RAJALAKSHMI ENGINEERING COLLEGE  
(An Autonomous Institution Affiliated to Anna University Chennai) 

DEPARTMENT OF MECHATRONICS ENGINEERING  
CURRICULUM AND SYLLABUS REGULATIONS – 2019  
B.E. MECHATRONICS ENGINEERING 

VISION:  
To attain excellence in academics, research and technological advancement in Mechatronics Engineering with a concern for society. 

MISSION:  

- To impart high quality professional education and produce Mechatronics Engineers with all round knowledge of multi-disciplinary branches of engineering and technology. 
- To foster skill sets required to be a global professional in the areas of automation, intelligent systems, robotics, research for technology management and to fulfill the expectations of industry and needs of the society. 
- To inculcate entrepreneurial qualities for creating, developing and managing global engineering ventures. 

Programme Educational Objectives (PEOs): 

**PEO I**  
Graduates will have comprehensive knowledge in the analytical, scientific and engineering fundamentals necessary to model, analyse and solve engineering problems and to prepare them for graduate studies and for successful careers in industry. 

**PEO II**  
Graduates will effectively design and develop products in the areas such as automation, manufacturing, Internet of Things, machine vision, system simulation, intelligent systems and robotics. 

**PEO III**  
Graduates will acquire Technical expertise, Leadership skills, Ethical practices and Team spirit with a concern towards greener society. 

PROGRAM OUTCOMES (POs):  

Engineering Graduates will be able to: 

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. 
2. **Problem analysis**: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. 
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**PROGRAM SPECIFIC OUTCOMES (PSOs)**

Engineering Graduates will be able:

- **PSO 1**: To innovate a Mechatronics system to meet the requirements and specifications.
- **PSO 2**: To analyse and improve the performance of a Mechatronics system and enhance the intellectual capabilities of the system
- **PSO 3**: To lead professional career in industries or an entrepreneur by applying Engineering and Management principles and practices.
### CURRICULUM AND SYLLABUS

#### SEMESTER I

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# PROFESSIONAL ELECTIVES (PE)*

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# DEPARTMENT OF MECHATRONICS ENGINEERING

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SEMESTER I

HS19151 TECHNICAL ENGLISH

Common to all branches of B.E/ B.Tech programmes – I semester

| Objective: |  |
| To enable learners to acquire basic proficiency in English reading and listening. |  |
| To write in English precisely and effectively. |  |
| To speak flawlessly in all kinds of communicative contexts. |  |

UNIT-I VOCABULARY BUILDING

The concept of word formation - Root words from foreign languages and their use in English - Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives - Synonyms, antonyms, and standard abbreviations. Compound words - abbreviation – single word substitution – Listening: Listening comprehension, Listening to motivational speeches, podcasts and poetry. Speaking: Short talks on incidents - place of visit – admiring personalities, etc.

UNIT-II BASIC WRITING SKILLS

Sentence structures - Use of phrases and clauses in sentences - punctuation - coherence - Organizing principles of paragraphs in documents - Techniques for writing precisely. Reading & Writing – Free writing – paragraphs - article reading and writing criticism - change of tense forms in short text or story – inferential reading – rewrite or interpret text - prepare questions based on the text. Speaking: Everyday situations – conversations and dialogues, speaking for and against.

UNIT-III GRAMMAR AND LANGUAGE DEVELOPMENT

Subject-verb agreement- Noun-pronoun agreement - Articles – Prepositions – Redundancies. Reading & Writing: Read from innovation and ideas that changed the world, newspaper column writing – Speaking: Demonstrative speaking practice using visual aids (charts, graphs, maps, pictures, etc,).

UNIT-IV WRITING FOR FORMAL PRESENTATION


UNIT-V EXTENDED WRITING AND SPEAKING


Total Contact Hours : 45

Course Outcomes:
On completion of course students will be able to
- Discuss and respond to the listening content.
- Read and comprehend different texts and appreciate them
- Understand structures and techniques of precise writing
- Analyse different genres of communication and get familiarized with new words, phrases, and sentence structures.
- Write and speak appropriately in varied formal and informal contexts.

Text Books:

Reference Books / Web links:
1. Technical Communication, Meenakshi Raman & Sangeeta Sharma, Oxford University Press
2. Effective Communication Skills, Kulbushan Kumar, Khanna Publishing House, Delhi
3. Communication Skills, Pushplata, Sanjay Kumar, Oxford University Press
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**Objectives:**
- To gain knowledge in using matrix algebra techniques and the limitations of using infinite series approximations for those problems arising in mathematical modelling.
- To understand the techniques of calculus which are applied in the Engineering problems.

**UNIT-I**  
**MATRICES**  
12  
Symmetric and skew – symmetric matrices, orthogonal matrices – Eigen values and Eigen vectors - Cayley – Hamilton theorem (without proof) and applications - orthogonal transformation and quadratic forms to canonical forms - Nature of quadratic forms.

**UNIT-II**  
**SEQUENCES AND SERIES**  
12  
Convergence of sequence and series – Test for convergence: Comparison Test, D’Alembert Ratio Test, Leibnitz Test, Integral test – Binomial series, Exponential series and logarithmic series: Summations and approximations.

**UNIT-III**  
**APPLICATIONS OF DIFFERENTIAL CALCULUS**  
12  
Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes - Evolute as envelope of normals.

**UNIT-IV**  
**FUNCTIONS OF SEVERAL VARIABLES**  
12  

**UNIT-V**  
**APPLICATION OF INTEGRATION**  
12  

**Total Contact Hours:** 60

**Course Outcomes:**
On completion of the course students will be able to
- Apply the concept of Eigenvalues and eigenvectors, diagonalization of a matrix for solving problems.
- Develop skills in solving problems involving sequences and series.
- Analyze, sketch and study the properties of different curves and to handle functions of several variables and problems of maxima and minima.
- Obtain the centre of gravity, moment of inertia for rigid bodies and also surface area and volume using multiple integrals.
- Process the data collected and analyze the data for central tendencies.

**Text Books:**

**Reference Books/Web links:**

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**Objectives:**
- To enhance the fundamental knowledge in Physics and its applications relevant to mechanical engineering streams.
To familiarize students in various experimental setups and instruments that are used to study/determine the various properties of materials.

UNIT I | MECHANICS & PROPERTIES OF MATTER | 9

UNIT II | CRYSTAL PHYSICS | 9
Basis – lattices - symmetry operations and crystal systems -Bravaislattics - atomic radius and packing fraction - SC, BCC, FCC, HCP lattices - Miller indices - diffraction by crystals - reciprocal lattice - interpreting diffraction patterns - crystal growth techniques-Czochralski and Bridgmann, crystal defects.

UNIT III | PHYSICS OF MATERIALS | 9

UNIT IV | ENGINEERING MATERIALS & TESTING | 9

UNIT V | QUANTUM PHYSICS | 9
Blackbody problem -Planck’s radiation law - duality of light -De Broglie hypothesis - properties of matter waves - wave packets –Schrödinger’s equations (time dependent and time independent) - Born interpretation (physical significance of wave function) - probability current - operator formalism (qualitative) - expectation values - uncertainty principle - particle in a box -eigen function and eigen values -Dirac notation (qualitative).

List of Experiments

| Contact Hours | 45 |
|----------------|

| Contact Hours | 30 |
|----------------|

| Total Contact Hours | 75 |
|---------------------|

Course Outcomes:
On completion of the course students will be able to
- Understand foundational mechanics and elastic nature of materials and determine the elastic moduli of materials.
- Apply the basic knowledge of crystallography in materials preparation and treatments.
- Create binary phase diagrams and TTT charts and use them to analyse and measure the properties of alloys.
- Understand various engineering materials, test or measure their properties and use them in suitable applications.
- Understand the concepts of quantum theory and the nature of light and determine the characteristics of a given laser source.

Text Books:
Reference Books / Web links:


Objectives:

● To understand the importance of the drawing in engineering applications
● To develop graphic skills for communication of concepts, ideas and design of engineering products
● To expose them to existing national standards related to technical drawings.
● To improve their visualization skills so that they can apply these skill in developing new products.
● To improve their technical communication skill in the form of communicative drawings

CONCEPTS AND CONVENTIONS (Not for Examination) Importance of graphics in engineering applications–Use of drafting instruments– BIS conventions and specifications– Size, layout and folding of drawing sheets– Lettering and dimensioning. Basic Geometrical constructions.

UNIT-I  PLANE CURVES AND FREE HAND SKETCH
Curves used in engineering practices: Conics–Construction of ellipse, parabola and hyperbola by eccentricity method– Construction of cycloids, Construction of involutes of square and circle drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects

UNIT-II  PROJECTION OF POINTS, LINES AND PLANE SURFACE
Orthographic projection- principles-Principal planes- projection of points. First angle projection - Projection of straight lines inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method- Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT-III  PROJECTION OF SOLIDS
Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.

UNIT-IV  PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES
Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of the section.

Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

UNIT-V  ISOMETRIC AND PERSPECTIVE PROJECTIONS
Principles of isometric projection–isometric scale–Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders and cones.

Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

Course Outcomes: After learning the course, the students should be able

● To construct different plane curves and free hand sketching of multiple views from pictorial objects.
● To comprehend the theory of projection and to draw the basic views related to projection of points, lines and planes
● To draw the projection of solids in different views
● To draw the projection of Sectioned solids and development of surfaces of solids
● To visualize and prepare Isometric and Perspective view of simple solids

Text Book (s):

Reference Books(s) / Web links:

Objectives:
● To understand the importance of natural resources, pollution control and waste management.
● To provide the students about the current social issues and environmental legislations.

UNIT-I | NATURAL RESOURCES | 9
--- | --- | ---
Environment - definition - scope and importance - forest resources - use and overexploitation - water resources - use and over utilization - dams - benefits and problems - water conservation - energy resources - growing energy needs - renewable and non renewable energy sources - use of alternate energy sources - land resources - land degradation - role of an individual in conservation of natural resources.

UNIT-II | ENVIRONMENTAL POLLUTION | 9
--- | --- | ---
Definition - causes, effects and control measures of air pollution - chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, and ozone depletion - noise pollution - mitigation procedures - control of particulate and gaseous emission (Control of SO2, NOx, CO and HC).
Soil pollution: definition - causes - effects and control of soil pollution.

UNIT-III | SOLID WASTE MANAGEMENT | 9
--- | --- | ---
Solid wastes - sources and classification of solid wastes - solid waste management options - sanitary landfill, recycling, composting, incineration, energy recovery options from wastes

UNIT-IV | SOCIAL ISSUES AND THE ENVIRONMENT | 9
--- | --- | ---
Sustainable development - concept, components and strategies - social impact of growing human population and affluence, food security, hunger, poverty, malnutrition, famine - consumerism and waste products - environment and human health - role of information technology in environment and human health - disaster management - floods, earthquake, cyclone and landslide.

UNIT-V | TOOLS FOR ENVIRONMENTAL MANAGEMENT | 9
--- | --- | ---
Course Outcomes:
On completion of the course students will be able to
- Be conversant to utilize resources in a sustainable manner.
- Find ways to protect the environment and play proactive roles.
- Apply the strategies to handle different wastes
- Develop and improve the standard of better living.
- Be conversant with tools of EIA and environmental legislation.

Text Books:

Reference Books / Web links:

Objectives:
To provide exposure to the students with hands on experience on various basic engineering practices in Civil and Mechanical Engineering.

CIVIL ENGINEERING PRACTICE
1. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings.
2. Preparation of basic plumbing line sketches for wash basins, water heaters, etc.
3. Hands-on-exercise: Basic pipe connections – Pipe connections with different joining components.

Carpentry Works:
4. Study of joints in roofs, doors, windows and furniture.

MECHANICAL ENGINEERING PRACTICE
6. Preparation of butt joints, lap joints and T-joints by Shielded metal arc welding.

Basic Machining:
8. Simple Turning and Taper turning
9. Drilling Practice

Sheet Metal Work:
10. Forming & Bending:
11. Model making – Trays and funnels
12. Different type of joints.
Machine Assembly Practice:

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<td>Study of air conditioner</td>
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Total Contact Hours : 30

Course Outcomes:

- Able to perform plumbing activities for residential and industrial buildings considering safety aspects while gaining clear understanding on pipeline location and functions of joints like valves, taps, couplings, unions, reducers, elbows, etc.
- Able to perform wood working carpentry activities like sawing, planning, cutting, etc. while having clear understanding of the joints in roofs, doors, windows and furniture.
- Able to produce joints like L joint, T joint, Lap joint, Butt joint, etc. through arc welding process while acquiring in depth knowledge in the principle of operation of welding and other accessories
- Able to perform operations like Turning, Step turning, Taper turning, etc. in lathe and Drilling operation in drilling machine
- Able to perform sheet metal operations like Forming, Bending, etc. and fabricating models like Trays, funnels, etc.

TOTAL: 30 PERIODS
**SEMESTER II**

**MA19251 DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS**

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Objectives:

- To handle practical problems arising in the field of engineering and technology using differential equations.
- To solve problems using the concept of Vectors calculus, Complex analysis, Laplace transforms.

**UNIT-I SECOND AND HIGHER ORDER DIFFERENTIAL EQUATIONS**

Second and higher order Linear differential equations with constant coefficients - Method of variation of parameters – Cauchy’s and Legendre’s linear equations - Simultaneous first order linear equations with constant coefficients.

**UNIT-II PARTIAL DIFFERENTIAL EQUATIONS**

Formation of partial differential equations - Solutions of standard types of first order partial differential equations - Lagrange’s linear equation -- Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

**UNIT-III VECTOR CALCULUS**

Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green’s theorem in a plane, Gauss divergence theorem and Stokes’ theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelepipeds.

**UNIT-IV ANALYTIC FUNCTIONS**


**UNIT-V LAPLACE TRANSFORM**


**Course Outcomes:**

On completion of course students will be able to

- Apply various techniques in solving ordinary differential equations.
- Develop skills to solve different types of partial differential equations
- Use the concept of Gradient, divergence and curl to evaluate line, surface and volume integrals.
- Use the concept of Analytic functions, conformal mapping and complex integration for solving Engineering problems.
- Use Laplace transform and inverse transform techniques in solving differential equations.

**Text Books:**


**Reference Books / Web links:**

Objectives:

- To understand the theoretical and practical principles of corrosion and its control
- To familiarise the fundamentals of chemical energy conversions in batteries and fuels
- To acquaint knowledge on alloys and analytical techniques

UNIT-I  CORROSION AND PROTECTIVE COATINGS


UNIT-II  ENERGY STORAGE DEVICES

Batteries - primary battery - alkaline battery - secondary battery (Lead acid storage battery, Nickel - Cadmium battery and Lithium – ion battery) -flow battery -components,working principle and applications of hydrogen-oxygen, solid oxide, direct methanol and proton exchange membrane fuel cells.

UNIT-III  PHASE RULE AND ALLOYS

Phase rule - definition of terms - one component system -water system - reduced phase rule - thermal analysis - two component system- eutectic system - lead silver system - safety fuses and solders.

Alloys - purpose of alloying - function and effects of alloying elements - properties of alloys - classification of alloys - Ferrous alloys - nichrome and stainless steel - Non-ferrous alloys - brass and bronze - heat treatment of alloys (annealing, hardening, tempering, normalising, carburizing and nitriding)

UNIT-IV  FUNDAMENTAL SPECTROSCOPIC TECHNIQUES AND THERMAL ANALYSIS

Principles of spectroscopy - UV,visible and IR spectroscopy principle - instrumentation (block diagram) - applications.Principles, block diagram, instrumentation and applications of TGA, DTA, DSC and Flame photometry

UNIT-V  FUELS AND COMBUSTION

Fuels- classification -coal-ranking of coal- proximate and ultimate analysis metallurgical coke - manufacture by Otto-Hoffmann method - Petroleum processing and fractions -knocking - octane number and cetane number - synthetic petrol - Fischer Tropsch and Bergius processes -power alcohol,biodiesel- Gaseous fuels CNG and LPG.

Combustion-calorific value- Dulong's formula-problems- flue gas analysis – Orsat apparatus-theoretical air for combustion – problems

| Contact Hours | 45 |

List of Experiments

1. Determination of corrosion rate on mild steel by weight loss method
2. Estimation of DO by winkler’s method
3. Determination of total, temporary and permanent hardness by EDTA method.
4. Estimation of alkalinity by indicator method.
5. Estimation of chloride by argentometric method
6. Estimation of extent of corrosion of iron pieces by potentiometry
7. Estimation of mixture of acids by conductometry.
8. Estimation of acid by pH metry
10. Estimation of sodium and potassium in water by flame photometry.
11. Determination of flash and fire point of lubricating oil
12. Determination of cloud and pour point of lubricating oil

| Contact Hours | 30 |

Total Contact Hours : 75
Course Outcomes:
On completion of the course students will be able to
- Analyse type of corrosion and identify suitable corrosion control method
- Construct electrochemical cells and measure its potential
- Modify metal properties by alloying
- Characterize various material systems
- Understand the role of fuels in day to day applications

Text Books:


Reference Books / Web links:


GE19141 PROGRAMMING USING C

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Objectives:
- To develop simple algorithms for arithmetic and logical problems.
- To develop C Programs using basic programming constructs
- To develop C programs using arrays and strings
- To develop applications in C using functions, pointers and structures
- To do input/output and file handling in C

UNIT-I GENERAL PROBLEM SOLVING CONCEPTS
Computer – components of a computer system-Algorithm and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops.

UNIT-II C LANGUAGE - TYPES OF OPERATOR AND EXPRESSIONS
Introduction- C Structure- syntax and constructs of ANSI C - Variable Names, Data Type and Sizes, Constants, Declarations - Arithmetic Operators, Relational Operators, Logical Operators, Type Conversion, Increment and Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation, proper variable naming and Hungarian Notation.

UNIT-III I/O AND CONTROL FLOW
Standard I/O, Formatted Output – Printf, Variable-length argument lists- Formatted Input – Scanf, Statements and Blocks, If-Else-If, Switch, Loops – while, do, for, break and continue, GoTo Labels.

UNIT-IV FUNCTIONS AND PROGRAM STRUCTURE
Basics of functions, parameter passing and returning type, External, Auto, Local, Static, Register Variables, Scope Rules, Block structure, Initialisation, Recursion, C Pre-processor, Standard Library Functions and return types.

UNIT-V POINTERS, ARRAYS AND STRUCTURES
Pointers and addresses, Pointers and Function Arguments, Pointers and Arrays, Address Arithmetic, character Pointers and Functions, Pointer Arrays, Pointer to Pointer, Multi-dimensional arrays, Strings, Initialisation of Pointer Arrays, Command line arguments, Pointers to functions, complicated declarations. Basic Structures, Structures and Functions, Array of structures, Pointer of Structures, Self-referential Structures, Table look up, Typedef, Unions, Bit-fields, File Access -Error Handling, Line I/O, Miscellaneous Functions.
List of Experiments

1. Algorithm and flowcharts of small problems like GCD.
   Structured code writing with:
   2. Small but tricky codes
   3. Proper parameter passing
   4. Command line Arguments
   5. Variable parameter
   6. Pointer to functions
   7. User defined header
   8. Make file utility
   9. Multi file program and user defined libraries
   10. Interesting substring matching / searching programs
   11. Parsing related assignments

Course Outcomes:

- To formulate simple algorithms for arithmetic and logical problems.
- To implement conditional branching, iteration and recursion.
- To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
- To use arrays, pointers and structures to formulate algorithms and programs.
- To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.

Text Books:


Reference Books:


Web links for virtual lab:

1. https://www.tutorialspoint.com/compile_c_online.php
3. https://www.jdoodle.com/c-online-compiler
4. https://rextester.com/l/c_online_compiler_gcc

Objectives:

- To introduce electric circuits and provide knowledge on the analysis of circuits using network theorems.
- To impart knowledge on the phenomenon of resonance in series and parallel circuits and also to obtain the transient response of RC, RL and RLC circuits.
- To provide knowledge on the principles of electrical machines.
- To learn the concepts of different types of power converter and batteries.
To teach methods of experimentally analyzing electrical circuits and machines

**UNIT-I  DC CIRCUITS**

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Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff’s current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems.

**UNIT-II  AC CIRCUITS**

|  | 9 |

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections

**UNIT-III  DC MOTORS AND TRANSFORMERS**

|  | 9 |


**UNIT-IV  AC ROTATING MACHINES**

|  | 9 |


**UNIT-V  BATTERIES AND POWER CONVERTERS**

|  | 9 |

Types of Batteries, Important Characteristics for Batteries -DC-DC buck and boost converters- duty ratio control - Single-phase and three-phase voltage source inverters – Sinusoidal modulation

**Total Contact Hours** : 45

**List of Experiments**

1. Experimental verification of Kirchhoff’s voltage and current laws.
2. Experimental verification of network theorems (Thevenin and, Norton Theorems).
3. Load test on DC shunt motor.
4. Speed control of DC shunt motor.
5. Load test on single-phase transformer.
6. Open circuit and short circuit tests on single phase transformer.
7. Speed control of chopper fed DC motor.
8. Speed control of 3Φ Induction motor.

**Contact Hours** : 30

**Total Contact Hours** : 75

**Course Outcomes:**

On completion of the course, the students will be able to

- analyse DC and AC circuits and apply circuit theorems.
- realize series and parallel resonant circuits.
- understand the principles of electrical machines.
- understand the principles of different types of power converter and batteries.
- experimentally analyze the electric circuits and machines.

**Text Book(s):**


**Reference Books(s) / Web links:**

Objectives:
- To understand the basics of mechanics and apply the concept of equilibrium to solve problems of concurrent forces.
- To understand the concept of equilibrium and to solve problems of rigid bodies.
- To learn about the center of gravity and moment of inertia of surfaces and solids.
- To learn the basic concepts of friction.
- To learn the concepts in kinematics and kinetics of rigid bodies in plane motion.

UNIT-I  STATICS OF PARTICLES  9

UNIT-II  EQUILIBRIUM OF RIGID BODIES  9
Free body diagram – Types of supports – Action and reaction forces – stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon’s theorem – Single equivalent force – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions – (Descriptive treatment only)

UNIT-III  PROPERTIES OF SURFACES AND SOLIDS  9

UNIT-IV  DYNAMICS OF PARTICLES  9

UNIT-V  FRICTION AND RIGID BODY DYNAMICS  9
Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction, Ladder friction, Rolling resistance – Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

Course Outcomes: On the successful completion of the course, students will be able to
- Comprehend and analysis the forces in the system.
- Solve problems in engineering systems using the concept of static equilibrium.
- Determine the centroid of objects such as areas and volumes, center of mass of body and moment of inertia of composite areas.
- Solve problems involving kinematics and kinetics of rigid bodies in plane motion.
- Solve problems involving frictional phenomena in machines.

Text Book(s):
1 Beer, F.P and Johnston Jr. E.R, Cornwell and Sanghi ., “Vector Mechanics for Engineers (In SI Units):
Reference Books(s) / Web links:


MC19102  INDIAN CONSTITUTION AND FREEDOM MOVEMENT  
(Common to Mech, Aero, Auto Civil and MCT)

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Objectives:
- To inculcate the values enshrined in the Indian constitution
- To create a sense of responsible and active citizenship
- To know about Constitutional and Non-Constitutional bodies
- To understand sacrifices made by the freedom fighters

UNIT-I  INTRODUCTION

9

UNIT-II  STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT

9
Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.

UNIT-III  STRUCTURE AND FUNCTION OF STATE GOVERNMENT AND LOCAL BODY

9

UNIT-IV  CONSTITUTIONAL FUNCTIONS AND BODIES

9
Indian Federal System – Center – State Relations – President’s Rule – Constitutional Functionaries – Assessment of working of the Parliamentary System in India- CAG, Election Commission, UPSC, GST Council and other Constitutional bodies-. NITI Aayog, Lokpal, National Development Council and other Non-Constitutional bodies

UNIT-V  INDIAN FREEDOM MOVEMENT

9

Total Contact Hours  :  45

Course Outcomes: On the successful completion of the course, students will be able to
- Understand the functions of the Indian government
- Understand and abide the rules of the Indian constitution.
- Gain knowledge on functions of state Government and Local bodies
- Gain knowledge on constitution functions and role of constitutional bodies and non constitutional bodies
- Understand the sacrifices made by freedom fighters during freedom movement
**Text Book(s):**

- Bipan Chandra, History of Modern India, Orient Black Swan, 2009
- P K Agarwal and K N Chaturvedi, Prabhat Prakashan, New Delhi, 1st ed, 2017

**Reference Books(s) / Web links:**


**MT19221 COMPUTER AIDED DRAWING LABORATORY**

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**Objectives:**

- To introduce the students the Indian standard code of practice for engineering drawing and general symbols and abbreviation used on the drawing.
- To provide hands on experience to develop 2D and 3D models of engineering components.
- To provide knowledge to use Drawing/Modeling software.

**List of Experiments**

1. **CODES AND STANDARDS**

2. **GEOMETRIC DIMENSIONING & TOLERANCING (GD&T) PRINCIPLES**

3. **INTRODUCTION TO DRAFTING SOFTWARE**
   - Introduction to the use of any drafting software – creation of simple geometric bodies using primitives (line, arc, circle etc.) and editing for the drawing. Dimensioning and text writing, concept of layer creation and setting, line types.

4. **MANUAL AND CAD DRAWING OF MACHINE ELEMENTS**
   - Preparation of 2-D drawings using CAD software for components and assemblies of Plummer block, screw jack, machine vice, lathe tailstock, tool head of the shaper. Introduction to 3-D modeling solid and frame modeling.

| Total Contact Hours | : | 30 |

**Course Outcomes:**

On completion of the course, the students will be able to

- Ability to develop engineering drawing and dimensioning for the industrial component using Indian Standard code of practice.
- Able to implement Geometric Dimensioning & Tolerancing principles in production drawing.
- Use CAD software for drafting machine components.
- Understand working principles of different machine elements.
- Ability to develop 2D and 3D models of the component using manual/software.
Objectives:
- To provide hands on experience on various basic engineering practices in Electrical Engineering.
- To impart hands on experience on various basic engineering practices in Electronics Engineering.

List of Experiments

A. ELECTRICAL ENGINEERING PRACTICE
1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring.

B. ELECTRONICS ENGINEERING PRACTICE
1. Study of Electronic components and equipment’s – Resistor, colour coding, measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
2. Study of logic gates AND, OR, EOR and NOT.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

Total Contact Hours : 30

Course Outcomes:
On completion of the course, the students will be able to
- fabricate electrical and electronic circuits
- formulate the house wiring
- design the AC-DC converter using diode and passive components

REFERENCE
### Course Outcomes:

On completion of course students will be able to

- develop skills to construct Fourier series for different periodic functions and to evaluate infinite series.
- classify different types of PDE and solve one dimensional boundary value problems.
- solve two-dimensional heat equations.
- solve Engineering problems using Fourier transform techniques.
- solve difference equations using $Z$- transforms that arise in discrete time systems.

### Text Books:


### Reference Books / Web links:

**Objectives:**

- Broad objective of this course is to give an introduction of life science to engineering students.
- The course helps students to familiarize with human physiology, life style diseases and their management and basic diagnostic aspects.

### UNIT-I OVERVIEW OF CELLS AND TISSUES 9

Introduction to Bacteria, virus, fungi and animal cells. Organization of cells into tissues and organs. Functions of vital organs.

### UNIT-II HEALTH AND NUTRITION 9


### UNIT-III UNHEALTHY PRACTICES AND THEIR IMPACT ON HEALTH 9

Drug induced toxicity, Unhealthy practices - Drug abuse/Narcotics/Smoking/Alcohol/Self-medication/Undue usage of electronic gadgets.

### UNIT-IV COMMON DISEASES AND LIFESTYLE DISORDERS 9

Prevention and management of food, water and airborne illness (Common cold, dehydration, food poisoning etc.). Lifestyle disorders – obesity, diabetes, stroke, heart attack, ulcer, renal calculi, cancer, AIDS, hepatitis- prevention and management.

### UNIT-V DIAGNOSTIC TESTS AND THEIR RELEVANCE 9

Normal range of biochemical parameters, significance of organ function tests, organ donation.

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**Total Contact Hours:** 45
Objectives:
• To study the IC fabrication procedure and basic characteristics of transistors.
• To study characteristics; realize circuits; design for signal analysis using Op-amp ICs.
• To study the applications of Op-amp.
• To study internal functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits, ADCs.

UNIT-I INTRODUCTION AND FABRICATION OF ANALOG DEVICES
Introduction to Integrated Circuit- IC Classification and Fabrication- Special Diodes, Transistor Characteristics, Configurations: BJT and FET- Working and Characteristics

UNIT-II OPERATIONAL AMPLIFIER
Ideal OP-AMP characteristics, DC characteristics, AC characteristics, differential amplifier; frequency response of OP-AMP; Basic applications of op-amp – Inverting and Non-inverting Amplifiers-V/I & I/V converters, summer, differentiator and integrator.

UNIT-III APPLICATIONS OF OPAMP
Instrumentation amplifier, Log and Antilog Amplifiers, first and second order active filters, comparators, multivibrators, waveform generators, clippers, clamping, peak detector, S/H circuit, Oscillators

UNIT-IV APPLICATIONS OF ANALOG ICs
Functional block, characteristics & application circuits with 555 Timer IC-566 voltage-controlled oscillator IC, 565-phase lock loop IC, Analog multiplier ICs.

UNIT-V VOLTAGE REGULATOR ICs

Total Contact Hours : 45

Course Outcomes: After the successful completion of the course, the student will be able to:
• Ability to understand and analyse, linear and digital electronic circuits.
• Learn different IC fabrication procedure.
• Design Op-amp ICs for signal analysis.
• Learn various applications of Op-amp.
• Analyze various internal functional blocks and special ICs

Text Book(s):

Reference Books(s) / Web links:

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Objectives:
- To introduce basic postulates of Boolean algebra and shows the correlation between Boolean expressions.
- To outline the formal procedures for the analysis and design of combinational circuits.
- To outline the formal procedures for the analysis and design of sequential circuits.
- To illustrate the concept of synchronous and asynchronous sequential circuits.
- To introduce the concept of memories and programmable logic devices.

UNIT-I  LOGIC GATES AND MINIMIZATION TECHNIQUES  9

UNIT-II  COMBINATIONAL CIRCUITS  9

UNIT-III  SEQUENTIAL CIRCUITS  9

UNIT-IV  SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS  9
Counters, Synchronous / Asynchronous Counters, Mod N Counters, Ring Counter, Johnson Counter – State Machines: State transition diagram, Moore and MEALY Machines – Design equation and circuit diagram.

UNIT-V  MEMORIES AND PROMMABLE LOGIC DEVICES  9
Memory Basics, ROMs, PROMs, and EPROMs, RAMs – Sequential Programmable Logic Devices – PAL, PLA. Introduction and basic concepts of FPGA, VHDL and Verilog – Implementation of AND, OR, Adders using VHDL and Verilog.

Total Contact Hours  : 45
## Objectives:
- To introduce the basic concepts of fluid mechanics.
- To make students understand the working principle of different types of pumps and Hydraulic turbines.
- To make students understand the basic laws of thermodynamics.
- To introduce various mechanisms of heat transfer.

### UNIT-I  PROPERTIES OF FLUIDS AND FLUID STATICS  
Fluid - definition, distinction between solid and fluid - Units and dimensions – Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapor pressure, capillary and surface tension. Fluid statics: Pascal law - Hydrostatic law - Pressure measurements using Manometers and pressure gauges.

### UNIT-II  FLUID KINEMATICS AND FLUID DYNAMICS  

### UNIT-III  HYDRAULIC MACHINES  

### UNIT-IV  LAWS OF THERMODYNAMICS  

### UNIT-V  HEAT TRANSFER MECHANISMS  

### Course Outcomes:
- Describe the properties of fluids and its importance in selection of fluid for suitable application
- Identify the major and minor losses involved in the fluid flow through pipes
- Differentiate the types of hydraulic machines and describe the working principle.
- Apply the basic laws of thermodynamics for different applications.
- Distinguish various modes of heat transfer and determine the heat transfer rate.

### Text Book(s):

### Reference Books(s) / Web links:
Objectives:

- To understand the fundamental concepts of stress, strain and elastic constants of solids under external loading
- To learn about the transverse loading and bending loads acting on structural components
- To learn about the deformation of shafts and springs subjected to torsion
- To know about the various methods for calculating deflection of beams
- To learn about the various stresses acting in shell structures like thin cylinders and spheres

UNIT-I | STRESS, STRAIN AND DEFORMATION OF SOLIDS | 9

UNIT-II | TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM | 9

UNIT-III | TORSION ON SHAFTS AND SPRINGS | 9
Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Maximum shear stress in spring section including Wahl Factor - Deflection of helical springs, carriage springs.

UNIT-IV | DEFLECTION OF BEAMS AND COLUMNS | 9

UNIT-V | THIN CYLINDERS, SPHERES AND THICK CYLINDERS | 9
Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame’s theorem.

Course Outcomes: At the end of this course, students able to

- Understand the concepts of principal planes and stresses and draw Mohr’s circle for the given stress conditions.
- Draw the shear force diagram and bending moment diagram for beams subjected to different loading conditions.
- Calculate the deformation of shafts subjected to torsional loads.
- Calculate the deflection of beams through Macaulay’s method, Moment area method and strain energy methods.
- Understand the effect of stresses acting on thin cylinders and spheres and calculate the deformation.

Text Books:


Reference Books(s) / Web links:


MT19304 | MECHANICS OF SOLIDS | PC | L | T | P | C
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Objectives: This laboratory course enables students to
- To understand the functionality of Logic Gates and Boolean Expressions.
- To understand the functionality of Adder, Subtractor and Comparator.
- To understand the functionality of Flip-Flops.
- To understand the functionality of combinational and sequential circuits
- To simulate basic combinational and sequential circuits using Hardware Description Language HDL

List of Experiments
1. Verification of logic gates and realization of Boolean expressions using gates.
2. Design and Implement Adders and Subtractors using logic gates.
3. Design and Implement 4-bit Parallel Adder / Subtractor using IC 7483.
4. Design and Implement 4-bit Magnitude Comparator using IC 7485.
5. Realize 3-variable function 8:1 Mux using IC 74151.
6. Realize 1:8 Demux and 3:8 Decoder using IC 74138.
7. Verification of state tables of SR, JK, T and D Flip-Flops using NAND & NOR gates.
8. Simulate Mod-8 Synchronous UP/DOWN Counter using Simulation tool.
10. Realization of Digital circuits using HDL – Combinational circuits
11. Realization of Digital circuits using HDL – Sequential circuits
12. Mini project on design of a digital circuit for solving practical problems

Course Outcomes: On completion of the course, the student will be able to:
- Simplify complex Boolean functions.
- Implement digital circuits using combinational logic ICs.
- Understand the characteristics of various Flip-Flops.
- Design digital circuits with combinational and sequential components.
- Use HDL to build digital systems.

Web links for virtual lab (if any)
2. http://he-coep.vlabs.ac.in/
3. https://www.iitg.ac.in/cseweb/vlab/vlsi/
5. http://cse14-iitd.vlabs.ac.in/

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MT19311 DIGITAL SYSTEM DESIGN LABORATORY

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Curriculum and Syllabus | B.E. Mechatronics Engineering | R 2019
Objectives: The main learning objective of this course is to prepare the students for

- To study the mechanical properties of materials when subjected to different types of loadings
- To study the impact strength and hardness properties of given specimen
- To understand the study of deflection and compression test on beam and spring for given material
- To verify the principles studied in fluid mechanics by experimentally.
- To verify the principles studied in hydraulic machines by experimentally of their performance and efficiencies.

List of Experiments

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen (Charpy and Izod test)
5. Hardness test on metals – (Brinell and Rockwell Hardness Number)
6. Deflection test on beams (Simply supported beam)
7. Compression test on helical springs (Closed coil)
8. Determination of the Coefficient of discharge of given Orifice meter.
10. Calculation of the rate of flow using Rota meter.
11. Determination of friction factor for a given set of pipes.
12. Conducting experiments and drawing the characteristic curves of centrifugal pump
13. Conducting experiments and drawing the characteristic curves of reciprocating pump.
14. Conducting experiments and drawing the characteristic curves of Pelton wheel.
15. Conducting experiments and drawing the characteristics curves of Kaplan turbine.

Course Outcomes: On completion of the course, the student is expected to be able to

- Perform Tension, shear test, Torsion, impact test and Hardness test on given material.
- Perform deflection and compression test on beam and springs.
- Verify and apply Bernoulli equation for flow measurement like orifice/venturi meter
- To measure the friction factor from given set of pipes
- Determine the performance characteristics and efficiencies of pumps and Turbines.

Objectives: This course aims at imparting basic principles of thought process, reasoning and inference. Sustainability is the core of Indian traditional knowledge system connecting society and nature. Holistic life style of yogic science and wisdom are important in modern society with rapid technological advancements and societal disruptions. The course mainly focuses on introduction to Indian knowledge system, Indian perspective of modern science, basic principles of Yoga and holistic healthcare system, Indian philosophical, linguistic and artistic traditions.

MC19301 ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

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Pedagogy: Problem based learning, group discussions, collaborative mini projects.

UNIT-I Introduction To Indian Knowledge System: Basic structure of the Indian Knowledge System –Veda 6

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<th>UNIT-II</th>
<th>Modern Science And Yoga: Modern Science and the Indian Knowledge System – a comparison - Merits and demerits of Modern Science and the Indian Knowledge System - the science of Yoga- different styles of Yoga – types of Yogaasana, Pranayam, Mudras, Meditation techniques and their health benefits – Yoga and holistic healthcare – Case studies.</th>
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<td>UNIT-III</td>
<td>Indian Philosophical Tradition: Sarvadharshan/Sadhdarshan – Six systems (dharshans) of Indian philosophy - Nyaya, Vaisheshika, Sankhya, Yoga, Mimamsa, Vedanta-Other systems- Chavarka, Jain (Jainism), Boudh (Buddhism) – Case Studies.</td>
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<td>UNIT-IV</td>
<td>Indian Linguistic Tradition: Introduction to Linguistics in ancient India – history – Phonetics and Phonology – Morphology – Syntax and Semantics-Case Studies.</td>
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<td>UNIT-V</td>
<td>Indian Artistic Tradition: Introduction to traditional Indian art forms – Chitrakala (Painting), Murthikala / Shilpakala (Sculptures), Vaasthukala, Sthaapathy kala (Architecture), Sangeeth (Music), Nruthya (Dance) and Sahithya (Literature) – Case Studies.</td>
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**Total Contact Hours**: 30

**Course Outcomes:**

- At the end of the course, students will be able to appreciate the importance of traditional Indian knowledge system, Yoga and other Indian traditions that are important in a modern society with technological advancements and lifestyle changes.

**Text Book(s):**

4. Fritzof Capra, *Tao of Physics*.

**Reference Books(s) / Web links:**

2. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata.
Objectives:

- To provide the necessary basic concepts of a few statistical methods in designing and solving problems.
- To provide various numerical methods in solving problems that occur in the field of Engineering and Technology.

UNIT-I | TESTING OF HYPOTHESIS | 12
Statistical hypothesis - Large sample test based on Normal distribution for single mean and difference of means. - Tests based on t, F and Chi-square test for single sample standard deviation. Chi-square tests for independence of attributes and goodness of fit.

UNIT-II | DESIGN OF EXPERIMENTS | 12
One way and two way classifications - Completely randomized design – Randomized block design – Latin square design.

UNIT-III | SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS | 12

UNIT-IV | INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION | 12
Curve fitting (\(y = a + bx\), \(y = a + bx + cx^2\)) - Lagrange’s interpolations – Newton’s forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal and Simpson’s 1/3 rules.

UNIT-V | NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS | 12

Total Contact Hours : 60

Course Outcomes:

On completion of course students will be able to

- Obtain statistical data from experiments and able to analyze the same using statistical test.
- Design experiments using suitable ANOVA techniques and draw conclusions.
- Solve algebraic equations and eigen value problems that arise during the study of engineering problems.
- Use interpolation methods to solve problems involving numerical differentiation and integration
- Solve differential equations numerically that arise in course of solving engineering problems.

Text Books:


Reference Books / Web links:

### Course Outcomes:

- To introduce the elements of control system and their modeling using various Techniques.
- To perform time domain and frequency domain analysis of control systems required for stability analysis.
- To design the compensation technique that can be used to stabilize control systems.
- To introduce the state variable analysis method.

### UNIT-I

**Control System Modeling**


### UNIT-II

**Time Response Analysis**


### UNIT-III

**Frequency Response Analysis**


### UNIT-IV

**Stability Analysis**


### UNIT-V

**State Variable Analysis**


**Total Contact Hours**: 45

### Course Books:


### Reference Books:

Objectives:

- To understand the basic concepts of sand casting technique and special casting technique.
- To understand the principles, equipment’s of different welding techniques.
- To know the various operations and equipment requirements of hot and cold metal forming processes.
- To understand the working principle and applications of different types of sheet metal processes.
- To understand the working principles of different types of thermo plastic manufacturing methods.

UNIT-I METAL CASTING

Sand Casting: Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – Moulding sand Properties and testing – Cores – Types and applications – Moulding machines – Types and applications; Melting furnaces: Blast and Cupola Furnaces; Principle of special casting processes: Shell - investment – Ceramic mould – Pressure die casting - Centrifugal Casting – Continuous casting, Vacuum casting; CO₂ process – Stir casting; Defects in Sand casting.

UNIT-II METAL JOINING PROCESSES

Operating principle, basic equipment, merits and applications of: Fusion welding processes: Gas Tungsten arc welding Gas metal arc welding – Submerged arc welding – Electro slag welding; Operating principle and applications of: Resistance welding - Plasma arc welding – Thermit welding – Electron beam welding – Laser welding- Friction welding and Friction Stir Welding; Brazing and soldering; Weld defects: types, causes and cure. Adhesive bonding.

UNIT-III MACHINING

General principles (with schematic diagrams only) of working and commonly performed operations in the following machines: Lathe, Shaper, Planer, Horizontal milling machine, Universal drilling machine, Cylindrical grinding machine, Capstan and Turret lathe. Basics of CNC machines. General principles and applications of the following processes: Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining, Plasma arc machining, Electron beam machining and Laser beam machining.

UNIT-IV SHEET METAL PROCESSES


UNIT-V METAL FORMING AND MANUFACTURE OF PLASTIC COMPONENTS

Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning. Types and characteristics of plastics – Moulding of thermoplastics – working principles and typical applications – injection moulding – Plunger and screw machines – Compression moulding, Transfer Moulding – Typical industrial applications

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

- Identify and Select suitable casting process for a specific component
- Explain the working principles and applications of different arc welding processes, special welding process and defects associated with it.
- Select the suitable process for manufacturing of components using suitable machining.
- Explain the principles and working of shearing, bending, drawing and forming in sheet metal.
- Understand various metal forming process and manufacturing methods of plastic components.
Text Books:

Reference Books(s) / Web links:
1 Roy A. Lindberg, "Processes and Materials of Manufacture”, PHI / Pearson education, 2006
5. https://nptel.ac.in/courses/112107144/

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MT 19403 | MICROCONTROLLERS AND EMBEDDED SYSTEMS | PC |
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Objectives:
- To learn about the architecture, functions, programming and usage of 8085 microprocessor.
- To understand architecture of microcontroller and usage of built-in special function blocks.
- To design and verify the various interfacing techniques with microcontrollers.
- To impart knowledge on basics of embedded system architecture.
- To provide essential knowledge on real time embedded operating system.

UNIT-I | BASICS OF MICROPROCESSOR
8085 Architecture – Address space – Instruction set – Addressing modes
Interrupts – Instruction cycle and Timing diagram – Assembly Language Programming.

UNIT-II | MICROCONTROLLER
Architecture of 8051 – Memory organization - I/O Ports - Instruction set - Addressing modes - Assembly language programming

UNIT-III | PROGRAMMING AND INTERFACING WITH PIC MICROCONTROLLER USING EMBEDDED C
I/O Port Programming – Arithmetic, Logical Instructions and Programs – PIC18 Timer – Serial Port Programming

UNIT-IV | INTRODUCTION TO EMBEDDED SYSTEMS
Embedded system Architecture - Design Process in Embedded system- Classification of Embedded system
Timer and Counting devices - Watchdog Timer - Real Time Clock - In circuit emulator - Target Hardware Debugging.

UNIT-V | REAL TIME OPERATING SYSTEM
Introduction to basic concepts of RTOS – Tasks and Data – Threads – Multiprocessing and Multitasking – Semaphores – Priority Inversion - Priority Inheritance – Queues – Pipes
Washing machines - Cruise control - antilock braking systems - Automatic chocolate vending machine - Pick and Place Robot – Automatic lubrication of supplier Conveyor belt.

Total Contact Hours : 45
**Course Outcomes:** Upon completion of this course the students can be able to
- Design 8085 microprocessor based system.
- Design and implement the programs of 8051.
- Design circuits for various applications using microcontrollers.
- Construct the basic architecture and components of embedded system.
- Develop embedded system in real time for simple applications.

**Text Book(s):**

**Reference Books(s) / Web links:**
2. K C Wang, “Embedded and Real time Operating systems” Springer, 2017

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**Objectives:**
- To understand the concepts of measurement and various transducers.
- To learn the various sensors used to measure various physical parameters.
- To acquire knowledge on acceleration, flow and optical measurements.
- To know about the different ranging sensors and advanced sensors.
- To learn about the fundamentals of data acquisition system and signal conditioning.

**UNIT-I  SCIENCE OF MEASUREMENT**

**UNIT-II  DISPLACEMENT, FORCE, PRESSURE AND TEMPERATURE SENSOR**

**UNIT-III  ACCELERATION, FLOW, ACOUSTIC AND OPTICAL SENSOR**

**UNIT-IV  RANGE, HEADING AND ADVANCED SENSORS**
UNIT-V | DATA ACQUISITION AND SIGNAL CONDITIONING


Course Outcomes:
- Familiar with various measurements, calibration techniques and types of transducers.
- Understand the basic principles of various displacement, pressure and temperature sensors.
- Describe the working of accelerometer, flow and optical sensor.
- Apply the various sensors in the Automotive and Mechatronics applications.
- Ability to implement the DAQ systems with different sensors for real time applications.

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9. Flash a LED connected at a specified output port terminal using 8085.
10. Interface LCD with Microcontroller.
11. Interface an ADC and a strain gauge to measure the given load using Microcontroller.
12. Generation of waveform using embedded C software at a specified port terminal.
13. Interfacing of traffic light control systems.
15. Rolling display and Flashing display.

Total Contact Hours: 45

Course Outcomes: Upon completion of the course, students will be able to:

- Develop simple programs using 8085 and 8051
- Perform ADC and DAC Conversions
- Develop interfacing circuits for real time applications
- Develop simple programs using Embedded C software
- Develop simple programs for Arduino and Raspberry Pi controllers

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MT19412 SENSORS AND INSTRUMENTATION LABORATORY PC L T P C

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Objectives:

- Study the interfacing of different sensors with LabVIEW.
- To design a LabView program to obtain a required measurement data for temperature
- To generate appropriate design procedure to obtain a required measurement data for force
- To create appropriate design procedure to obtain a required measurement data for displacement.
- To develop an appropriate design procedure, suitable for signal conversion to interface with computer.

List of Experiments

1. Design and testing of Digital Comparator
2. Design and testing of Voltage to frequency converter and frequency to voltage converter
3. Design and testing of sample and hold circuit.
4. Design and testing of Flash type Analog to Digital Converters.
5. Design and testing of instrumentation amplifier using OP-AMP.
6. Displacement measurement using potentiometer and LVDT and plotting the characteristic curves.
7. Study of Characteristics and calibration of strain gauge and Load Cell
8. Measurement of strain using resistive type strain gauges with temperature compensation and various bridge configurations.
9. Temperature measurement using Thermocouple, Thermistor and RTD and comparing the characteristics.
10. Comparison of capacitive and resistive type transducer for humidity measurement with their characteristics.
11. Measurement of sound using microphones and sound level meter.
12. Measurement of 3 phase power and power factor.

Course Outcomes: Upon completion of the course, students will be able to:

- Design a LabView program to obtain a required measurement data for temperature
- Generate appropriate design procedure to obtain a required measurement data for force
- Develop appropriate design procedure to obtain a required measurement data for displacement.
- Develop an appropriate design procedure, suitable for signal conversion to interface with computer.
Develop the LabView program to control the speed and position of servomotor

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MT19421 | MANUFACTURING TECHNOLOGY LABORATORY | PC | L | T | P | C |
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Objectives: Enable the students

- To practice the moulding process using green sand.
- To practice different types of sheet metal operating.
- To perform various machining operations like facing, turning, knurling, thread cutting, shaping, grinding and milling.
- To obtain the knowledge of different gear manufacturing processes.
- To acquire knowledge on selection of appropriate processes, machines to complete a given job.

LIST OF EXPERIMENTS

1. Preparation of sand mould using single piece pattern
2. Preparation of sand mould using split piece pattern
3. Fabrication of tray in sheet metal
4. Fabrication of funnel in sheet metal
5. Taper turning using lathe
6. Knurling and external thread cutting using lathe
7. Step turning and drilling using Capstan / Turret lathe
8. Drilling and Tapping
9. Cube formation using shaper
10. Study of Indexing mechanism in milling machine
11. Hexagonal milling using vertical milling machine
12. Spur gear cutting using milling machine
13. Gear generation in gear hobbing machine
14. Surface grinding
15. Cylindrical grinding

Total Contact Hours : 30

Course Outcomes: At the end of this course students will have the

- Ability to make a mould in green sand using different types of patterns.
- Ability to create different objects using sheet metal.
- Ability to perform different possible machining processes in lathe, shaper, grinders and milling machines.
- Ability to select and perform different gear generating process based on requirements.
- Ability to select suitable manufacturing method, machines, equipment and tools to make a job based on given requirements.
Objectives:
- To help students break out of shyness.
- To build confidence
- To enhance English communication skills.
- To encourage students’ creative thinking to help them frame their own opinions.

Course Description:
The course, “Soft Skills-I” intends to enhance the students’ confidence to communicate in front of an audience effectively. The emphasis is on improving the spoken skills of the students so that they can communicate both, in the college and in the corporate setting to deliver their message successfully. In today’s technology driven world, communicating with confidence is imperative. Hence, this course aims at providing students with the necessary practice in the form of debates, discussions and role plays.

Program Learning Goals:
This program will help our students to build confidence and improve their English communication in order to face the corporate world as well as providing them with opportunities to grow within an organisation.

Learning and Teaching Strategy:
The program is completely student centric where the focus is on activities led by students which include role plays, discussions, debates other games as well. These activities would be supplemented by interactive use of technology and brief trainer input.

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<th>Sl No</th>
<th>Activity Name</th>
<th>Description</th>
<th>Objective</th>
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<tr>
<td>1</td>
<td>Introduction</td>
<td>The trainer and the college facilitator talk to the students about the course and in turn the students introduce themselves.</td>
<td>To set expectations about the course and the students are made aware of the rules and regulations involved in this program</td>
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<td>2</td>
<td>If I ruled the world</td>
<td>This is a quick and useful game by getting students to form a circle and provide their point of view. Each student then repeats what the other has said and comes up with their own opinion.</td>
<td>The aim of this activity is to for students to get to know each other and also develop their listening skills as well as learning how to agree and disagree politely.</td>
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<td>3</td>
<td>Picture Narrating</td>
<td>This activity is based on several sequential pictures. Students are asked to tell the story taking place in the sequential pictures by paying attention to the criteria provided by the teacher as a rubric. Rubrics can include the vocabulary or structures they need to use while narrating.</td>
<td>The aim of this activity is to make the students develop creative way of thinking.</td>
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<td>4</td>
<td>Brainstorming</td>
<td>On a given topic, students can produce ideas in a limited time. Depending on the context, either individual or group brainstorming is effective and learners generate ideas quickly and freely. The good characteristics of brainstorming are that the students are not criticized for their ideas so students will be open to sharing new ideas.</td>
<td>The activity aims at making the students speak freely without the fear of being criticized. It also encourages students to come up with their own opinions.</td>
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<td>5</td>
<td>Debate</td>
<td>Is competition necessary in regards to the learning</td>
<td>The aim of this activity is to develop</td>
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<td>6</td>
<td>Short Talks</td>
<td>Here the students are given topics for which they take one minute to prepare and two minutes to speak. They can write down points but can’t read them out. They can only use it as a reference.</td>
<td>The activity aims at breaking the students’ shyness and encouraging them to standup in front of the class and speak. It also aims at creating awareness that they are restricted for time so they only speak points that are relevant and important.</td>
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<td>7</td>
<td>Debate</td>
<td>Will posting students’ grades on bulletin boards publicly motivate them to perform better or is it humiliating?</td>
<td>This activity aims at enhancing the students unbiased thought process when it comes to exams and grades as well as develop their skills to debate</td>
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<td>8</td>
<td>The Art of diplomacy</td>
<td>The facilitator proceeds to share multiple concepts of conversation and helps the participants to identify the various methods of being diplomatic and how do deal with misinformation.</td>
<td>The aim of the lesson is to provide an opportunity for the participants to learn about body language and choosing the appropriate words for conversation.</td>
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<td>9</td>
<td>Debate</td>
<td>Are humans too dependent on computers?</td>
<td>The aim of this activity is to test the students debating skills and thought process with a topic that affects everybody in daily life.</td>
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<td>10</td>
<td>Story Completion</td>
<td>The teacher starts to tell a story but after 2 sentences he/she asks students to work in groups to create the rest of the story which includes the plot and the ending.</td>
<td>This activity aims at building their narrating skills as well as their creativity and ability to work in a team.</td>
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<td>11</td>
<td>Role play debate</td>
<td>Students scrutinize different points of view or perspectives related to an issue. For example, a debate about the question “Should students be required to wear uniforms at school?” might yield a range of opinions. Those might include views expressed by a student (or perhaps two students – one representing each side of the issue), a parent, a school principal, a police officer, a teacher, the owner of a clothing store, and others.</td>
<td>The aim of this activity is to get students to speak based on other people’s perspective instead of their own. The students take the role of various characters and debate accordingly.</td>
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<td>12</td>
<td>I Couldn’t Disagree More</td>
<td>This is a game where students practice rebuttal techniques where one student provides a thought or an idea and the other students starts with the phrase I couldn’t disagree more and continues with his opinion</td>
<td>The aim of this activity is to improve general communication skills and confidence.</td>
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</tbody>
</table>

**Feedback**

At the end of the session in the final week (12) the trainer would provide feedback to the students on best practices for future benefits. The aim is to do both give feedback to students as well as obtain feedback on the course from them.

**Total Contact hours : 30**

**Course Outcomes:** Upon completion of the course, students will be able to:

- Be more confident
- Speak in front of a large audience
- Be better creative thinkers
- Be spontaneous
- Know the importance of communicating in English.

**Learning Resources:**

1. Kings Learning work sheets.