measurement of Properties</b>	<ul style="list-style-type: none"> <li>• Temperature, Force, weight, Pressure &amp; flow, Noise, Lux and vibrations. Concept of fitting, tightening and torquing in a line and its equipment.</li> </ul>
IV	<b>Screw thread and Gear teeth metrology:</b>	<ul style="list-style-type: none"> <li>• <b>Screw Measurement:</b> Introduction, screw thread terminology, screw thread measurement</li> <li>• <b>Gear measurement:</b> Introduction, types of gears, gear terminology, Gear Teeth Measurement, errors in gears, measurement of spur gear.</li> </ul>

**Suggested Readings:**

## TEXT BOOKS:

1. Jain R.K. "Engineering Metrology", Khanna Publishers, 2005.
2. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.

## REFERENCES:

1. Shot bolt, "Metrology for Engineers", McGraw Hill, 1990.
2. Backwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education, 2006.

**SUBJECT: Measurement & Metrology Lab**  
**CODE: BBME-106P**  
**CATEGORY: Skill Education Component**

<b>Credit</b>	<b>Hours</b>	<b>Marks</b>		
1	30	I	E	To
		35	15	50

### **Objectives**

- To study the fundamentals of modern measurement and quality concepts.
- To study fundamentals of inspection methods and systems
- To acquaint with operation of precision measurement tools and equipment's.

### **Learning Outcomes**

- Apply inspection gauge and checking systems.
- Demonstrate the understanding of measuring instruments and their principle.
- Analyze simple parts for dimensional accuracy and functionality using different instruments.

### **List of Practicals**

1. To Study and apply Linear Measuring Instruments for measurement of given specimens (Vernier calipers, scale, measuring tape etc.)
2. To Check bore diameter using bore dial gauge
3. Measurement of Gear parameters using flange micrometer
4. To check pitch of thread using thread gauge: Ring gauge, plug gauge, micrometer etc.
5. To measure intensity of light in a room for different conditions using lux meter and analysis of the result.
6. To study of Radius gauge and Depth gauge, Filler and other similar gauges used in the industry.
7. To check Outer Diameter and Internal Diameters of given components using Air gauges.
8. Measurement of Taper Angle Using Slips, Rollers & Sine bar.
9. Demonstration of Coordinate measuring machine.
10. To measure total composite error (TCE) and Teeth to Teeth error (TTE) for given gear specimen using gear roll tester/Parkinson gear tester.

**3<sup>rd</sup> Semester**

**SUBJECT:Electrical Machines & Control system**

**CODE: ABEE-201**

**CATEGORY: General Education Component**

Credit	Hours	Marks		
2	30	I	E	To
		15	35	50

**Objectives**

- To prepare students to perform the analysis of any electromechanical system.
- To empower students to understand the working of electrical equipment used in everyday life.
- To prepare the students for advanced courses in robotics.

**Learning Outcomes**

- The ability to formulate and then analyze the working of D.C Machine
- The ability to formulate and then analyze the working of A.C Machine.
- The ability to explain the three phase synchronous machine.
- The student acquire the knowledge control system.
- Ability to identify the components of control system

Unit	Topic	Key Learning
I	<b>D.C. Machines:</b>	<ul style="list-style-type: none"> <li>• Constructional features</li> <li>• Principles of operation</li> <li>• EMF equation, Voltage build up phenomenon in a D.C. shunt generator,</li> <li>• Characteristics of different types of generators.</li> <li>• Principle of operation of DC motor, back emf,</li> <li>• Speed and torque equation,</li> <li>• Various characteristics of different motors</li> </ul>
II	<b>A.C. Machines:</b>	<ul style="list-style-type: none"> <li>• Constructional features</li> <li>• Concept of revolving magnetic field, and principle of operation of Three phase induction motors</li> <li>• Torque slip characteristics and power flow in induction motors</li> <li>• Induction motor as a transformer, equivalent circuit</li> </ul>
III	<b>Three Phase synchronous Machine:</b>	<ul style="list-style-type: none"> <li>• Constructional features EMF equation.</li> <li>• Armature reaction of synchronous generator</li> <li>• Voltage regulation of generators</li> <li>• Phasor diagrams and equivalent circuits of synchronous machine</li> <li>• Starting methods and principle of operation of synchronous motor</li> <li>• Constructional features EMF equation.</li> </ul>
IV	<b>Control system- Introduction</b>	<ul style="list-style-type: none"> <li>• Introduction to control system,</li> <li>• Closed loop and open loop systems, examples</li> <li>• Temperature control, traffic control, numeric control</li> <li>• General block diagram of a control system, transfer function</li> </ul>

		<ul style="list-style-type: none"> <li>• Mason gain formula, Signal Flow graph.</li> </ul>
V	<b>Components of control systems</b>	<ul style="list-style-type: none"> <li>• Components of control systems, potentiometer.</li> <li>• Synchro and synchro transmitter and receiver.</li> <li>• 5.3 Controllers - two position controllers, preparation of controllers, analysis. Integrated controllers, electronic PID controllers</li> </ul>

**Suggested Readings:**

- D C Kulshreshtha: Basic Electrical Engineering: McGraw Hill Education, 2011.
- I.J. Nagrath, T.P. Kothari., Basic Electrical Engineering, McGraw-Hill Publishing company Ltd.,
- Nagsarkar T K and Sukhija M S, —Basics of Electrical Engineering, Oxford press
- GopalM. Control System Principles and Design, Tata McGraw-Hill, 1998

**SUBJECT:Electrical Machines & Control systems lab**

**CODE: ABEE-201P**

**CATEGORY: General Education Component**

Credit	Hours	Marks		
		I	E	To
2	60	35	15	50

**Objectives**

To expose the students the operation of electric drives to gain hands on experience

**Learning Outcomes**

- Ability to perform load test on D.C. shunt motor
- Ability to perform speed control test
- Ability to do characteristics of different electrical motors

**List of Practical's**

1. To perform load test on DC shunt generator
2. To perform speed control of DC shunts motor.
3. To perform load test of DC shunt motor.
4. To perform no load and block rotor test of 3 phase induction motor.
5. To study DC speed control system.
6. To perform the dc **position** control system.
7. To study linear system simulator
8. To use a synchronous pair as error detector.
9. To perform and study potentiometer as an error detector.
10. To perform synchro transmitter receiver pair



**SUBJECT: Digital and Power Electronics**

**CODE: ABEC-201**

**CATEGORY: General Education Component**

Credit	Hours	Marks		
		I	E	To
3	45	15	35	50

**Objectives**

- To simplify the mathematical expressions using Boolean functions – simple problem
- Study & design the combinational & sequential circuits.
- Get an overview of different types of power semiconductor devices and their

**Learning Outcomes**

- Understand the basic gates and the number.
- To simplify Boolean function.
- Discuss tradeoffs involved in power semiconductor switches.
- Analyze different types of power converters.
- Analyze issues involved in controlling of AC and DC drives.
- Realize drive considerations for different industrial applications

Unit	Topic	Key Learning
I	<b>Introduction</b>	<ul style="list-style-type: none"> <li>• Logic Levels and Pulse Waveforms</li> <li>• Elements and Functions of Digital Logic</li> <li>• Digital Integrated Circuits</li> <li>• Number system and codes</li> <li>• AND, OR, NAND, NOR, Gate Propagation Delay Time, Power Dissipation Noise Immunity, Fan In &amp; Out, Loading Considerations</li> <li>• AND – OR Logic AOL Logic, XOR Logic, Universal Property of NAND and NOR Logic – Half and Full Adders</li> <li>• Decoders and Encoders – Multiplexers and Demultiplexers</li> </ul>
II	<b>Boolean Algebra and Latches:</b>	<ol style="list-style-type: none"> <li>1.</li> <li>2. <ul style="list-style-type: none"> <li>• Boolean Operations, Logic Expressions</li> <li>• Rules and Laws of Boolean Algebra De Morgan’s Theorem</li> <li>• Simplifications of Boolean Expressions, Karnaugh Map</li> <li>• Flip Flops, Different Types of Flip Flops, Flip Flops Operations, Operating Characteristics, Applications of Flip Flops</li> </ul> </li> </ol>
III	<b>Power Semi-Conductor Devices</b>	<ul style="list-style-type: none"> <li>• Study of switching devices</li> </ul>

		<ul style="list-style-type: none"> <li>• Diode, SCR, TRIAC, GTO, BJT, MOSFET, IGBT-Static Dynamic characteristics, Triggering and commutation circuit for SCR</li> <li>• Design of Driver and Snubber circuit</li> </ul>
IV	<b>Cyclo Converter</b>	<ul style="list-style-type: none"> <li>• Principle of Cyclo-converter operation.</li> <li>• Single phase to single phase circuit step up Cyclo converter</li> <li>• Single phase to single phase circuit step down Cyclo converter</li> </ul>
V	<b>Inverters</b>	<ul style="list-style-type: none"> <li>• Single phase and three phase voltage source inverters (both 1200 mod and 1800 mode)</li> <li>• Voltage &amp; harmonic control</li> <li>• WM techniques: Sinusoidal PWM, modified sinusoidal PWM - multiple PWM</li> <li>• Introduction to space vector modulation</li> <li>• Current source inverter</li> </ul>

**Suggested Readings:**

- **Morris Mano M., —Digital Circuits and Logic Designl, Prentice Hall of India, II Edition, 1996.**
- **Reshid, M.H., Power Electronics – Circuits Devices and Application, Prentice Hall International, New Delhi, 3rd Edition, 2004.**

**SUBJECT: Digital and power Electronics lab**  
**CODE: ABEC-201P**

Credit	Hours	Marks		
		I	E	To
2	60	35	15	50

**CATEGORY:** General Education Component

**Objectives**

- To introduce the students different power electronics components and use of them in electronic circuits.
- To study characteristic of different power electronics of components.

**Learning Outcomes**

- Ability to use SCR, MOSFET, TRIAC in electronic circuit
- Ability to perform characteristic study on the electronics components.

**List of Practicals**

1. Single phase Semi / Full Converter with R & R-L load.
2. Three phase Semi / Full Converter with R load.
3. To draw the firing characteristics of DIAC.
4. To draw UJT characteristics
5. Observe the output wave UJT relaxation oscillator.
6. Single phase AC voltage controller using SCRs for R load
7. Single-Phase PWM bridge inverter for R load.
8. Configuring NAND and NOR logic gates as universal gates.
9. Implementation of Boolean Logic Functions using logic gates and combinational circuits
10. Construction of half adder and full adder
11. Verification of state tables of RS, JK, T and D flip-flops
12. Implementation & verification of Decoder/Demultiplexer and Encoder/multiplexer using logic gates

**SUBJECT: Environmental studies & Professional Ethics**

**CODE: ZBGE-201**

**CATEGORY: General Education Component**

Credit	Hours	Marks		
		I	E	To
3	90	30	70	100

**Objectives**

- Imparting Basic knowledge about the environment
- To Develop an attitude of concern for the environment
- Train students about quality assurance programmes implemented in industries.
- To examine the latest business practices crucial for running successful business.

**Learning Outcomes**

- To Participate in environment protection and environment improvement
- The Industrial environment management
- Graduate will develop a sense community responsibility by becoming aware of environmental issues in the large social context
- The course will provide a conceptual framework of handling the diverse and complex problems in business and industries. It will help in addressing and solving the real life problems relating to industrial setups.

Unit	Topic	Key Learning
I	<b>Environmental Studies</b>	<ul style="list-style-type: none"> <li>• Nature, Scope and Importance,</li> <li>• Need for Public Awareness,</li> <li>• Renewable and Non-Renewable Resources</li> <li>• Role of an Individual in Conservation of Natural Resources</li> </ul>
II	<b>Ecosystems</b>	<ul style="list-style-type: none"> <li>• Concept, Structure and Function of an Ecosystem</li> <li>• 2.2 Energy Flow in the Ecosystem,</li> <li>• 2.3 Ecological Succession,</li> <li>• 2.4 Types of Ecosystem: Forest Ecosystem, Grassland Ecosystem, Desert Ecosystem, Aquatic Ecosystems</li> </ul>
III	<b>Pollution</b>	<ul style="list-style-type: none"> <li>• Environmental Pollution: Definition, Causes, Effects and Control Measures of</li> <li>• Different Types of Pollutions, Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution,</li> <li>• Thermal Pollution,</li> </ul>

		Nuclear Hazards
IV	<b>Introduction to Industrial Management</b>	<ul style="list-style-type: none"> <li>• Concept</li> <li>• Development</li> <li>• Application and scope of Industrial Management</li> <li>• Productivity: Definition, Measurement, Types of production system</li> </ul>
V	<b>Industrial safety and Basic QC tools</b>	<ul style="list-style-type: none"> <li>• 5.1 Concept of safety in industries</li> <li>• 5.2 Introduction to Integrated Management system. (ISO 14001,OHSAS18001)</li> <li>• 5.3 OPL (One point lesson), Control charts</li> <li>• 5.4 Seven QC Tools</li> <li>• 5.5Kaizen, Five S (5S)</li> </ul>

**Suggested Readings:**

- P. Khanna, “Industrial Engineering and Management”, Dhanpatrai publications Ltd, New
- L.C.Jhamb ,SavitriJhamb , Industrial Management – I , Everest Publishing House .
- K.ShridharaBhat, “Materials and Logistics Management”, Himalaya Publishing House.
- AzarKazmi , “Strategic Management & Business Policy “, Tata McGraw Hill, New Delhi
- Ravi M. Kishore, “Project Management”, Tata McGraw Hill, New Delhi

**SUBJECT: Microcontroller and Programmable Logic Controller**

**CODE: ABEC-205**

**CATEGORY: Skill Education Component**

Credit	Hours	Marks		
		I	E	To
2	30	15	35	50

**Objectives**

- Understand the basic concept of microprocessors.
- Learn about architectures of 8051 microcontroller.
- Learn to write the program.
- Learn about the PLC

**Learning Outcomes**

- Know about microprocessor & microcontroller.
- Start to write the program using microprocessor & microcontroller
- Gain the detailed knowledge in microprocessor & microcontroller.
- Know the basic of programmable logic controller hardware and software.
- Learn about timer and counter use in PLC

Unit	Topic	Key Learning
I	<b>INTRODUCTION</b>	<ul style="list-style-type: none"> <li>• Comparing Microprocessors and Microcontrollers.</li> <li>• Technological trends in Microcontrollers development.</li> <li>• Microcontrollers- 8 bit, 16 bit, 32 bit microcontrollers.</li> <li>• Applications of microcontrollers</li> </ul>
II	<b>8051 ARCHITECTURE</b>	<ul style="list-style-type: none"> <li>• Block diagram, pin. Diagram of 8051.</li> <li>• Functional descriptions of internal units, registers, PSW, internal RAM ROM, Stack, Oscillator and Clock.</li> <li>• Counters and timers, Serial data interrupt Serial data transmission and transmission modes.</li> <li>• Timer flag interrupt. External interrupt, software generated interrupts</li> </ul>
III	<b>8051 INSTRUCTION SET AND PROGRAMMING</b>	<ul style="list-style-type: none"> <li>• 8051 Instruction syntax, addressing modes, Data transfer instructions, logical</li> </ul>

		<p>instructions, arithmetic instructions, Jump and Call instructions.</p> <ul style="list-style-type: none"> <li>• Interrupts and interrupt handler subroutines. Writing assembly Language programs.</li> </ul>
IV	<b>Programmable Logic Controllers</b>	<ul style="list-style-type: none"> <li>• Introduction – Parts of PLC, Principles of operation</li> <li>• PLC sizes – PLC hardware components – I/O section Analog I/O Section Analog I/O modules –digital I/O modules CPU processor memory module</li> <li>• Programming devices – PLC programming Simple instructions – Manually operated switches – Mechanically operated and Proximity switches Output control devices - Latching relays PLC ladder diagram, Converting simple relay ladder diagram in to PLC relay ladder diagram</li> </ul>
V	<b>Timers, Counters and Their Applications</b>	<ul style="list-style-type: none"> <li>• Timer instructions ON DELAY, OFF DELAY and RETENTIVE Timers</li> <li>• UP COUNTER, DOWN COUNTER and UP DOWN COUNTERS</li> <li>• Control instructions – Data manipulating instructions, math instructions; Applications of PLC – Simple materials handling applications.</li> </ul>

**Suggested Readings:**

- Kennath J. Ayala. The 8051 Microcontroller Architecture, Programming and Applications,
- Penram International Publishing (India), Second Edition, Mumbai.
- Frank D. Petruzella. “Programmable Logic Controllers”, McGraw–Hill Book, Company, 1989.
- B.P. Singh, Microprocessors and Microcontrollers, Galcotia Publications (P) Ltd, First edition, New Delhi, 1997.
- Embedded Controller Hand book, Intel Corporation, USA.
- Microcontroller Hand Book, INTEL, 1984.

**SUBJECT:Microcontroller and programmable logic controller lab**

**CODE: ABEC-205P**

**CATEGORY: Skill Education Component**

Credit	Hours	Marks		
		I	E	To
1	30	35	15	50

**Objectives**

- To introduce and train the students to use microcontroller and PLC for actuation, control of Speed.

**Learning Outcomes**

- Ability to use microcontroller and PLC to control different motor/equipment.

**List of Practical's**

1. Familiarization of Micro Controllers (8051) kit
2. Write an Assembly language Programme (ALP) to generate 10 kHz square wave
3. Write an ALP to generate 10 kHz frequency using interrupts.
4. Write an ALP for temperature and pressure measurement.
5. Write an ALP to interface one Microcontroller with other wiring serial/parallel communication.
6. Make the Ladder diagram logics gates.
8. Actuation of Single Acting Cylinder with ON Delay Timer Using PLC.
9. Control of Double Acting Cylinder with UP Counter Using PLC.
10. Operation of Single Acting Cylinder with AND Logic Using PLC
11. Operation of Single Acting Cylinder with OR Logic Using PLC.
12. Automation of Single Acting Cylinder Using PLC.
13. Automation of Double Acting Cylinder Using PLC.



**SUBJECT: Sensors and Transducers**

**CODE: ABME-201**

**CATEGORY: Skill Education Component**

Credit	Hours	Marks		
		I	E	To
2	30	15	35	50

**Objectives**

- To introduce the concept, classification and calibration of different types of sensors. The objective of this course is to impart basic knowledge about the different sensors and their applications in robotics

**Learning Outcomes**

- Study the classification, characteristics and calibration of mechanical, electrical, optical, thermal, magnetic, chemical and biological sensors.
- Get exposure to displacement, force, torque, tactile, pressure, flow and temperature sensors.
- Learn the applications of different sensors in robotics.

Unit	Topic	Key Learning
I	<b>Principles of Sensors</b>	<ul style="list-style-type: none"><li>• Sensor classification, characteristics and calibration of mechanical, electrical, optical, thermal, magnetic, chemical and biological sensors, sensor reliability</li></ul>
II	<b>Displacement Sensors</b>	<ul style="list-style-type: none"><li>• principles of variable resistance, variable inductance, variable reluctance</li><li>• synchros and resolver, variable capacitance, Hall Effect device, digital displacement sensors.</li></ul>
III	<b>Force, Torque, Tactile and Pressure Sensors and Transducers</b>	<ul style="list-style-type: none"><li>• 3.1 Different types of load cells, digital force transducer, pressure transducer, transmission type, driving type and absorption type dynamometer</li><li>• 3.2 tactile sensors using contact closure, magnetic, piezoelectric, photoelectric, capacitive and ultrasonic methods, manometer, elastic elements, electrical and piezoelectric pressure transducers, Pirani gage.</li></ul>
IV	<b>Flow Sensors</b>	<ul style="list-style-type: none"><li>• Head type flow meter, electromagnetic flow meter, rota meter, anemometer, ultrasonic flow meter.</li></ul>

V	<b>Temperature Sensors</b>	<ul style="list-style-type: none"> <li>• 5.1 Resistance and mechanical type temperature sensors, thermocouples, thermistor, optical pyrometer. Sensors in Robotics: Potentiometers, synchros and resolvers, optical encoders, tactile and proximity sensors, non-contact ranging sensors, ultrasonic transducers, optoelectric sensors, gyroscopes.</li> </ul>
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**Suggested Readings:**

- Doebelin, E.O., Measurement systems, Applications and Design, McGraw Hill (2011).
- Nakra, B. C. and Chaudhry, K. K., Instrumentation Measurement and Analysis, Tata McGraw Hill (2008). 87th Senate approved Courses Scheme & Syllabus for B.E. Mechatronics Engg. (2014).
- Murthy, D.V.S., Transducers and Instrumentation, Prentice Hall of India Private Limited (2003).
- Sawhney, A.K., A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai and Co. (P) Ltd. (2007).

**SUBJECT: Sensors and Transducers Lab**

**CODE: ABME-201P**

**CATEGORY: Skill Education Component**

Credit	Hours	Marks		
		I	E	To
1	30	35	15	50

**Objective**

- To provide knowledge sensors and signal processing
- To provide hand experience to measure different signal using sensor and processing them in

Required form.

**Learning Outcomes**

- Ability to use the sensors for the measurement of different signals and use of signal Processing techniques to convert them to useful signal.

**List of Practical's**

1. Speed measurement using inductive pickup/proximity sensor
2. Measurement to temperature using thermocouple
3. Measurement to temperature using thermister
4. Measurement to temperature using RTD
5. Measurement of displacement using LVDT & Capacitive transducer,
6. Measurement of displacement using position and velocity measurement using encoders,
7. Flow measurement using rotameter.
8. Measurement of weight using strain gauge.

**4<sup>th</sup> Semester**

**SUBJECT: Applied Hydraulics & Pneumatics****CODE: ABME-202****CATEGORY:** General Education Component

Credit	Hours	Marks		
		I	E	To
3	45	15	35	50

**Objectives**

- To introduce the industrial hydraulics and pneumatics, their parts, functions and their structure. To give the required information about hydraulics and pneumatics and to teach the fundamentals of hydraulic and pneumatic circuit design

**Learning Outcomes**

- Working principle of various components used in hydraulic & pneumatic systems.
- learn about various components such as hydraulic Pumps systems, Hydraulic Actuators and Valve
- To learn about basic principles of Pneumatics
- To understand pneumatic elements, their working, uses
- To learn about the hydraulic & pneumatic circuits

Unit	Topic	Key Learning
I	<b>Introduction</b>	<ul style="list-style-type: none"> <li>• Need and importance of hydraulic and pneumatic, Hydrostatic and hydrodynamic definitions, properties of fluid, Pascal's law, Continuity equation and Bernoulli's equation. Advantages and limitations of hydraulic and pneumatic systems</li> </ul>
II	<b>Hydraulic Pump</b>	<ul style="list-style-type: none"> <li>• Type, construction, working applications and selection criteria. Other Elements such as filters, manifold, receivers, coolers and connectors. Hydraulic Actuators- Type, working and applications. Control Valves- Type, designation, symbols, working and applications, Hydraulic Pipes- Type, materials, designations, pressure ratings and selection criteria. Piping Layout, Concept, rules/norms</li> </ul>
III	<b>Fundamentals of Pneumatics</b>	<ul style="list-style-type: none"> <li>• Compressible fluid flow, mass flow rate, compressible fluid- Type, properties and applications</li> </ul>
IV	<b>Pneumatic Element</b>	<ul style="list-style-type: none"> <li>• Pipes- Type, applications and properties. Air Compressor- Type (Reciprocating and rotary), working and selection. Pneumatic Cylinders- Type, symbol, cushion, assemblies, mounting and, Pneumatic Valves- Type, symbols, working, applications and selection. Air Motors- Type, working and applications. Other Elements - Air receivers, filters, pressure regulator, lubricator. Introduction to Solenoid valves- their working and types</li> </ul>

V	<b>Hydraulic and Pneumatic Circuits</b>	<ul style="list-style-type: none"><li>• Concept, Meaning and ISO symbols. Brief on designing of hydraulic and pneumatic circuits. Applications</li></ul>
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**Suggested Readings:**

- **Fluid Mechanics & Hydraulic Machines, R. K. Rajput, S. Chand Limited**
- A Textbook of Fluid Mechanics and Hydraulic Machines, R. K. Bansal
- **A Textbook Of Fluid Mechanics, R. K Rajput, S. Chand Limited**
- Hydraulics and Pneumatics, Andrew Parr

**SUBJECT: Applied Hydraulics & Pneumatics Lab****CODE: ABME-202P****CATEGORY:** General Education Component

Credit	Hours	Marks		
		I	E	To
1	30	35	15	50

**Objectives**

- To introduce and provide hand on experience to students to design and test hydraulic circuit to Control press, flow etc.
- To provide hands on experience to design and test the pneumatic circuit to perform basic Operations

**Learning Outcomes**

- Ability to design and test hydraulic, pneumatic circuit
- Upon Completion of this subject, the students can able to have hands on experience in flow measurements using different devices and also perform calculation related to losses in pipes and also perform characteristic study of pumps, turbines etc.,

**List of Pra cticals**

1. Determination of friction factor for a given set of pipes.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Determination of viscosity by capillary tube viscometer
4. Flow visualization using Reynolds apparatus
5. Study of Counter Balancing Circuit on Hydraulic Trainer
6. Controlling the Speed of the Cylinder Using Metering In and out valve circuit.
7. Single Cycle Automation of Double Acting Cylinder Using Limit Switch.
8. Operation of double acting cylinder using double solenoid valve.
9. Single Cycle Automation of Multiple Cylinders in Sequence ( $A^+B^+A^-B^-$ ).
10. To prepare basic hydraulic and pneumatic circuits on fluid sim.

**SUBJECT: Manufacturing Automation & Ergonomics****CODE: ABME-204****CATEGORY: General Education Component**

Credit	Hours	Marks		
		I	E	To
2	30	35	15	50

**Objectives**

- To introduce a student to industry 4.0 Manufacturing technologies.
- Application based learning of advance technologies and their feasibility in incorporation with existing setup

**Learning Outcomes**

- To explain general functioning of automation systems
- Explain & Implement the skills required for automation, control and monitoring of industrial processes.
- Knowledge of Flexible manufacturing systems and their implementation in various stages.
- To understand concepts of Ergonomics and Work study and their application in industry scenario.

Unit	Topic	Key Learning
I	<b>Introduction</b>	<ul style="list-style-type: none"> <li>• Types and strategies of automation, pneumatic and hydraulic components circuits, Automation in machine tools. Mechanical feeding and tool changing and machine tool control transfer the automation. Manufacturing automation principles and elements in product realization</li> </ul>
II	<b>Automated Flow Lines Assembly systems and Line balancing</b>	<ul style="list-style-type: none"> <li>• Methods, Mechanical buffer storage control function, Design and fabrication consideration.</li> <li>• Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines. Latest technologies being employed in Industry 4.0 era for achieving higher efficiency</li> </ul>
III	<b>Advancement in Manufacturing</b>	<ul style="list-style-type: none"> <li>• Application of Nanotechnology and allied field, AFM, SEM, TEM, Advanced electronic Packaging</li> </ul>
IV	<b>Introduction To Robotics</b>	<ul style="list-style-type: none"> <li>• Classifications of robots, Work envelope, manipulators- Electronic and Pneumatic manipulators, end effectors. Applications of Robots</li> </ul>
V	<b>Introduction to Ergonomics</b>	<ul style="list-style-type: none"> <li>• Evolution of Ergonomics, Introduction, Definitions of Ergonomics, The Scope of Ergonomics, Aspects of Ergonomics Application Areas of Ergonomics, Man and Machine Interaction</li> </ul>



**Suggested Readings:**

1. Mikell P. Grover “Automation, Production Systems and Computer-Integrated Manufacturing” Pearson Education, New Delhi. ISBN: 0132393212
2. Antony Esposito, “Fluid power with Applications” Pearson Education India. ISBN:8177585800
3. Andrew Parr, " Hydraulic and Pneumatics ", Butterworth-Heinemann. ISBN:0750644192
4. Bolton. W. “Pneumatic and Hydraulic Systems” Elsevier Science & Technology Books. ISBN:0750638362
5. N. Viswanandham, Y. Narhari “Performance Modeling of Automated Manufacturing Systems” Prentice-Hall. ISBN: 0136588247
6. S. R. Mujumdar, “Pneumatic system”, Tata McGraw Hill. ISBN: 0074602314
7. W Bolton., “Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering” Prentice-Hall. ISBN: 0131216333
8. C D Johnson, “Process Control Instrumentation Technology”, Prentice Hall of India, New Delhi. ISBN: 8120309871.

**SUBJECT: Manufacturing Automation & Ergonomics**

**CODE: ABME-204P**

**CATEGORY:** General Education Component

Credit	Hours	Marks		
2	60	I	E	To
		35	15	50

**Objectives**

- Students will learn about basics of robots and its applications
- Student will learn about Manufacturing automation system

**Learning Outcomes**

- Student will able describe the functioning of the Auto flow lines ,numerical control system
- Student will able to explain the concept of Automated material handling system and inspection system
- Able to kwon the Virtual CNC and Virtual high performance machining system

**List of Practicals**

1. Study of Autoflow lines.
2. Study of Numerical control system.
3. Study of different types of robots based on configuration and application
4. Study of Automated material handling system.
5. Study of Automated inspection system.
6. Study of Group technology.
7. Study of CAPP systems.
8. Study of Virtual CNC
9. Study of Virtual High Performance Machining System (MACHPRO)}

**SUBJECT: Computer Numerical control Machines**

CODE: ABME-206

Credit	Hours	Marks		
		I	E	To
2	30	15	35	50

CATEGORY: General Education Component

**Objectives**

Upon completion of this subject, student will be able to:

- Understand evolution and principle of CNC machine tools
- Describe constructional features of CNC machine tools
- Explain drives and positional transducers used in CNC machine tools
- Write simple programs for CNC turning and machining centres
- Generate CNC programs for popular CNC controllers
- Describe tooling and work holding devices for CNC machine tools

**Learning Outcomes:**

- Upon completion of this course the student can provide knowledge on principle, constructional features, programming, tooling and workholding devices in CNC machine tools

Unit	Topic	Key Learning
I	<b>Introduction of the CNC Machines</b>	<ul style="list-style-type: none"> <li>• Basic components of CNC and DNC machines, Advantages and Disadvantages of CNC machines, Application of CNC machines, difference between Conventional and CNC machines, applications of CNC Machines. Environmental control for CNC Machines</li> </ul>
II	<b>NC Machine Tooling</b>	<ul style="list-style-type: none"> <li>• Introduction to cutting tools for CNC Machine on the basis of Setting up of cutting tools pre-set tooling, qualified tools, on the basis of Cutting tool construction- solid tools, brazed tools, inserted bit Tools, on the basis of cutting tool material- high carbon tools steels (HCS), Cast alloys, Cemented carbides and others. Factors considered in selecting the tooling for CNC Machines. Design features of CNC tooling</li> </ul>
III	<b>Introduction to Part Programming</b>	<ul style="list-style-type: none"> <li>• Part Programming, definition and need, Basis concepts of part programming, basic terms-Bit, Byte, Character, NC Work, Block, G and M Codes</li> </ul>
IV	<b>Part Programming for different operations</b>	<ul style="list-style-type: none"> <li>• Methods of writing a part program, axis identification, part zero, floating zero and machine zero, part programming (point to point machining), Part Programming of drilling machine (point to point), Part Programming for machining along straight line and curved surface, part program for lathe operation, part programming for milling machine operations</li> <li>•</li> </ul>
V	<b>Automatically Programmed Tools</b>	<ul style="list-style-type: none"> <li>• Introduction, Computer aided Part Programming, Programming language: APT, Adapt, Auto Map, Exapt, and Prompt. APT Programming sequence, part geometric definition in APT-&gt; Defining a point,</li> </ul>

		defining a line, defining a circle, Defining a plane. Miscellaneous/Auxiliary statements-> Spindle speed, feed rate, tool change. Tool definition and others. Manual data input. On line editing of programme.
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**Suggested Readings:**

**TEXT BOOKS:**

1. HMT, "Mechatronics", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.
2. Warren S.Seamers, "Computer Numeric Control", Fourth Edition – Thomson Delmar, 2002.

**REFERENCES:**

1. James Madison, "CNC Machining Hand Book", Industrial Press Inc., 1996.
2. Ken Evans, John Polywka& Stanley Gabrel, "Programming of CNC Machines", Second Edition – Industrial Press Inc, New York, 2002
3. Peter Smid, "CNC Programming Hand book", Industrial Press Inc., 2000

**SUBJECT:Computer numerical control Machines lab**

**CODE: ABME-206P**

**CATEGORY:** General Education Component

Credit	Hours	Marks		
		I	E	To
2	60	35	15	50

**Objectives**

- To train the students in manual and computer assisted part programming, tool path generation And control, operation and control of CNC machines tools

**Learning Outcomes**

- Ability to write manual part programming using G code and M code for simple components
- Ability to operate CNC controlled machine tools

**List of Practicals**

1. To study G codes and M codes
2. To study NC/CNC machining tools.
3. To familiarize with control panel.
4. To familiarize with different co-ordinate systems.
5. To perform setting and off-setting the component.
6. To learn programming technique such as interpolation, helical and compensation and their application
7. CNC Part programming, sub programming and execution of an operation on milling machine
8. CNC Part programming, sub programming and execution of an operation on drilling machine.
9. CNC Part programming and sub programming on types of pockets

**SUBJECT:Project Management****CODE: ZBGE-204**

Credit	Hours	Marks		
		I	E	To
3	45	30	70	50

**CATEGORY:** Skill Education Component**Objectives**

This course develops the competencies, skills for planning and controlling projects. It will help in understanding interpersonal issues for driving successful project outcomes

**Learning Outcomes**

- To know the importance of project management how to approach successfully.
- To understand the project management design, development, and deployment.
- To identify the key performance metrics for success of project

Unit	Topic	Key Learning
I	Basics of Project Management	<ul style="list-style-type: none"> <li>• Introduction to Project Management, Objective of Project Management, Project Characteristics, Product Life Cycle Management, Devising Product Life Cycle Management Database</li> </ul>
II	Project Life cycle	<ul style="list-style-type: none"> <li>• The Project Life Cycle, Phases of Project Management Life Cycle, Project Management Processes, Project Identification Process, Project Initiation</li> </ul>
III	Project Planning	<ul style="list-style-type: none"> <li>• Project Planning, Need of Project Planning, Project Planning Process, Project Identification Process, Project Initiation. Feasibility Studies, Project Break-even point, Project Planning, Need of Project Planning, Project Planning Process.</li> </ul>
IV	Project Execution and Control	<ul style="list-style-type: none"> <li>• Project Execution, Project Close-out, Steps for Closing the Project, Project Termination, Project Follow-up, Classification of Projects, Project Performance Measurement, Project Performance Evaluation, Benefits and Challenges of Performance</li> </ul>
V	Project Performance Measurement and Evaluation	<ul style="list-style-type: none"> <li>• Measurement and Evaluation, Controlling the Projects, Work Breakdown Structure</li> <li>• Development of Project Network, PERT, CPM Model. Project Management Information System, Social Cost Benefit Analysis, Steps for Project Success, Case Studies in Project Management, Activity planning through GANTT Chart.</li> </ul>

**Suggested Readings:**

- P. Chandra Projects, 7th edition, Tata McGraw Hill
- S. Chaudhary: Project Management, Tata McGraw Hill
- Bhavesh M Patel (2000): Project Management, Vikas publishing house.
- RamarajuThirumalai (2002): Project Management, Himalaya publishing house.
- Jeffery K. Pinto (2012): Project Management, 2nd edition, Pearson Education

**SUBJECT: Plant Maintenance and safety**  
**CODE: ABME-208**

Credit	Hours	Marks		
		I	E	To
2	30	15	35	50

**CATEGORY:** Skill Education Component

**Objectives:**

- To enhance the fundamental knowledge in plant maintenance and safety

**Learning Outcomes**

The student will be able to:

- Understand the various plant hazards encountered in industry as well as protective equipment's
- Understand fire and use proper equipment's to extinguish fire
- Understand importance of plant Maintenance in an Industry

Unit	Topic	Key Learning
I	<b>Introduction to Maintenance &amp; its Planning</b>	<ul style="list-style-type: none"> <li>• History and evolution of maintenance strategies, classification of maintenance, Maintenance planning and need, Breakdown and Corrective Maintenance, Creation of Maintenance Notification, Release of Maintenance Notification, Maintenance Order creation from Notification, Material Requirement Planning, Purchase Order creation for Maintenance Materials</li> </ul>
II	<b>Maintenance Processing Execution</b>	<ul style="list-style-type: none"> <li>• Maintenance Order Release, Goods issue for Maintenance Order, Confirmation of Maintenance Order, Closing of Maintenance Order, Creation of Measuring Document</li> </ul>
III	<b>Preventive Maintenance</b>	<ul style="list-style-type: none"> <li>• Maintenance Strategy, Time based strategy Plan, Performance based strategy Plan, Condition based Maintenance, Creation of Maintenance Plan, Scheduling of Maintenance Plan, Preventive Maintenance Order execution, Dead line Monitoring</li> </ul>
IV	<b>Security Systems</b>	<ul style="list-style-type: none"> <li>• Fundamentals: Introduction to Security Systems, Concepts, CCTV: Camera: Operation &amp; types, Camera Selection Criteria, Camera Applications, CCTV Applications: CCTV Applications</li> </ul>
V	<b>Accident preventions, protective equipment's and Safety</b>	<ul style="list-style-type: none"> <li>• : Personal protective equipment, Survey the plant for locations and hazards, Part of body to be protected, Education and training in safety, Prevention causes and cost of accident, Housekeeping, First aid, Firefighting equipment, Accident reporting, Investigations, Industrial psychology in accident prevention, Safety trials</li> </ul>



### **Suggested Readings:**

- . Understanding Building Automation Systems (Direct Digital Control, Energy Management, Life Safety, Security, Access Control, Lighting, Building Management Programs) (Hardcover) by Reinhold A. Carlson (Author), Robert A. Di Giandomenico (Author)
- Building Automation: Control Devices and Applications by In Partnership with NJATC (2008)
- Building Control Systems, Applications Guide (CIBSE Guide) by the CIBSE (2000)
- MAINTENANCE ENGG. PRINCIPLES, PRACTICES & MANAGEMENT 1st Edition (English, Paperback, S. K. Srivastava

**SUBJECT: Plant Maintenance and safety Lab**  
**CODE: ABME-208P**

Credit	Hours	Marks		
		I	E	To
1	30	35	15	50

**CATEGORY:** Skill Education Component

### Objectives

- Maintenance of equipment in industries is very critical issue to ensure quality and quantity of production. Industries are not able to survive and progress if proper maintenance of equipment is not done. In the absence of proper maintenance, industries are busy in every day firefighting to repair the breakdowns and manage production in very unsafe manner. This course provides information about wear, corrosion, lubrication, preventive maintenance; decision tree to diagnose faults, important provisions of factory act, alignment of equipment etc. This course also provides basic knowledge and skills regarding maintenance problems, their causes and remedies in industries

### Learning outcomes

- Recognize troubles in mechanical elements.
- Assemble, dismantle and align mechanisms in sequential order.
- Carry out plant maintenance using tri-bology, corrosion and preventive maintenance

### List of Practicals

#### 1. Preparatory Activity:

Study and demonstrate use of various types of tools. (Fix spanners, box spanners, ring spanners, allen keys, types of pliers, screw drivers, bearing puller, etc.).

#### 2. Measurement of Wear:

Measure wears of anyone of the following.

- a. Machine guide ways.
- b. Shaft –sleeve
- c. Piston –cylinder.
- d. Bearing.

#### 3. Corrosion:

Each student will collect corroded component from field and identify the types of corrosion and possible causes. Student will also suggest prevention methods.

#### 4. Fault Tracing and Decision Tree:

Develop decision tree for location of fault for any two items from followinga. Internal combustion (IC) engine. b. Boiler. c. Pump. d. Machine tool. e. Air compressor. f. Electric motor.

#### 5. Maintenance of Mechanical Based Equipment/Device/Machine.

Maintenance of any two from following. Batch may be divided in to two groups and each group may be given one case. a. Head stock. b. Tail stock. c. Feed box. d. Indexing head. g. Internal combustion (IC) engine. h. Pump.

#### 6. Preventive Maintenance:

Prepare a preventive maintenance schedule of any workshop having- air compressors, car washing pumps, tyre changer, lifts, welding machines, and wheel alignment

# **5<sup>th</sup> Semester**

**SUBJECT: Digital Signal Processing**  
**CODE: ABEC-301**  
**CATEGORY: General Education Component**

Credit	Hours	Marks		
		I	E	To
3	45	15	35	50

**Objectives**

- To introduce discrete Fourier transform and its applications.
- To teach the design of infinite and finite impulse response filters for filtering undesired signals.
- To introduce signal processing concepts in systems having more than one sampling frequency

**Learning Outcomes**

- Ability to apply current knowledge and applications of mathematics, science, engineering and technology
- Ability to identify, formulate, analyze and solve technical and engineering problems

Unit	Topic	Key Learning
I	<b>DISCRETE-TIME SIGNALS:</b>	<ul style="list-style-type: none"> <li>• Signal classifications, frequency domain representation, time domain representation, representation of sequences by Fourier transform, properties of Fourier transform.</li> <li>• Discrete time random signals, energy and power theorems.</li> </ul>
II	<b>DISCRETE-TIME SYSTEMS</b>	<ul style="list-style-type: none"> <li>• Classification, properties, time invariant system</li> <li>• finite impulse Response (FIR) system</li> <li>• Infinite impulse response (IIR) system.</li> </ul>
III	<b>SAMPLING OF TIME SIGNALS</b>	<ul style="list-style-type: none"> <li>• Sampling theorem, application, frequency domain representation of sampling, and reconstruction of band limited signal from its samples.</li> <li>• Discrete time processing of continuous time signals, changing the sampling rate using discrete time processing.</li> <li>• Z-TRANSFORM: Introduction, properties of the region of convergence, properties of the Z-transform, inversion of the Z-transform, applications of Z-transform.</li> </ul>
IV	<b>BASICS OF DIGITAL FILTERS:</b>	<ul style="list-style-type: none"> <li>• Fundamentals of digital filtering, various types of digital filters</li> <li>• Design techniques of digital filters: window technique for FIR, bi-linear transformation and backward difference methods for IIR filter design</li> </ul>
V	<b>MULTIRATE DIGITAL SIGNAL PROCESSING</b>	<ul style="list-style-type: none"> <li>• Introduction to multirate digital signal processing</li> <li>• Sampling rate conversion, filter structures, multistage decimator and interpolators</li> <li>• 5.3 Digital filter banks.</li> </ul>

**Suggested Readings:**

- Digital Signal Processing : Proakis and Manolakis; Pearson
- Digital Signal Processing: Salivahanan, Vallavaraj and Gnanapriya;TMH

**REFERENCE BOOKS:**

- Digital Signal Processing: Alon V. Oppenheim;PHI
- Digital Signal processing (II-Edition): Mitra, TMH

**SUBJECT: Digital Signal Processing Lab**  
**CODE: ABEC-301P**  
**CATEGORY: General Education Component**

<b>Credit</b>	<b>Hours</b>	<b>Marks</b>		
2	60	I	E	To
		35	15	50

### **Objectives**

- To provide knowledge digital modulation technique
- To provide hand experience to
- To provide hand experience to MAT Labsoftware

### **Learning Outcomes**

- Able to understand Quantization technique, PCM encoding & hamming code generation
- Able to do the programming on MAT Labsoftware

### **List of Practical's**

1. To understand sampling theorem & generation of waveforms like sine, square & Triangle.
2. To study Quantization technique.
3. To study PCM encoding & Hamming code generation.
4. To Study Digital modulation techniques ASK/FSK&PSK.
5. To study FIR Filter Implementation.
6. To study Auto correlation & Linear convolution.

### **MATLAB**

1. Represent basic signals (Unit step, unit impulse, ramp, exponential, sine and cosine).
2. To develop program for discrete convolution.
3. To develop program for discrete correlation.
4. To design analog filter (low-pass, high pass, band-pass, band-stop).
5. To design digital IIR filters (low-pass, high pass, band-pass, band-stop).
6. To design FIR filters using windows technique.

**SUBJECT: Entrepreneurship Development**

CODE: ZBGE-303

CATEGORY: General Education Component

Credit	Hours	Marks		
		I	E	To
3	45	30	70	100

**Objectives**

- Enable the students to develop the insight needed to discover and create entrepreneurial opportunities.
- Successfully start and manage their own businesses to take the advantage of these opportunities.

**Learning Outcomes**

- The course will create awareness among the students about the entrepreneurship and factors that will help in facilitating the entrepreneurial development with a focus on new ventures/ start ups.

Unit	Topic	Key Learning
I	<b>Entrepreneurship</b>	<ul style="list-style-type: none"> <li>• Entrepreneurship- Meaning, Nature and Scope 1.2</li> <li>• Characteristics and Qualities of a Successful Entrepreneur</li> <li>• Relationship between Entrepreneurship Development and Economic Development.</li> </ul>
II	<b>Overview of business and its functioning</b>	<ul style="list-style-type: none"> <li>• Entrepreneurship and Society</li> <li>• New Venture Development- Meaning and Stages</li> <li>• Sources of Financing Entrepreneurship, Managerial Vs Entrepreneurial Approach.</li> </ul>
III	<b>Foundations of New Venture Finance</b>	<ul style="list-style-type: none"> <li>• EDP Programmes, Concept of Economic Freedom, Financial Markets and Entrepreneurship</li> <li>• Venture Capital; Angel Capital, Project Report Preparation, Balance Sheet, Cash Statement, Asset Vs Liability Gamification.</li> </ul>
IV	<b>Concepts related to planning and efficiency</b>	<ul style="list-style-type: none"> <li>• Entrepreneurial Strategies and Business Plan, Presenting Business Plans to the Investors</li> <li>• Future of Entrepreneurship in India.</li> </ul>
V	<b>Women Entrepreneurship and Marketing Strategy</b>	<ul style="list-style-type: none"> <li>• Concept, Factors governing women entrepreneurship, Schemes for women entrepreneurship</li> <li>• Rural Entrepreneurship, Concept, advantage and challenges, Introduction to Market Forecasting.</li> </ul>

**Suggested Readings:**

- Dollinger, MJ, Entrepreneurship- Strategies and Resources, Pearson Education.
- Desai, Vasant, Entrepreneurship Development, Himalaya Publishing House.
- Gupta, C.B. and Srinivasan, P., Entrepreneurship Development, Sultan Chand & Sons.
- Charanthimath, P.M., Entrepreneurship Development and Small Business Enterprise, Pearson Education.
- Havinal, Veerbhadrapa, Management and Entrepreneurship, 1st Edition, New Age International Publishers,

**SUBJECT: Industry 4.0**

**CODE: BBME-309**

**CATEGORY: General Education Component**

Credit	Hours	Marks		
		I	E	To
2	45	15	35	50

**Objectives**

- Objective of the course is to provide an introduction to Industry 4.0, Internet of Things (IoT) and related topics.
- Students will be introduced to technological and business challenges and opportunities as well as ethical concerns related to IoT

**Learning Outcomes**

- Understand the concept of Industry 4.0
- Learn about **Industry 4.0 Technologies**
- Understand the concepts of Internet of Things
- Understand the concepts AI

Unit	Topic	Key Learning
I	<b>Introduction of Industry 4.0</b>	<ul style="list-style-type: none"><li>• Industry 4.0 definition</li><li>• Benefits of Industry 4.0</li><li>• Industrial Revolutions and Future View</li><li>• The digital transformation of industry and the fourth industrial revolution</li><li>• Principles of “Smart Factory”</li><li>• Industry 4.0 strategy and implementation</li><li>• Industry 4.0 challenges and risks</li></ul>
II	<b>Industry 4.0 Technologies</b>	<ul style="list-style-type: none"><li>• Articulate how key IoT technologies can improve organizational productivity and add value</li><li>• Human-machine interaction</li><li>• Advanced robotics and 3-D printing</li><li>• Lean Manufacturing</li><li>• Touch interfaces, virtual reality and augmented-reality systems</li><li>• Cloud Computing</li></ul>
III	Introduction to IoT	<ul style="list-style-type: none"><li>• Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT,</li></ul>
IV	IoT & M2M	<ul style="list-style-type: none"><li>• Machine to Machine, Difference between IoT and M2M, Software define Network</li></ul>
V	Introduction of Artificial intelligent	<ul style="list-style-type: none"><li>• Foundations, scope, problems, and approaches of AI. Intelligent agents: reactive, deliberative, goal-driven, utility-driven, and learning agents</li></ul>

**Suggested Readings:**

Reference Books:

1. Vijay Madiseti, Arshdeep Bahga, “Internet of Things: A Hands-On Approach”
2. Waltenequs Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

**SUBJECT: Rapid Prototyping&3D Printing Lab**

**CODE: BBME-309P**

**CATEGORY: General Education Component**

<b>Credit</b>	<b>Hours</b>	<b>Marks</b>		
2	60	I	E	To
		35	15	50

### **Objectives**

- an understanding of a class of 3D printing and rapid prototyping (RP) technologies for rapid product development, including reverse engineering, 3D printing and additive manufacturing, and rapid tooling
- An holistic view of various applications of these technologies in relevant fields

### **Learning Outcomes**

- Be able to open, view, manipulate and edit three dimensional object files
- To create new three-dimensional object files from scratch.
- Prepare and optimize those files for 3D printing
- Successfully fabricate the file design through a 3D printing service provider using appropriate material and method selections.

### **List of Practical's**

1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
2. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
5. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
6. To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
7. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to Smartphone using Bluetooth.
8. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth.



**SUBJECT: Design of Mechatronics**  
**CODE: ABME-303**  
**CATEGORY: Skill Education Component**

Credit	Hours	Marks		
		I	E	To
3	45	15	35	50

**Objectives**

- To present architecture of the mechatronics system design
- To study on broad spectrum the characteristics of the mechanical and electrical systems and their selection for automation.
- Development of process plan and templates for design of mechatronic systems

**Learning Outcomes**

- Interface different component for a mechatronic system.
- Indigenously design and develop a mechatronic system.
- Mechatronics system designing.
- Modeling and simulation.
- Advanced application in mechatronic system design

Unit	Topic	Key Learning
I	<b>INTRODUCTION TO MECHATRONICS SYSTEM DESIGN</b>	<ul style="list-style-type: none"> <li>• Need for Mechatronics in Industries - Benefits</li> <li>• Mechatronics approach - Challenges before R&amp;D in Mechatronics.</li> <li>• Integrated design issues in Mechatronics - Mechatronics key elements</li> <li>• The Mechatronics design process.</li> <li>• Advanced approaches in Mechatronics.</li> </ul>
II	<b>PRINCIPLES OF MODELING &amp; SIMULATION</b>	<ul style="list-style-type: none"> <li>• Introduction - Model categories.</li> <li>• FIELDS OF APPLICATION - Bottom up design - Top down design Relationship of design strategies to modeling - Modeling for the specification - Modeling for the design.</li> <li>• MODEL DEVELOPMENT - Structural modeling - Physical modeling - Experimental modeling.</li> <li>• Model verification - Model validation - Model simplification.</li> <li>• SIMULATORS &amp; SIMULATION - Circuit - Logic – Multi-body - Block Diagram Finite element and Software simulation.</li> </ul>
III	<b>BASIC SYSTEM MODELS</b>	<ul style="list-style-type: none"> <li>• Mathematical models.</li> <li>• Mechanical system building blocks.</li> <li>• Electrical system building blocks.</li> <li>• Fluid system building block</li> </ul>
IV	<b>CASE STUDIES ON MECHATRONIC SYSTEM</b>	<ul style="list-style-type: none"> <li>• Introduction –Fuzzy based Washing machine – pH control system – Autofocus Camera</li> <li>• exposure control– Motion control using D.C.Motor&amp; Solenoids, Control of pick and place robot</li> </ul>
V	<b>ADVANCED APPLICATIONS IN MECHATRONICS SYSTEM DESIGN</b>	<ul style="list-style-type: none"> <li>• Sensors for condition monitoring</li> <li>• Mechatronic control in automated manufacturing.</li> <li>• Artificial intelligence in mechatronics.</li> <li>• Fuzzy logic applications in mechatronics.</li> </ul>

		<ul style="list-style-type: none"><li>• Micro sensors in mechatronics.</li></ul>
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**Suggested Readings:**

- Georg pelz, Mechatronic Systems: Modeling and simulation with HDL's, John wileyandsons Ltd, 2003.
- Devdasshetty, Richard A. Kolk, "Mechatronics System Design", Thomson Learning Publishing Company, Vikas publishing house, 2001.
- Bolton, -Mechatronics - Electronic Control systems in Mechanical and Electrical Engineering-, 2nd Edition, Addison Wesley Longman Ltd., 1999.
- Bishop, Robert H, Mechatronics Hand book, CRC Press, 2002.
- Bradley, D.Dawson, N.C. Burd and A.J. Loader, Mechatronics: Electronics in Products and Processes, Chapman and Hall, London, 1991.

**SUBJECT: Design of Mechatronics Lab**  
**CODE: ABME-303P**  
**CATEGORY: Skill Education Component**

Credit	Hours	Marks		
		I	E	To
1	30	35	15	50

### **Objectives**

- Students will be exposed to electronics devices and their controls used in industrial environment

### **Learning Outcomes**

- The student will able to use the concept of control motion system
- The student will able to use the different type of sensor and actuator
- The students will be able to use advanced sensors and actuators in the up gradation of automobiles

### **List of Practical's**

1. To study implementation of motion control system.
2. To study implementation of compensator design.
3. To study implementation of dynamic tuning of controller gains.
4. To study and Implementation of digital control algorithms for process control with minicomputers
5. To study Implementation, testing and debug of interface module.
6. Familiarization with various sensors, actuators, and process in the Automatic Control laboratory
7. To study Sensors for Motion Control Encoders, resolvers, decoders, tachogenerators

**SUBJECT: Minor Project Lab**  
**CODE: ABME-301P**  
**CATEGORY: Skill Education Component**

Credit	Hours	Marks		
		I	E	To
2	60	70	30	100

**Objectives**

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.
- Expose the students to actual design aspects by providing hands on skills

**Learning Outcomes**

- Identify various components, materials used, manufacturing process involved and assembly and dismantle of that commercial object.
- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology

**List of Practicals**

**Exercises:**

- To Dismantle and identify the various components, material used, manufacturing process involved and to assemble any Mechatronics system.
- A student will have to defend his project/thesis and credit will be given on the merit of viva-voce Examination.

**6<sup>th</sup> Semester**

**SUBJECT: Artificial Intelligence**  
**CODE: ABLQ-306**  
**CATEGORY: General Education Component**

Credit	Hours	Marks		
		I	E	To
3	45	30	70	100

**Objectives**

- To be familiar with the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, machine learning, knowledge acquisition and learning methods in solving particular engineering problems

**Learning Outcomes**

- Learn the basics and applications of artificial intelligence and categorize various problem domains, basic knowledge representation and reasoning methods.
- Analyze basic and advanced search techniques including game playing evolutionary search algorithms, and constraint satisfaction.
- Design of programs in AI language(s).
- Acquire knowledge about the architecture of an expert system and design new expert systems for real life applications

Unit	Topic	Key Learning
I	<b>Overview</b>	<ul style="list-style-type: none"> <li>• Foundations, scope, problems, and approaches of AI.</li> <li>• Intelligent agents: reactive, deliberative, goal-driven, utility-driven, and learning agents</li> </ul>
II	<b>Problem-solving through Search</b>	<ul style="list-style-type: none"> <li>• Forward and backward, state-space, blind, heuristic, problem reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications.</li> </ul>
III	Introduction to Knowledge Representation and Reasoning Planning:	<ul style="list-style-type: none"> <li>• Planning as search, partial order planning, construction and use of planning graphs</li> </ul>
IV	<b>Representing and Reasoning with Uncertain Knowledge</b>	<ul style="list-style-type: none"> <li>• Probability, connection to logic, independence, Bayes rule, Bayesian networks, probabilistic inference, sample applications.</li> <li>• Decision-Making: basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications.</li> </ul>
V	<b>Machine Learning and Knowledge Acquisition</b>	<ul style="list-style-type: none"> <li>• Learning from memorization, examples, explanation, and exploration.</li> <li>• Learning nearest neighbour, naive Bayes, and decision tree classifiers, Q-learning for learning action policies, applications</li> <li>• Languages for AI problem solving: Introduction to PROLOG syntax and data structures, representing objects and relationships, built-in predicates.</li> <li>• Introduction to LISP- Basic and intermediate LISP programming</li> <li>• Expert Systems: Architecture of an expert system, existing expert systems like MYCIN, RI, Expert system shells.</li> </ul>

**Suggested Readings:**

**TEXT BOOKS**

- Rich E., Artificial Intelligence, Tata McGraw Hills (2009).
- George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education Asia (2009).
- Patterson D.W, Introduction to AI and Expert Systems, McGrawHill (1998).
- ShivaniGoel, Express Learning- Artificial Intelligence, Pearson Education India(2013)

**SUBJECT: Consumer Affair**

**CODE: ZBGE-304**

**CATEGORY: General Education Component**

Credit	Hours	Marks		
		I	E	To
3	45	30	70	100

**Objectives.**

- This paper seeks to familiarize the students with their rights and responsibilities as a consumer, the social framework of consumer rights and legal framework of protecting consumer rights. It also provides an understanding of the procedure of redress of consumer complaints, and the role of different agencies in establishing product and service standards.
- The student should be able to comprehend the business firms' interface with consumers and the consumer related regulatory and business environment.

**Learning Outcomes**

- Able to understand the conceptual framework of consumer affair
- Able to explain the consumer protection law in India
- Able to explain the Grievance Redressal Mechanism under the Indian Consumer Protection Law
- Able to explain the Role of Industry Regulators in Consumer Protection
- Able to explain the Contemporary Issues in Consumer Affairs

Unit	Topic	Key Learning
I	<b>Conceptual Framework</b>	<ul style="list-style-type: none"><li>• <b>Consumer and Markets:</b> Concept of Consumer, Nature of markets: Liberalization and Globalization of markets with special reference to Indian Consumer Markets, E-Commerce with reference to Indian Market, Concept of Price in Retail and Wholesale, Maximum Retail Price (MRP), Fair Price, GST, labelling and packaging along with relevant laws, Legal Metrology.</li><li>• <b>Experiencing and Voicing Dissatisfaction:</b> Consumer buying process, Consumer Satisfaction/dissatisfaction-Grievances-complaint, Consumer Complaining Behaviour: Alternatives available to Dissatisfied Consumers; Complaint Handling Process: ISO 10000 suite.</li></ul>
II	<b>The Consumer Protection Law in India</b>	<ul style="list-style-type: none"><li>• <b>Objectives and Basic Concepts:</b> Consumer rights and UN Guidelines on consumer protection, Consumer goods, defect in goods, spurious goods and services, service, deficiency in service, unfair trade practice and restrictive trade practice.</li><li>• <b>Organizational set-up under the Consumer Protection Act:</b> Advisory Bodies: Consumer Protection Councils at the Central, State and District Levels; Adjudicatory Bodies: District Forums, State Commissions and National Commission: Their Composition, Powers, and Jurisdiction (Pecuniary and Territorial), Role of Supreme Court under the CPA with important case law.</li></ul>
III	<b>Grievance Redressal Mechanism under the Indian Consumer Protection Law</b>	<ul style="list-style-type: none"><li>• Who can file a complaint? Grounds of filing a complaint; Limitation period; Procedure for filing and hearing of a complaint; Disposal of cases, Relief/Remedy available;</li></ul>



		<p>Temporary Injunction, Enforcement of order, Appeal, frivolous and vexatious complaints; Offences and penalties.</p> <ul style="list-style-type: none"> <li>• <b>Leading Cases decided under Consumer Protection law by Supreme Court/National Commission:</b> Medical Negligence; Banking; Insurance; Housing &amp; Real Estate; Electricity and Telecom Services; Education; Defective Products; Unfair Trade Practices.</li> </ul>
IV	<b>Role of Industry Regulators in Consumer Protection</b>	<ul style="list-style-type: none"> <li>• Banking: RBI and Banking Ombudsman</li> <li>• Insurance: IRDA and Insurance Ombudsman</li> <li>• Telecommunication: TRAI</li> <li>• Food Products: FSSAI</li> <li>• Electricity Supply: Electricity Regulatory Commission</li> <li>• Real Estate Regulatory Authority</li> </ul>
V	<b>Contemporary Issues in Consumer Affairs</b>	<ul style="list-style-type: none"> <li>• <b>Consumer Movement in India:</b> Evolution of Consumer Movement in India, Formation of consumer organizations and their role in consumer protection, Misleading Advertisements and sustainable consumption, National Consumer Helpline, Comparative Product testing, Sustainable consumption and energy ratings.</li> <li>• <b>Quality and Standardization:</b> Voluntary and Mandatory standards; Role of BIS, Indian Standards Mark (ISI), Ag-mark, Hallmarking, Licensing and Surveillance; Role of International Standards: ISO an Overview</li> </ul>

**Note: Unit 2 and 3 refers to the Consumer Protection Act, 1986. Any change in law would be added appropriately after the new law is notified.**

**Suggested Readings:**

- Khanna, Sri Ram, Savita Hanspal, Sheetal Kapoor, and H.K. Awasthi. Consumer Affairs" (2007) Delhi University Publication; pp. 334/
- Aggarwal, V. K. (2003). Consumer Protection: Law and Practice. 5th Ed. Bharat Law House, Delhi, or latest edition.
- Girimaji, Pushpa (2002). Consumer Right for Everyone Penguin Books.
- Nader, Ralph (1973). The Consumer and Corporate Accountability. USA, Harcourt Brace Jovanovich, Inc.
- Sharma, Deepa (2011). Consumer Protection and Grievance-Redress in India: A Study of Insurance Industry (LAP LAMBERT Academic Publishing GmbH & Co.KG, Saarbrucken, Germany; pp.263 pp.
- Empowering Consumers e-book, [www.consumeraffairs.nic.in](http://www.consumeraffairs.nic.in)
- EBook [www.bis.org](http://www.bis.org)
- The Consumer Protection Act, 1986

**SUBJECT:** Applied Mechatronics  
**CODE:** ABME-302  
**CATEGORY:** General Education Component

Credit	Hours	Marks		
		I	E	To
3	45	15	35	50

**Objectives**

- To expose the students to applied Mechatronics

**Learning Outcomes**

- To get an overview of different types of power semiconductor devices and their switching characteristics.
- To understand the operation, characteristics and performance parameters of controlled rectifiers
- To study the operation, switching techniques and basics topologies of DC-DC switching regulators.
- To learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To study the operation of AC voltage controller and various configurations

Unit	Topic	Key Learning
I	<b>INTRODUCTION</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Power Electronics Vs Linear Electronics</li> <li>• Scope &amp; Applications</li> </ul>
II	<b>POWER SEMICONDUCTOR DEVICES</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Basic Structure, Characteristics, Operation, Limitations Power Diodes</li> <li>• BJTs &amp; MOSFETs Thyristors, GTOs IGBTs</li> </ul>
III	<b>CONVERTERS</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Control of dc – converters</li> <li>• Buck Converter</li> <li>• Boost Converter</li> <li>• Buck - Boost Converter</li> <li>• Full Bridge dc - dc Converter</li> </ul>
IV	<b>AC TO AC CONVERTERS</b>	<ul style="list-style-type: none"> <li>• Single phase and Three phase AC voltage controllers–Control strategy- Power Factor Control – Multistage sequence control -single phase and three phase cyclo converters –Introduction to Matrix converters .</li> </ul>
V	<b>PHASE CONTROLLED RECTIFIERS</b>	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Thyristor Circuits</li> <li>• Single Phase Converters</li> <li>• Three Phase Converters</li> </ul>

**Suggested Readings:**

- Industrial Electronics - James Homphires&Lestie Sheets
- Power Electronics Circuits Devices & Applications - M.H. Rashid
- Power Electronics - P.C. Sen, KjeldThorborg

**SUBJECT: Applied Mechatronics Lab**  
**CODE: ABME-302 P**  
**CATEGORY: General Education Component**

Credit	Hours	Marks		
		I	E	To
3	90	35	15	50

### Objectives

- To introduce the students different power electronics components and use of them in electronic circuits.
- To study characteristic of different power electronics components.

### Learning Outcomes

- Ability to use SCR, MOSFET, TRIAC in electronic circuit
- Ability to perform characteristic study on the electronics components

### List of Practicals

1. Static Characteristics of Power diode & Schottky diode and to study reverse recovery of Power Diode & Schottky diode.
2. Characteristics of IGBT
3. Characteristics of GTO
4. To study buck converter.
5. To study the boost converter.
6. To study the full bridge dc-dc converter.
7. To study the characteristic single phase converter.
8. To study the characteristic of three phase converter

**SUBJECT: Leadership & Quality Management****CODE: ZBLQ-304****CATEGORY: Skill Education Component**

Credit	Hours	Marks		
		I	E	To
3	45	30	70	100

**Objectives**

- To understand the need of quality and quality control
- Know about the importance of leadership skill in industries
- Understand the responsibilities of workmen for quality management in industry

**Learning Outcomes**

- The purpose of this course is to put quality management into perspective, and to highlight its critical importance, as well as to present in-depth ideas on different methodologies, tools and techniques proposed for product and process improvement.

Unit	Topic	Key Learning
I	Concept of Leadership	<ul style="list-style-type: none"> <li>• Trait and Behavioural Approaches, Contingency Approach, Leadership and Values, Leadership Behaviour, Courage and Moral Leadership</li> </ul>
II	Motivation and Empowerment	<ul style="list-style-type: none"> <li>• Leadership Diversity, Leader as Social Architect, Leadership and Change</li> </ul>
III	Problem Solving Methods	<ul style="list-style-type: none"> <li>• Resource Management, Work effectively in a Team, Process and Product Quality Monitoring,</li> <li>• Evolution of Quality Management, Concepts of Product and Service Quality, Introduction to Process Quality, Graphical and statistical techniques for Process Quality Improvement,</li> </ul>
IV	7 QC Tools, Control Charts	<ul style="list-style-type: none"> <li>• TQM, Benchmarking, Quality Audit, Quality Circles, OEM Guidelines, Quality Function Deployment</li> </ul>
V	Robust Design and Taguchi Method	<ul style="list-style-type: none"> <li>• Design Failure Mode &amp; Effect Analysis, Product Reliability Analysis, Case study on Six Sigma in Product Development, Kizen, 5S, etc.</li> </ul>

**Suggested Readings:**

- Daft, Richard L., Leadership, Cengage Learning India Pvt. Ltd., New Delhi.
- Hughes, Richard L, Robert C., Ginnett and Gordon J, Curphy, Leadership – Enhancing the Lessons of Experience, Tata McGraw Hill Co. Ltd, New Delhi
- D. C. Montgomery, Introduction to Statistical Quality Control, John Wiley & Sons, 3<sup>rd</sup> Edition.
- Mitra A., Fundamentals of Quality Control and Improvement, PHI, 2nd Ed., 1998.
- Besterfield, D H et al., Total Quality Management, 3rd Edition, Pearson Education, 2008

**SUBJECT: Major Project Lab**  
**CODE: ABME-304P**  
**CATEGORY: General Education Component**

Credit	Hours	Marks		
		I	E	To
3	90	70	30	100

**Objectives**

- Team work for designing and fabrication of an original mechatronics system.
- Decision making and design considerations for an individual/team projects

**Learning Outcomes**

- Work effectively in a team with a concept from initial stage to the final stage.
- Learn detailed designing and fabrication of mechatronics system.
- Apply all the learnings of the course for proper implementation of the project work.

**List of Practicals**

- Each student either individually or in a group, will be assigned a mechatronic system design project involving problem definition, selection, analysis, synthesis, optimization and detailing for production.
- Assembly and detailed production drawings will be prepared for the presentation of the design along with a printed report, PPT presentation and soft copy submission of work using software tools for final evaluation by a committee. Specialized software may be used for the design modelling, synthesis, optimization, analysis and for production drawings.
- Use of conventional / unconventional manufacturing processes for the fabrication of the physical prototype. The final manufacturing and working of the system will be required to be analysed.
- The course concludes with a final showcase using poster/ presentation along with comprehensive viva