

1701MA101

**ENGINEERING MATHEMATICS I**  
(Common to all B.E / B.Tech Degree Programmes )

L	T	P	C
3	2	0	4

**COURSE OBJECTIVES:**

1. To educate Matrix Algebra Technique and curvature Theory
2. To impart knowledge of Techniques in solving Ordinary Differential Equations and to apply in solving Modern Engineering Problems
3. To acquaint the students about functions of several variables and also to familiarize the students in infinite series and their convergence

**UNIT I EIGEN VALUE PROBLEMS**

**9 Hours**

Characteristic equation - Eigen values and Eigen vectors of a real matrix – Properties - Cayley– Hamilton theorem- Diagonalization of Matrices - Reduction of a quadratic form to a canonical form by orthogonal transformation – Application of Matrices in Structural Engineering and image processing

**UNIT II ORDINARY DIFFERENTIAL EQUATIONS**

**9 Hours**

Higher order linear differential equations with constant coefficients – Cauchy’s and Legendre’s linear equations – Method of variation of parameters in solution of ordinary differential equations.

**UNIT III DIFFERENTIATION AND GEOMETRICAL APPLICATIONS**

**9 Hours**

Derivative of special functions (Trigonometry, Exponential, Logarithmic), Derivative by rule (Product, Quotient, Chain rule), Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature- Evolutes and involutes.

**UNIT IV MULTIVARIABLE CALCULUS**

**9 Hours**

Functions of two variables and solutions(Partial derivatives and Euler’s theorem)– Taylor’s series - Maxima and Minima – Application of Partial Derivatives to find the optimum requirement using Lagrangian multipliers.

**UNIT V SEQUENCES AND SERIES**

**9 Hours**

Sequences: Definition and examples – Series: Types and Convergence – Series of positive terms – Tests of convergence: Comparison test, Integral test and D’Alembert’s ratio test – Alternating series – Leibnitz’s test – Application of Sequences in real life.

**TOTAL: 45 + 15 HOURS**

**FURTHER READING:**

1. Modeling and solutions using Newton’s Law of Cooling of Bodies
2. Differentiation of implicit Functions, Jacobians and Properties

**COURSE OUTCOMES:**

On the Successful completion of the course, Students will be able to

- CO1: Analyze the characteristics of a linear system with Eigen value and Eigen Vectors
- CO2: Recognize and solve Higher order Ordinary Differential Equations
- CO3: Solve Derivative of special functions and apply it in solving Geometrical problems
- CO4: Apply Partial Derivatives in finding Maxima and Minima of a function
- CO5: Test the convergence of any series

**REFERENCES:**

1. Veerarajan R., “Engineering Mathematics”, updated second edition for semester I and II,(2017)
2. Grewal. B.S, “Higher Engineering Mathematics”, 44th Edition, Khanna Publications, Delhi, (2014).
3. Bali N. P and Manish Goyal, “Text book of Engineering Mathematics”, Sixth edition, Laxmi Publications(p) Ltd.,(2014).
4. Glyn James, “Advanced Modern Engineering Mathematics”, 3<sup>rd</sup> Edition, Pearson Education, (2012).
5. P.Kandasamy, K. Gunavathy and K. Thilagavathy, Engineering Mathematics ,Volume II, S. Chand & Co ., New Delhi, (2009)
6. Erwin Kreyszig, Advanced Engineering Mathematics,9<sup>th</sup> Edition, Wiley International edition, (2006)
7. Ramana B.V, “Higher Engineering Mathematics”,Tata McGrawHill Publishing, New Delhi, (2007).
8. M K Venkataraman, Engineering mathematics, Volume I, 2<sup>nd</sup> ed., National Publishing Co.(2003)
9. nptel.ac.in/courses/111105035, www.nptelvideos.in/2012/11/Mathematics.html
10. www.learnerstv.com/Free-maths-video lectures - ltv348-page1.htm

1701PH101

**APPLIED PHYSICS FOR ENGINEERS**  
(Common to all B.E. / B.Tech Degree Programmes)

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES:**

1. To impart knowledge in properties of matter, crystallography and ultrasonics.
2. To understand the applications of lasers and fiber optics.
3. To implement the principles of quantum physics in the respective engineering fields.

**UNIT I PROPERTIES OF MATTER**

**9 Hours**

Elasticity: elastic and plastic materials – Hooke's law – elastic behavior of a material – stress – strain diagram – factors affecting elasticity. Three moduli of elasticity – Poisson's ratio – torsional pendulum – twisting couple on a cylinder. Young's modulus – uniform bending – non-uniform bending. Viscosity: coefficient of viscosity – streamline and turbulent flow – experimental determination of viscosity of a liquid – Poiseuille's method.

**UNIT II APPLIED OPTICS**

**9 Hours**

Interference: air wedge – theory – uses – testing of flat surfaces – thickness of a thin wire. Laser: introduction – principle of laser – characteristics of laser light – types: CO<sub>2</sub> laser – semiconductor laser (homojunction). Fiber optics: principle of light transmission through fiber – expression for acceptance angle and numerical aperture – types of optical fibers (refractive index profile and modes) – fiber optic communication system (block diagram & description).

**UNIT III ULTRASONICS**

**9 Hours**

Ultrasonics: introduction – properties of ultrasonic waves – generation of ultrasonic waves – magnetostriction – piezo electric methods – detection of ultrasonic waves – Determination of velocity of ultrasonic waves (acoustic grating). Applications of ultrasonic waves: pulse echo method, SONAR – measurement of velocity of blood flow – modes of operation (A scan, B Scan & C Scan).

**UNIT IV SOLID STATE PHYSICS**

**9 Hours**

Crystal Physics: lattice – unit cell – crystal systems – Bravais lattices – Miller indices – „d“ spacing in cubic lattice – calculation of number of atoms per unit cell, atomic radius, coordination number and determination of packing density for SC, BCC, FCC and HCP structures – X-ray diffraction: Laue's method – powder crystal method.

**UNIT V QUANTUM MECHANICS**

**9 Hours**

Quantum Physics: development of quantum theory – de Broglie wavelength – Schrodinger's wave equation – time dependent and time independent wave equations – physical significance. Application: particle in a box (1D) – degenerate and non-degenerate states. **Electron Microscopy-SEM, TEM** } principle and working – problem solving.

**TOTAL: 45 HOURS**

**FURTHER READING:**

Neutrino's – expanding universe

**COURSE OUTCOMES:**

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

- CO1: Realize the concept of properties of matter and apply the same for practical applications.
- CO2: Identify the suitable laser source for fiber optic communication applications.
- CO3: Determine the velocity of ultrasonic waves and apply the same for day today applications.
- CO4: Classify the different types of crystal structures and analyze their properties.
- CO5: Comprehend the efficacy of quantum equations in modern areas.

**REFERENCES:**

1. D.S.Mathur, Elements of Properties of matter, 5th edition, S.Chand & Company Ltd., New Delhi,2012.
2. Charles Kittel, Introduction to Solid State Physics, 8th edition, Wiley India Pvt. Ltd., New Delhi, 2012
- 3.Arthur Beiser, Shobhit Mahajan and S. Rai Choudhury, Concepts of Modern Physics, 6th edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
4. B.K. Pandey and S. Chaturvedi, Engineering Physics, 1st edition, Cengage Learning India Pvt. Ltd., New Delhi, 2012.
5. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011.
6. Ian Morison, Introduction to Astronomy and Cosmology, John Wiley and Sons, Ltd, 2013.
7. <http://nptel.ac.in/>

1701EN101

**TECHNICAL ENGLISH**  
(Common to all B.E / B.Tech Degree Programmes)

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES:**

- 1.To develop the ability to read and comprehend technical texts in the field of Engineering
- 2.To develop vocabulary building through the study of word construction
3. To develop ability to write formal definitions of technical terms and expression.
4. To recognize various grammatical structures that will aid the student improve his/her theoretical knowledge.

**UNIT I**

**9 Hours**

Articles-Preposition-Subject-Verb-Object-Adjective-Adverb-Conjunction-Nouns- Usages of Have, has, had- Simple Present-Simple Past-Simple Future-**Self introduction-Framing Questions**

**UNIT II**

**9 Hours**

Present Continuous-Past Continuous-Future Continuous-Describing a place, person or thing-Framing negative questions-Gerund-Listening to Articles, speeches and audios

**UNIT III**

**9 Hours**

Present perfect-past perfect-future perfect-writing short paragraph-sentence pattern- Infinitive-Tag questions- Reading newspaper cutting

**UNIT IV**

**9 Hours**

Present perfect continuous –Past perfect continuous-Future perfect continuous-writing an Essay in 100 words-Types of sentences-Prefix-suffix-word formation-Dialogue writing.

**UNIT V**

**9 Hours**

Active voice-passive voice-impersonal passive voice –Synonyms and Antonyms-phrasal verbs- Punctuation- Common Errors-**Letter writing.**

**TOTAL: 45 HOURS**

**FURTHER READING:**

*Letters from a Father to His Daughter*- Jawaharlal Nehru

**COURSE OUTCOMES:**

On the successful completion of the course, Students will be able to

- CO1: Read and comprehend technical texts in the field of Engineering
- CO2: Acquire vocabulary building and write effectively in technical writing
- CO3: Write formal definitions of technical terms and expression in both verbal and written form.
- CO4: Understand grammatical structures and use flawless English in the professional documents

**REFERENCES:**

1. Meenakshi Raman, Sangeetha Sharma, “*Technical Communication : English Skills for Engineers*” Oxford University Press: New Delhi, 2016.
2. Rizvi Ashrav.M, “*Effective Technical Communication*” Tata McGraw Hill: New Delhi, 2017
3. Herbert, A.J, “*Structure of Technical English*”, London English Language Society. <https://archive.org/details/in.ernet.dli.2015.136456>
4. J.D. O'Connor, Better *English Pronunciation* Paperback, 2nd edition, 162 pages, Published September 16th 2013 by Cambridge University Press, October 23rd 1967
5. Nehru, Jawaharlal. *Letters from a Father to His Daughter*, Puffin Books, 2004
6. *Technical English* by faculty of English –published by EGS Pillay press 2017

1701CH102

**MATERIALS CHEMISTRY**  
( B.E. Mechanical Engineering )

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES:**

1. Imparting knowledge on the principles of water characterization, treatment methods and industrial applications.
2. Understanding the principles and application of electrochemistry and corrosion science.
3. Basic information and application of polymer chemistry, nanotechnology and analytical techniques.

**UNIT I WATER TECHNOLOGY**

**9 Hours**

Sources, hard & soft water-Degree of hardness and its estimation (EDTA method)– Water Quality Parameters - boiler feed water-requirements - softening of hard water -external treatment –demineralization, internal treatment- boiler compounds - boiler troubles- desalination of sea water –reverse osmosis- Domestic water treatment –disinfection of water – Basic principle of green chemistry (12 guiding principles)-detergents.

**UNIT II CORROSION AND PROTECTIVE COATING**

**9 Hours**

Corrosion – types-chemical, electrochemical corrosion (galvanic, differential aeration) - Factors influencing corrosion -corrosion control – material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method. Protective coatings: Electroplating of gold and electroless plating of nickel. Paints - Constituents and Functions.

**UNIT III POLYMER AND NANO TECHNOLOGY**

**12 Hours**

Introduction: Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerization. Addition (Free Radical Mechanism) condensation and copolymerization. Fabrication of Plastics. Application -Nylon 66, Teflon and Epoxy resin.

Unique properties of nano material- introduction to quantum materials, quantum dots, supramolecular materials and molecular crystal engineering – molecular machines and devices- Logic gate using electronics material for molecular electronic- nano cluster, nano rod, nanotube (CNT) and nanowire. - Synthesis-precipitation, thermolysis, chemical vapour deposition, laser ablation; Nano polymers- Properties and applications.

**UNIT IV FUELS AND ENGINEERING MATERIALS**

**9 Hours**

Fuel-Introduction- classification of fuels - coal analysis of coal (proximate and ultimate)- carbonization-manufacture of metallurgical coke (Otto Hoffmann method) - Refining of petroleum- manufacture of synthetic petrol (Bergius process)- natural gas- compressed natural gas(CNG)- producer gas- water gas. Combustion-calorific value - Flue gas analysis (ORSAT Method).

Abrasives: definition, classification -grinding wheel, Application. Refractories: definition, properties – Manufacture of alumina, magnesite and silicon carbide bricks.

**UNIT V INSTRUMENTAL TECHNIQUES OF CHEMICAL ANALYSIS**

**6 Hours**

Laws of photochemistry - Grotthus–Draper law, Stark–Einstein law and Lambert-Beer Law. Electromagnetic spectrum - UV-visible and IR spectroscopy – principles, instrumentation (Block diagram only)- Applications. Colorimetry- principles, instrumentation (Block diagram only) estimation of iron. Flame photometry – principles, instrumentation (Block diagram only) estimation of sodium.

**FURTHER READING:**

1. Batteries-Battery recycling process -Lithium battery
2. Cambridge structural database (protein data bank)-noting data bank

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

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

- CO1: Understand the chemistry of water and its industrial & domestic application  
 CO2: Utilization of electrochemistry principle in corrosion control and industrial application  
 CO3: Understanding the various types of polymers, material and its industrial application  
 CO4: Applications of nanotechnology and analytical techniques in day to day life

**REFERENCES:**

1. Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2010
2. Gowariker V.R., Viswanathan N.V. and Jayadev Sreedhar, "Polymer Science", New Age
3. Ozin G. A. and Arsenault A. C., "Nanochemistry: A Chemical Approach to Nanomaterials", RSC Publishing, 2005.
4. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New delhi 2010
5. [https://en.wikipedia.org/wiki/Ramachandran\\_plot](https://en.wikipedia.org/wiki/Ramachandran_plot)
6. <https://www.ccdc.cam.ac.uk/solutions/csd-system/components/csd/>
7. [https://link.springer.com/chapter/10.1007/978-3-642-28030-6\\_2](https://link.springer.com/chapter/10.1007/978-3-642-28030-6_2)
8. [www.santarosa.edu/~yataiia/4D/QuantumDotsMk2.ppt](http://www.santarosa.edu/~yataiia/4D/QuantumDotsMk2.ppt)
9. [onlinelibrary.wiley.com/doi/10.1002/9780470661345.smc107/pdf](http://onlinelibrary.wiley.com/doi/10.1002/9780470661345.smc107/pdf)
10. [https://en.wikipedia.org/wiki/Molecular\\_electronics](https://en.wikipedia.org/wiki/Molecular_electronics)
11. <https://books.google.co.in/books?isbn=008053239X>
12. <https://www.ccdc.cam.ac.uk/solutions/csd-system/components/csd/>
13. Jain and Jain, "Engineering Chemistry", Sixteenth edition, Dhanpatrai publications, 2012.

<b>1701GE104</b>	<b>FUNDAMENTALS OF MECHANICAL ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	(Common to B.E - Mech. & Civil Programmes)	<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

**COURSE****OBJECTIVES:**

1. To make the students practice various fundamental and derived units to manipulate length, time, mass, temperature and derived concepts from the fundamental quantities.
2. To make the students familiar with various forces and its conversions, material properties and geometric properties through demonstrations.
3. To make the students capable for understanding the energy in various forms (except nuclear energy) and make them capable of converting energy in one form to another form.
4. To familiarize students with all commonly used mechanical elements along with its applications.
5. To expose students with all conventional and unconventional manufacturing techniques along with their application for enabling them to start doing mechanical projects from the second semester.

**UNIT I ENGINEERING MEASUREMENTS I 7**

**Hours** Basic Concepts : Length using scale, sine rule and cosine rule, radians, calculation of surface area and volume of standard objects, time zones, period and frequency, linear velocity, linear acceleration, volume flow rate, angular velocity, angular acceleration, mass, density, specific volume, specific gravity, mass flow rate, momentum, conservation of mass and energy, temperature, heat, conduction, convection, radiation, insulation, thermal expansion, specific heat, calorific value, self-ignition temperature, cryogenic temperature, latent heat, evaporation, condensation. Demonstration, measurement and experiments: Length, surface area and volume of standard objects, periods and frequency, linear velocity, linear acceleration, volume flow rate, angular velocity, mass, density, momentum, conservation of mass and energy, temperature, heat, conduction, convection, radiation, insulation, thermal expansion, specific heat, calorific value, self-ignition temperature, latent heat.

**UNIT II ENGINEERING MEASUREMENTS II 7 Hours**

Basic Concepts: Newton's Laws, Force, Centripetal Force, Work, Energy, Power, Pressure load area relation, Stress and its types, Atmospheric Pressure, Types of fluids, Elasticity, Plasticity, Fluid Pressure Head Velocity head relation, Surface tension, Archimedes, Principle, Pascal's Law, Force Displacement Relations, Speed and Torque relations, Siphon, Compressibility, Hardness, Brittleness, Toughness, Ductility, Moment, First moment of Area, Second moment of Area. Demonstration, measurement and experiments: Newton's laws, force, centripetal force, power, pressure, pressure load area relation, stress and its types (tension, compression and shear), atmospheric pressure, fluid pressure head and velocity head relation, elasticity, plasticity, types of fluid, surface tension, viscosity, Archimedes principle, Pascal law, siphon, compressibility, hardness, brittleness, toughness, ductility, moment, first moment of area, second moment of area.

### UNIT III ENERGY CONVERSION

6 Hours

Basic Concepts : Kinetic energy in linear and rotary form, potential energy in head and pressure form, energy stored in springs, elastic energy, mechanical energy, thermal energy, chemical energy, magnetic energy, law of conservation of energy, conversion of kinetic energy to potential energy vice versa, mechanical energy in various forms to thermal energy, chemical energy to mechanical energy, fluid energy to mechanical energy vice versa, damping, electrical energy to mechanical energy vice versa, electrical energy to thermal energy, efficiency, flywheel energy storage, thermal energy storage, transmission of energy in pressure form, thermal form, kinetic energy form. Demonstration, measurement and experiments: Conversion of linear kinetic, rotary kinetic, potential in pressure head, spring, elastic, thermal, chemical into other forms, law of conservation of energy, energy storage in flywheel and thermal form, transmission of energy in pressure, thermal and kinetic form.

### UNIT IV MECHANICAL ELEMENTS

5 Hours

Basic Concepts, Demonstration, measurement and experiments: Bearings - ball bearing, roller bearing, thrust bearing, linear bearing, taper roller bearing, journal / bush bearing, needle bearing, spherical roller bearings, bearing blocks, one way bearings-Gears - spur, helical, herringbone, internal ring, face, hypoid, straight bevel, spiral bevel, screw, worm gears, rack and pinion, sprockets, ratchet and Paul, gear trains, sun planet gears-Couplings - rigid coupling - sleeve, flange, clamp couplings. Flexible coupling - Oldham, belt, universal, jaw and fluid couplings. Torque limiter -Belt drives - flat belt, v belt, timing belt drives. Chain drives, cable drives, chain block-Conveyers - roller conveyer, belt conveyer, vertical conveyer, pneumatic conveyer, chain conveyer, screw conveyer-Shafts, keys, spline shafts-Cam and followers - plate cam, wedge / translating cam, barrel cam, face cam, Globoidal cam, Geneva mechanism-Springs - tension spring, compression spring, coil spring, torsion spring, leaf spring, gas spring-Fasteners - screws, bolts, nuts and their specifications in mm and inch scale-Tools - double end spanners, box spanners, Allen keys and standards.

### UNIT V MANUFACTURING PROCESSES

5 Hours

Basic Concepts, Demonstration, measurement and experiments: Turning, facing, drilling, internal and external thread cutting, boring, grooving, taper turning in lathe. Milling using end milling cutters. drilling using universal drilling machine -sheet metal spinning, deep drawing, forging of clay models, making water tank using FRP, sheet metal work-arc welding, brazing, riveting -investment casting, sand casting, injection molding, vacuum molding, blow molding -powder coating.

### FURTHER READING:

Triangulation, projectile motion in trebuchet, water hammer, water bug, air suspension, MR fluid, five axis milling.

### EXPERIMENT

S

1. Measure the size, area and volume of given object. 2 Hours
2. Measure the natural period, natural frequency and maximum velocity of an oscillating pendulum. 2 Hours
3. Measure the volume and mass low rate of water through a given pipe. 2 Hours
4. Measure the mass, weight and density of given material or fluid. 2 Hours
5. Demonstrate the conservation of energy in a colliding object and name all the energy conversions.
6. Design a setup to prevent heat loss from a given hot object through conduction, convection and radiation. 2 Hours
7. Find the calorific value, specific heat and self-ignition temperature of a given fuel. 2 Hours
8. Demonstrate an experimental setup to prove Archimedes Principle. 2 Hours
9. Design an experimental setup to prove Pascal Law. 2 Hours
10. Identify the given materials based on their mechanical properties such as hardness, brittleness and Toughness..Design an experimental setup to convert mechanical energy in rotation form to any other form. 4 Hours
12. Design an experimental setup to convert potential energy into mechanical rotation. 4 Hours

**TOTAL: 30 + 30 HOURS**

### COURSE OUTCOMES:

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

- CO1: Use the instruments to measure any fundamental quantities such as length, time, mass, temperature.
- CO2: Measure force, fluid and material related parameters and convert the measured values from instruments into any system of units.
- CO3: Convert energy in one form into another form by understanding conservation of mass energy principle.
- CO4: Identify any commonly known mechanical component along with its application and its working

principle.

CO5: Identify any conventional manufacturing process and understand their limits and capabilities.

**REFERENCES:**

1. David Halliday, Robert Resnick, Jearl Walker, Principles of Physics, 10th Edition International Student Version, John Wiley & Sons, 2014.
2. Moaveni, Saeed, Engineering fundamentals: an introduction to engineering, Cengage Learning, 2015.
3. Wickert, Jonathan, and Kemper Lewis, An introduction to mechanical engineering, Cengage learning, 2012.
4. Serway, Raymond, and John Jewett. Physics for scientists and engineers with modern physics, Cengage learning, 2013.
5. Roger Timing, Engineering Fundamentals, Newnes, 2002.
6. C. F. Gerald and P. O. Wheatley, Applied Numerical Analysis, Pearson Education 2003.

**1701GEX03**

**PROGRAMMING IN C**  
(Common to all B.E. / B.Tech Degree Programmes)

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES:**

1. To prepare students to comprehend the fundamental concepts
2. To demonstrate fine grained operations in number system
3. To gain exposure in programming language using C
4. To develop programming skills using the fundamentals and basics of C Language

**UNIT I BASIC CONCEPTS**

**8 Hours**

Organization and Classifications of Computer- Generations of Computers- Number System- Problem Solving Techniques – Algorithm Design – Flowchart–Pseudocode

**UNIT II INTRODUCTION TO C LANGUAGE 10 Hours**

Overview of C - Constants, Variables and Data Types- Compilation and Linking - Operators and Expressions- Decision Making and Branching – Looping statements

**UNIT III ARRAYS AND STRINGS 9 Hours**

Arrays-One Dimensional Array- Declaration and Initialization-Two Dimensional Array-Declaration and Initialization- Programs using Arrays- Strings- String Handling Functions, Programs using Strings- Managing I/O Operations

**UNIT IV FUNCTIONS & STRUCTURES 10 Hours**

Functions-Function Prototypes-Declaring, Defining and Calling Functions-Call by value and Call by Reference-Recursive Functions-Structures- Declaration and Definition -Accessing Structure Members-Arrays of Structures-Unions- Programs using Structures and Unions

**UNIT V POINTERS & FILES 8 Hours**

Pointers-Dynamic Memory Allocation-Arithmetic Operations using Pointers, Files – File Manipulation-I/O Operations, Preprocessor Directives, Storage Classes

**TOTAL: 45 HOURS**

**FURTHER READING:**

Object Oriented Programming Approach.

**COURSE OUTCOMES:**

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

CO1: Describe basic concepts of computers

CO2: Paraphrase the operations of number system

CO3: Describe about basic concepts of C-Language

CO4: Understand the code reusability with the help of user defined functions

CO5: Analyze the structure concept, union, file management and preprocessor in C language

**REFERENCES:**

1. E. Balagurusamy, “Programming in ANSI C”, McGraw Hill Education India Private Limited; Seventh Edition, 2017.
2. Pradip Dey, Manas Ghosh , “Computer Fundamentals and Programming in C”, Second Edition, Oxford University Press, 2013.
3. Ashok N. Kamthane, “Programming in C”, Pearson Education India, 3<sup>rd</sup> Edition, 2015.
4. Yashavant P. Kanetkar, “Let Us C”, BPB Publications, 15<sup>th</sup> Revised and Updated Edition, 2016.
5. <http://nptel.ac.in/>



1701HS151

**PHYSICS AND CHEMISTRY LABORATORY-I**  
(Common to all B.E. / B.Tech Degree Programmes)

L	T	P	C
0	0	2	1

**COURSE OBJECTIVES:**

1. The Objective of this course is to make the students gain practical knowledge to co-relate with the theoretical studies
2. To achieve perfectness in experimental skills
3. To bring confidence and ability to develop and fabricate engineering and technical equipments.
4. To train the students to analyses the water sample
5. To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis

**PHYSICS**

**LIST OF EXPERIMENTS:**

1. Determine the moment of inertia of the disc and calculate the rigidity modulus of a given wire using torsion pendulum (symmetrical masses method).
2. Find the elevation of the given wooden beam at the midpoint by loading at the ends and hence calculate the Young's modulus of the material by uniform bending.
3. Determine the coefficient of viscosity of the given liquid by Poiseuille's method.
4. From the interference fringes from the air wedge setup and calculate the thickness of the given wire.
5. By applying the principle of diffraction, determine the wavelength of given laser light and the average particle size of lycopodium powder using laser source.
6. Determine the
  - (i) Wavelength of ultrasonic in a liquid medium
  - (ii) Velocity of ultrasonic waves in the given liquid
  - (iii) Compressibility of the given liquid using ultrasonic interferometer.

**CHEMISTRY**

**LIST OF EXPERIMENTS:**

1. Determination of total, temporary & permanent hardness of water by EDTA method
2. Determination of strength of given hydrochloric acid using pH meter
3. Estimation of iron content of the given solution using potentiometer
4. Estimation of sodium present in water using flame photometer
5. Corrosion experiment – weight loss method
6. Determination of molecular weight of a polymer by viscometry method
7. Conductometric titration of strong acid Vs strong Base

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

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

- CO1: Realize the concept of properties of matter and apply the same for practical applications.  
CO2: Identify the suitable laser source for fiber optic communication applications.  
CO3: Determine the velocity of ultrasonic waves and apply the same for day today applications.  
CO4: Classify the different types of crystal structures and analyze their properties.  
CO5: Comprehend the efficacy of quantum equations in modern areas.  
CO6: Identify the pH of the solution.  
CO7: Find the iron content of the water sample using potentiometer.  
CO8: Explain and demonstrate the conductance of the solution.  
CO9: Interpret the hardness and metal ions present in the water.

**REFERENCES:**

1. D.S.Mathur, Elements of Properties of matter, 5th edition, S.Chand & Company Ltd., New Delhi,2012.
2. Charles Kittel, Introduction to Solid State Physics, 8th edition, Wiley India Pvt. Ltd., New Delhi, 2012.
3. Arthur Beiser, Shobhit Mahajan and S. Rai Choudhury, Concepts of Modern Physics, 6th edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
4. B.K. Pandey and S. Chaturvedi, Engineering Physics, 1st edition, Cengage Learning India Pvt. Ltd., New Delhi, 2012.
5. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011.
6. Ian Morison, Introduction to Astronomy and Cosmology, John Wiley and Sons, Ltd, 2013.
7. Daniel R. Palleros, "Experimental organic chemistry" John Wiley & Sons, Inc., New Yor (2001).
8. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel's Textbook of practical organic chemistry", LBS Singapore (1994).
9. Jeffery G.H., Bassett J., Mendham J.and Denny vogel's R.C, "Text book of quantitative analysis chemical analysis", ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.10. Kolthoff I.M., Sandell E.B. et al. "Quantitative chemical analysis", Mcmillan, Madras 1980.

1701GEX51

**PROGRAMMING IN C LABORATORY**  
(Common to all B.E. / B.Tech. Degree Programmes)

L	T	P	C
0	0	2	1

**COURSE OBJECTIVES:**

1. To prepare students to comprehend the fundamental concepts
2. To demonstrate fine grained operations in number system
3. To gain exposure in programming language using C
4. To develop programming skills using the fundamentals and basics of C Language.

**LIST OF EXPERIMENTS:**

1. Working with word and style sheets
2. Write a C program to implement basic concepts
3. Write a C program to implement Decision Making and Branching statements
4. Write a C program to implement looping statements
5. Write a C program to implement Arrays
6. Write a C program to implement Strings
7. Write a C program to implement pointers
8. Write a C program to implement Structures
9. Write a C program to work with files in C

**TOTAL: 30 HOURS**

**ADDITIONAL EXPERIMENTS:**

1. Write a c program to remove the occurrence of "the" word from entered string.
2. Create two files test1.txt and test2.txt and write a C program to read the file text1.txt character by character on the screen and paste it at the end of test2.txt

**COURSE OUTCOMES:**

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

- CO1: Understand basic concepts of computers
- CO2: Implement basic concepts of c-language
- CO3: Implement arrays, strings and pointers.
- CO4: Implement the basics of structures, unions, file management and preprocessor in C language

**REFERENCES:**

1. E. Balagurusamy, "Programming in ANSI C", McGraw Hill Education India Private Limited; Seventh Edition, 2017.
2. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013.
3. Ashok N. Kamthane, "Programming in C", Pearson Education India, 3<sup>rd</sup> Edition, 2015.
4. Yashavant P. Kanetkar, "Let Us C", BPB Publications, 15<sup>th</sup> Revised and Updated Edition, 2016.
5. <http://nptel.ac.in/>

1701GEX53

**WORKSHOP PRACTICE**  
(Common to all B.E. / B.Tech Degree Programmes)

**L T P C**  
**0 0 2 1**

**COURSE OBJECTIVES:**

- 1.To provide hands on training for fabrication of components using sheet metal and welding equipment / tools.
- 2.To develop skill for using carpentry and fitting tools to make simple components and metal joints.
- 3.To provide hands on training for preparing the green sand mould using foundry tools.
- 4.To provide training for making simple house hold electrical & pipe line connections using suitable tools.
- 5.To develop the skill to make / operate/utilize the simple engineering components.

**LIST OF EXPERIMENTS**

- |   |                |
|---|----------------|
| 1. Forming of simple object in sheet metal using suitable tools (Example: Dust Pan / Soap Box) (or) making simple object using Metal Spinning Machine. (Example: Aluminum Cup).   | <b>4 Hours</b> |
| 2. Prepare V (or) Half round (or) Square (or) Dovetail joint from the given mild Steel flat.  | <b>4 Hours</b> |
| 3. Fabrication of a simple component using thin and thick plates. (Example: Book rack)  | <b>2 Hours</b> |
| 4. Making a simple component using carpentry power tools. (Example: Electrical switch Box/Tool box/ Letter box.   | <b>2 Hours</b> |
| 5. Construct a household pipe line connections using pipes, Tee joint, Four way joint, elbow, union, bend, Gate way and Taps (or) Construct a pipe connections of house application centrifugal pump using pipes, bend, gate valve, flanges and foot valve. | <b>4 Hours</b> |
| 6. Prepare a green sand mould using solid pattern/split pattern.  | <b>4 Hours</b> |
| 7. Study of gas welding equipment and its demonstration   | <b>2 Hours</b> |
| 8. Soldering Practice for simple printed circuit board.   | <b>4 Hours</b> |
| 9. Construct a domestic electrical wire connections using indicator, one way switch with calling bell, two way switch with lamp, one way switch with fan regulator and one way switch with socket.  | <b>4 Hours</b> |

**TOTAL: 30 HOURS**

**COURSE OUTCOMES:**

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

- CO1: Fabricate simple components using sheet metal & welding equipment/tools.  
CO2: Make simple components / joints using carpentry and fitting tools.  
CO3: Prepare green sand mould using suitable tools.  
CO4: Make simple house hold electrical & pipe line connections using suitable tools.  
CO5: Make / operate / utilize the simple engineering components.

1701MA201

**ENGINEERING MATHEMATICS II**  
(Common to all B.E / B.Tech Degree Programmes )

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>2</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVES:**

1. To develop an understanding of the standard techniques of Complex variable theory to apply in areas such as heat conduction, elasticity, fluid Dynamics and flow of electric current
2. To train the students with the concepts of Vector calculus needed for problems in all Engineering Disciplines
3. To make the Students apply Laplace Transform to create a new domain in which it is easier to handle the problem that is being investigated

**UNIT I ANALYTIC FUNCTIONS**

**9 Hours**

Analytic functions – Cauchy Riemann Equations – Properties – Determination of Analytic function using Milne Thomson's method, Conformal Mappings – Mappings of  $w = z + a$ ,  $az$ ,  $1/z$  – Bilinear Transformation – Application of Analytic Functions.

**UNIT II COMPLEX INTEGRATION**

**9 Hours**

Cauchy's fundamental theorem (statement only) – Application of Cauchy's Integral formula – Laurent's series – Classification of singularities – Cauchy's Residue theorem (statement only) – Contour integration.

**UNIT III MULTIPLE INTEGRAL**

**9 Hours**

Double integration – Cartesian and polar coordinates – Change the order of Integration – Applications: Area of a curved surface using double integral – Triple integration in Cartesian co-ordinates – Volume as triple integral.

**UNIT IV VECTOR CALCULUS**

**9 Hours**

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) – Applications of the above theorems to find surface area of a closed region and volume of cube and parallel piped.

**UNIT V LAPLACE TRANSFORM**

**9 Hours**

Laplace Transform – Conditions for existence – Transform of Elementary Functions – Basic Properties – Transform of Unit step function and Impulse function – Transform of Periodic function – Inverse Laplace Transform – Convolution Theorem (excluding Proof ) – Initial and Final value Theorems – Solution of Linear ODE of Second order with constant coefficient using Laplace Transform techniques.

**TOTAL: 45 + 15 HOURS**

**FURTHER READING:**

1. Volume of Cylindrical and spherical polar co ordinates.
2. Application of Integral theorems in finding Volume/Area of Hemispheres, cylinders etc.

**COURSE OUTCOMES:**

On the Successful completion of the course, Students will be able to

- CO1: Construct Analytic functions and trace the image of a region using transformation.
- CO2: Solve complex integrals.
- CO3: Apply multiple integral technique to find area and volume.
- CO4: Compute surface and volume integral in vector field.
- CO5: Apply Laplace Transform in solving Boundary value problems of second order ODE.

**REFERENCES:**

1. Veerarajan R., "Engineering Mathematics", updated second edition for Semester I and II, 2017.
2. Grewal. B.S, "Higher Engineering Mathematics", 44th Edition, Khanna Publications, Delhi, 2014.
3. Bali N. P and Manish Goyal, "Text book of Engineering Mathematics", Sixth edition, Laxmi Publications Pvt. Ltd., 2014.
4. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.
5. P.Kandasamy, K. Gunavathy and K. Thilagavathy, Engineering Mathematics, Volume II, S. Chand & Co., New Delhi, 2009.
6. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing, New Delhi, 2007.
7. Veerarajan R., "Engineering Mathematics", fifth Edition, Tata Mc Graw Hill Publishing Company, New Delhi, 2006.
8. M K Venkataraman, Engineering mathematics, Volume I, 2nd ed., National Publishing Co. 2003.
9. nptel.ac.in/courses/111105035, www.nptelvideos.in/2012/11/Mathematics.html
10. www.learnerstv.com/Free-maths-video lectures - ltv348-page1.htm

1701PH203

**MATERIALS SCIENCE**  
(Common to B.E - Mech. & Civil Programmes)

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES:**

1. To explain the properties of conducting, semiconducting and dielectric materials.
2. To impart fundamental knowledge in optical materials.
3. To understand the nature and application of different magnetic materials.

**UNIT I ELECTRICAL PROPERTIES OF METALS**

**9 Hours**

Quantum free electron theory – Fermi – Dirac distribution function – Fermi energy and its variation with temperature – density of energy states – calculation of density of electrons and Fermi energy at 0 K – mean energy of electrons at 0 K – problem solving.

**UNIT II SEMICONDUCTING PROPERTIES OF MATERIALS**

**9 Hours**

Introduction – elemental and compound semiconductors – intrinsic semiconductors: expression for number of electrons and holes – determination of carrier concentration and position of Fermi energy – electrical conductivity – band gap energy determination – carrier concentration in extrinsic semiconductors. Hall Effect theory and experimental determination – uses – problem solving.

**UNIT III DIELECTRIC PROPERTIES OF MATERIALS**

**9 Hours**

Introduction – fundamental definitions in dielectrics – expression for electronic and ionic polarizations-orientation polarization – space charge polarization – Langevin – Debye equation – frequency and temperature effects on polarization – internal field – expression for internal field ( cubic structure) – Clausius – Mosotti equation and its importance – applications of dielectric materials – problems solving.

**UNIT IV OPTICAL PROPERTIES OF MATERIALS**

**9 Hours**

Introduction – optical absorption in metals, semiconductors and insulators. **Fluorescence and phosphorescence. Light emitting diode:** principle, construction, working and applications. Liquid crystal display: general properties – dynamic scattering display – twisted pneumatic display – applications – comparison between LED and LCD. Blue ray disc – principle – working.

**UNIT V MAGNETIC PROPERTIES OF MATERIALS**

**9 Hours**

Introduction – orbital and spin magnetic moments – Bohr magneton – basic definitions – classification of magnetic materials – domain theory of ferromagnetism – process of domain magnetization – explanation of hysteresis curve based on domain theory – hard and soft magnetic materials, ferrites and spinels- applications.

**TOTAL: 45 HOURS**

**FURTHER READING:**

1. Giant magnetoresistance.

**COURSE OUTCOMES:**

On the Successful completion of the course, Students will be able to

- CO1: Distinguish electrical properties of different kinds of conducting materials.
- CO2: Identify the different types of semiconductors and its applications.
- CO3: Categorize the various polarization mechanisms in dielectrics.
- CO4: Choose the suitable material for the construction of display devices.
- CO5: Select appropriate magnetic materials for magnetic storage devices.

**REFERENCES:**

1. William D. Callister, “Materials Science and Engineering an Introduction”, John Wiley and Sons, Inc, 2010.
2. S.O. Pillai, “Solid State Physics”, New Age International Publications, New Delhi, 2014.
3. M.N. Avadhanulu and P.G. Kshirsagar, “A Text Book of Engineering Physics”, S. Chand & Company Ltd, New Delhi, 2011.
4. P.K. Palanisamy, “Physics for Engineers”, Scitech Publications (India) Pvt. Ltd, Chennai, 2010.
5. V. Raghavan, “Materials Science and Engineering”, Prentice Hall of India, New Delhi, 2010.
6. R.K.Gaur and S.L.Gupta, “Engineering Physics”, Dhanpet Rai publications, New Delhi, 2010.

1701CH201

**ENVIRONMENTAL STUDIES**  
(Common to all B.E. / B.Tech Degree Programmes)

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES:**

1. Realize the interdisciplinary and holistic nature of the environment.
2. Understand how natural resources and environment affect the quality of life and stimulate the quest for sustainable development.
3. Recognize the socio-economic, political and ethical issues in environmental science.

**UNIT I ECOSYSTEMS AND BIODIVERSITY 10 Hours**

Concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – hot – spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man – wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Documentation of the medicinal plants in your native place.

**UNIT II NATURAL RESOURCES 10 Hours**

Forest resources: Use and over – exploitation, deforestation, case studies – timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer – pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Documentation of the effect of modern Agriculture in your nearby Village.

**UNIT III ENVIRONMENTAL POLLUTION 9 Hours**

Definition – Source, causes, effects and control measures of: (a) Air pollution – Mitigation procedures – Control of particulate and gaseous emission, Control of SO<sub>x</sub>, NO<sub>x</sub>, CO and HC) – Technology for capturing CO<sub>2</sub> (metallo- organic frame works) (b) Water pollution – Waste water treatment processes. (c) Soil pollution – soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – role of an individual in prevention of pollution – pollution case studies. Documentation study of local polluted site – Urban / Rural / Industrial / Agricultural.

**UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 8 Hours**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – environmental ethics: Issues and possible solutions – 12 Principles of green chemistry – consumerism and waste products – environment protection act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments – scheme of labeling of environmentally friendly products (Ecomark) central and state pollution control boards – disaster management: floods, earthquake – Public awareness. Analyze the recent steps taken by government of India to prevent pollution (Green India and Clean India).

**UNIT V HUMAN POPULATION AND THE ENVIRONMENT 8 Hours**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – Environmental impact analysis (EIA) – GIS – remote sensing – role of information technology in environment and human health – Case studies. Documentation study of the Human health and the environment in nearby Hospital (Statistical report).

**TOTAL: 45 HOURS**

**FURTHER READING:**

Human rights: E – waste and biomedical waste – Identification of adulterants in food materials

**COURSE OUTCOMES:**

On the Successful completion of the course, Students will be able to

- CO1: Describe the importance of ecosystem and its conservation.
- CO2: Differentiate various natural resources and the urgent need to conserve the natural resources.
- CO3: Explain the different types of pollution and its effects.
- CO4: Describe the various environmental protection acts.
- CO5: Explain the major diseases, women, child development and the impacts of population explosion.

**REFERENCES:**

1. Trivedi. R.K., “Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards”, Vol. I and II, Enviro Media, 3<sup>rd</sup> edition, BPB publications, 2010.
2. Cunningham, W.P.Cooper, T.H. Gorhani, “Environmental Encyclopedia”, Jaico Publishing House, Mumbai, 2001.
3. Dharmendra S. Sengar, “Environmental law”, Prentice hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan. R, “Environmental Studies-From Crisis to Cure”, Oxford University Press, 2005.
5. Benny Joseph, “Environmental Science and Engineering”, Tata McGraw-Hill, New Delhi, 2006.
6. [https://en.wikipedia.org/wiki/Carbon\\_capture\\_and\\_storage](https://en.wikipedia.org/wiki/Carbon_capture_and_storage)
7. Ravikrishnan. A., “Environmental Science and Engineering”, Sri Krishna Hi-tech Publishing Company Pvt. Ltd.

<b>1701GEX01</b>	<b>BASIC ELECTRICAL AND ELECTRONICS ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	(Common to B.E. / B.Tech. – CSE, IT, CIVIL & MECH)	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES:**

1. To introduce basic electrical terminologies and laws
2. To impart knowledge on solving series and parallel circuits
3. To introduce about the three phase system
4. To explain the working principle of dc and ac machines, power plants
5. To familiarize about basic electronic components, circuits, transducers, digital logic and communication systems

### **UNIT I DC AND AC CIRCUIT FUNDAMENTALS 9 Hours**

Definition of terms - voltage, current, power, energy, active and passive elements; Ohm's law and Kirchhoff's laws; **Series and parallel circuits; source transformation; equivalent resistance** star/delta conversion; Concepts of AC circuits - RMS and average values, form and peak factors, real and reactive power, power factor.

### **UNIT II THREE PHASE SYSTEM 9 Hours**

Introduction to three phase circuits; balanced and unbalanced system; phase and line parameters - relations; power measurement - voltmeter and ammeter method, two and three watt meter methods; Components of AC transmission and distributions systems (single line diagram approach).

### **UNIT III ELECTRICAL MACHINES AND POWER PLANTS 9 Hours**

Operating principle, classification and applications of DC generator, DC motor, transformer and induction motor (single phase); Power plants - Thermal power plant, hydroelectric power plant and nuclear power plant (Block diagram approach only).

### **UNIT IV SEMICONDUCTOR DEVICES AND TRANSDUCERS 9 Hours**

Characteristics of PN junction diode and zener diode; Rectifiers- Half wave and full wave rectifiers (qualitative treatment only); BJT – configurations; Amplifiers & Oscillators - definition, classification and applications; Transducers – classification, resistance temperature detector (RTD), linear variable differential transformer (LVDT).

### **UNIT V DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS 9 Hours**

Boolean algebra - Reduction of Boolean expressions; De-Morgan's theorem; Logic gates - Implementation of Boolean expressions; Model of communication system - Analog and digital, Wired and wireless channel; Block diagram of various communication systems - Microwave, satellite, optical fiber and cellular mobile system.

**TOTAL: 45 HOURS**

### **FURTHER READING:**

1. Working principle and operation of Fax and ISDN
2. LED lightings

### **COURSE OUTCOMES:**

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

- CO1: Remember the basic laws and fundamental concepts related to electrical, electronics and communication engineering
- CO2: Apply basic concepts to solve problems in DC and AC circuits
- CO3: Recall the principle of operation of DC & AC machines and power plants
- CO4: Summarize the Boolean algebra and digital logic gates
- CO5: Elucidate the characteristics of diode, BJT and applications of amplifiers and oscillators
- CO6: Explain the operation of functional blocks of various communication systems

### **REFERENCES:**

1. Smarajit Ghosh, "Fundamentals of Electrical and Electronics Engineering", 2<sup>nd</sup> Edition, PHI Learning, 2010.
2. R.Muthusubramaniam, S.Salaivahanan and K.A.Mureleedharan, "Basic Electrical Electronics and Computer Engineering", Tata McGraw Hill, 2004.
3. D.P.Kothari and I.J.Nagrath, "Theory and Problems of Basic Electrical Engineering", PHI learning, New Delhi, 2004.
4. J.B.Gupta, "Fundamentals of Electrical Engineering and Electronics", S K Kataria and Sons, Reprint 2012 Edition.
5. R.L.Boylestad and L.Nashelsky, "Electronic Devices and Circuit Theory", Pearson, 11<sup>th</sup> Edition, 2013.
6. George Kennedy and Bernard Davis, "Kennedy's Electronic communication Systems", McGraw Hill Education, 5<sup>th</sup> Edition, 2011.
7. Donald P.Leach, Albert Paul Malvino and GoutamSaha, "Digital Principles and Applications", McGraw-Hill Education, 8<sup>th</sup> Edition, 2014.
8. <http://nptel.ac.in/>



1701GEX02

**ENGINEERING GRAPHICS**  
(Common to all B.E. / B.Tech Degree Programmes)

L	T	P	C
2	2	0	3

**COURSE OBJECTIVES:**

1. To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
2. To expose them to existing national standards related to technical drawings.

**CONCEPTS AND CONVENTIONS (Not for Examination)**

**2 Hours**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

**UNIT I PLANE CURVES AND FREE HAND SKETCHING**

**10 Hours**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves, Scales: Construction of Diagonal and Vernier scales.

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

**UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES**

**10 Hours**

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

**UNIT III PROJECTION OF SOLIDS**

**10 Hours**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method.

**UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES**

**10 Hours**

Sectioning of above 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 section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes.

**UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS**

**10 Hours**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

**COMPUTER AIDED DRAFTING (Demonstration Only)**

**8 Hours**

Basics commands of AutoCAD- two dimensional drawing, editing, layering and dimensioning - coordinate Systems-Drawing practice - orthographic views of simple solids using AutoCAD.

**FURTHER READING:**

Applications of engineering graphics in students' discipline

**TOTAL: 60 HOURS**

**COURSE OUTCOMES:**

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

- CO1: Perform free hand sketching of basic geometrical constructions and multiple views of objects.
- CO2: Do orthographic projection of lines and plane surfaces.
- CO3: Draw projections and solids and development of surfaces.
- CO4: Prepare isometric and perspective sections of simple solids.
- CO5: Demonstrate computer aided drafting.

**REFERENCES:**

1. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore,2007.
2. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
3. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2009.
4. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2008.
5. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
6. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
7. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50<sup>th</sup> Edition, 2010.

**PUBLICATION OF BUREAU OF INDIAN STANDARDS:**

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

**SPECIAL POINTS APPLICABLE TO UNIVERSITY EXAMINATIONS ON ENGINEERING GRAPHICS:**

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.

1701GEX04

**ENGINEERING MECHANICS**  
(Common to B.E - Mech. & Civil Programmes)

L	T	P	C
2	2	0	3

**COURSE OBJECTIVES:**

1. To familiarize on various methods of adding and resolving various force systems in a real world environment.
2. To provide knowledge on understanding the effects of forces on a point and at a distance and to arrive at equivalent systems from the given force system.
3. To provide knowledge on various support conditions of a rigid body and deciding a support system for given condition.
4. To expose students with impact of geometries of load bearing systems and make them calculate moment of inertia of various cross sections.
5. To make students understand concepts of friction under various applications and make them calculate frictional forces induced.

**UNIT I BASIC CONCEPTS AND FORCE SYSTEM**

**5 Hours**

Introduction to mechanics - idealization of mechanics - laws of mechanics - principle of transmissibility - vector - addition, subtraction and product. Force- types - system of forces - resultant forces - composition of forces - resolution of force-free body diagram for real world systems.

**UNIT II STATICS OF PARTICLES AND FORCE SYSTEM**

**6 Hours**

Equilibrium of particle in space, moment of couple-equilibrant Moment about point and specific axis-moment at couple- simplification of force and couple systems.

**UNIT III STATICS OF RIGID BODIES**

**7 Hours**

Equilibrium of rigid bodies in two and three dimensions - beams - types of loads, supports and their reactions Two and three force Members-Static determinacy.

**UNIT IV PROPERTIES OF SURFACES AND SOLIDS**

**7 Hours**

Determination of centroid of areas, volumes and mass - Pappus and Guldinus theorems - moment of inertia of plane and areas Parallel axis theorem radius of gyration of area- product of inertia- mass moment of inertia.

**UNIT V FRICTION**

**5 Hours**

Introduction - mechanism of friction-types -laws of friction - friction on horizontal and inclined planes, ladder and wedge friction - rolling resistance.

**FURTHER READING:**

Moment of Inertia of flywheel - Internal force of a member - Equilibrium of rigid bodies in three dimensions: Ball and socket joint.

**TOTAL: 30 + 15 HOURS**

**COURSE OUTCOMES:**

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

- CO1: Draw a free body diagram from the given real world system and add or subtract or resolve the forces involved in the system.
- CO2: Calculate the moment created by the applied force with reference to any reference in a three dimensional space.
- CO3: Determine the appropriate support system for the given real world system by calculating the reactions generated.
- CO4: Suggest suitable cross section or geometry for a load bearing support to prevent it from collapsing due to bending.
- CO5: Calculate the frictional force involved in various real world systems.

**REFERENCES:**

1. F.P. Beer, and Jr. E.R Johnston, Vector Mechanics for Engineers - Statics and Dynamics, Tata McGraw-Hill Publishing Company, New Delhi, 2007.
2. N.H. Dubey, Engineering Mechanics- Statics and Dynamics, Tata McGraw-Hill Publishing Company, New Delhi, 2013.
3. Irving H. Shames, Engineering Mechanics - Statics and Dynamics, Pearson Education Asia Pvt. Ltd., 2006.
4. R.C. Hibbeler, Engineering Mechanics: Combined Statics & Dynamics, Prentice Hall, 2009.
5. D. P. Sharma, Engineering Mechanics, Dorling Kindersley (India) Pvt. Ltd., New Delhi, 2010.
6. S. Rajasekaran and G. Sankara subramanian, Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt. Ltd., New Delhi, 2005.

1701GEX52

**COMMUNICATION SKILLS LAB**  
(Common to all B.E. / B.Tech Degree Programmes)

L	T	P	C
0	0	2	1

**COURSE OBJECTIVES:**

This Lab focuses on using multi-media instruction for language development to meet the following targets:

1. To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts
2. Further, they would be required to communicate their ideas relevantly and coherently in writing.
3. To prepare all the students for their placements.

**LIST OF EXPERIMENTS:** The following course content to conduct the activities is prescribed for the Communication Skills Lab:

1. **Activities on Fundamentals of Inter-personal Communication and Building Vocabulary –**  
**Starting a conversation - responding appropriately and relevantly - using the right body language -**  
Role Play in different situations & Discourse Skills- using visuals - Synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy, idioms and phrases, collocations & usage of vocabulary.
2. **Activities on Reading Comprehension** - General Vs Local comprehension, reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, critical reading & effective googling.
3. **Activities on Writing Skills** - Structure and presentation of different types of writing - letter writing/ Resume writing/ e-correspondence/ Technical report writing/ Portfolio writing - planning for writing - improving one's writing.
4. **Activities on Presentation Skills** - Oral presentations (individual and group) through JAM sessions / seminars / PPTs and written presentations through posters/ projects/ reports/ e-mails/ assignments etc.
5. **Activities on Group Discussion and Interview Skills** - Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conferencing and Mock Interviews.

**TOTAL: 30 HOURS**

**ADDITIONAL EXPERIMENTS:**

Phonetics

**COURSE OUTCOMES:**

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

- CO1: Accomplishment of sound vocabulary and its proper use contextually.
- CO2: Flair in Writing and felicity in written expression
- CO3: Enhanced job prospects.
- CO4: Effective Speaking Abilities.

**REFERENCES:**

1. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009
2. Advanced Communication Skills Laboratory Manual by Sudha Rani, D, Pearson Education 2011.
3. Technical Communication by Paul V. Anderson, 2007. Cengage Learning pvt. Ltd. New Delhi
4. English Vocabulary in Use series, Cambridge University Press 2008.
5. Management Shapers Series by Universities Press (India) Pvt Ltd., Himayatnagar, Hyderabad 2008.
6. English for Technical Communication for Engineering Students, Aysha Vishwamohan, Tata Mc Graw Hill 2009.
7. Books on TOFEL/ GRE/ GMAT/ CAT/ IELTS by Barron's/ DELTA/ Cambridge University Press.

1701HS251

**PHYSICS AND CHEMISTRY LABORATORY-II**

(Common to all B.E. / B.Tech Degree Programmes)

**L T P C**  
**0 0 2 1**

**COURSE OBJECTIVES:**

1. The Objective of this course is to make the students gain practical knowledge to co-relate with the theoretical studies.
2. To achieve perfectness in experimental skills.
3. To bring confidence and ability to develop and fabricate engineering and technical equipments.
4. To make the student acquire practical skills in the wet chemical and instrumental methods for quantitative estimation of hardness, alkalinity, metal ion content, corrosion in metals and cement analysis.

**PHYSICS**

**LIST OF EXPERIMENTS:**

1. Using lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.
2. Find the band gap value of the given semiconductor diode. Based on the band gap value, identify the given semiconductor.
3. With the aid of spectrometer, find the angle of Prism and refractive index of the medium.
4. Determine the wavelengths of polychromatic source in the visible region using spectrometer grating.
5. Find the depression at the midpoint of the given wooden beam subjected to non-uniform bending and determines the Young's modulus of the material of the beam.
6. Find the given unknown resistance using Carey-Foster's Bridge.

**CHEMISTRY**

**LIST OF EXPERIMENTS:**

1. Conductometric Precipitation titration of  $\text{BaCl}_2$  Vs  $\text{Na}_2\text{SO}_4$
2. Estimation of dissolved oxygen in a water sample/sewage by Winklers method.
3. Estimation of chloride content in water by argentometric method.
4. Conductometric titration of mixture of acids.
5. Comparison of alkalinities of the given water samples.

**Additional Experiments:**

1. Estimation of heavy metals in the given solution by EDTA method.
2. Determination of concentration of unknown colored solution using spectrophotometer.

**COURSE OUTCOMES:**

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

**TOTAL: 30 HOURS**

- CO1 : Realize the concept of properties of matter and apply the same for practical applications. CO2 : Identify the suitable laser source for fiber optic communication applications.  
CO3 : Determine the velocity of ultrasonic waves and apply the same for day today applications. CO4 : Classify the different types of crystal structures and analyze their properties.  
CO5 : Comprehend the efficacy of quantum equations in modern areas. CO6 : Illustrate the EMF of the Redox reaction.  
CO7 : Compare the Alkalinity of given water Sample with their standards. CO8 : Identify the Concentration of metal ion present in water sample.  
CO9 : Outline the precipitation titration using Conductivity meter.  
CO10: Interpret the dissolved oxygen present in the water.

**REFERENCES:**

1. D.S.Mathur, Elements of Properties of matter, 5th edition, S.Chand & Company Ltd., New Delhi,2012.
2. Charles Kittel, Introduction to Solid State Physics, 8th edition, Wiley India Pvt. Ltd., New Delhi, 2012.
3. Arthur Beiser, Shobhit Mahajan and S. Rai Choudhury, Concepts of Modern Physics, 6th edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
4. B.K. Pandey and S. Chaturvedi, Engineering Physics, 1st edition, Cengage Learning India Pvt. Ltd., New

Delhi, 2012.

- Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011.
- Ian Morison, Introduction to Astronomy and Cosmology, John Wiley and Sons, Ltd, 2013.
- Laboratory Manual on Engineering Chemistry, S.K. Bhasin, S. Rani, Dhanpat Rai Publishing Company, New Delhi, 2011.
- Daniel R. Palleros, "Experimental organic chemistry" John Wiley & Sons, Inc., New Yor (2001).
- Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel"s Textbook of practical organic chemistry", LBS Singapore (1994).
- Jeffery G.H., Bassett J., Mendham J.and Denny vogel"s R.C, "Text book of quantitative analysis chemical analysis", ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.
- Kolthoff I.M., Sandell E.B. et al. "Quantitative chemical analysis", Mcmillan, Madras 1980.

**MA6351 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C**  
**3 1 0 4**

**OBJECTIVES**

To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.

To acquaint the student with Fourier transform techniques used in wide variety of situations.

To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

**UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9 + 3**

Formation of partial differential equations – Singular integrals -- 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 II FOURIER SERIES 9 + 3**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

**UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9 + 3**

Classification of PDE – Method of separation of variables - Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

**UNIT IV FOURIER TRANSFORMS 9 + 3**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

**UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9 + 3**

Z- transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

**TOTAL (L:45+T:15): 60 PERIODS**

**OUTCOMES**

The understanding of the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

**TEXT BOOKS**

pg. 22

Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd.,  
Second reprint, New Delhi, 2012.  
Grewal. B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.  
Narayanan.S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering  
Students" Vol. II & III, S.Viswanathan Publishers Pvt Ltd. 1998.

## REFERENCES

1. Bali.N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7<sup>th</sup> Edition, Laxmi Publications Pvt Ltd, 2007.
2. Ramana.B.V., "Higher Engineering Mathematics", Tata Mc-Graw Hill Publishing Company Limited, New Delhi, 2008.
3. Glyn James, "Advanced Modern Engineering Mathematics", 3<sup>rd</sup> Edition, Pearson Education, 2007.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 8<sup>th</sup> Edition, Wiley India, 2007.
5. Ray Wylie. C and Barrett.L.C, "Advanced Engineering Mathematics", Sixth Edition, Tata McGraw Hill Education Pvt Ltd, New Delhi, 2012.
6. Datta.K.B., "Mathematical Methods of Science and Engineering", Cengage Learning India Pvt Ltd, Delhi, 2013.

**CE6306**

**STRENGTH OF MATERIALS**

**L T P C**  
**3 1 0 4**

### OBJECTIVES:

To understand the stresses developed in bars, compounds bars, beams, shafts, cylinders and spheres.

### UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS

**9**

Rigid bodies and deformable solids - Tension, Compression and Shear Stresses - Deformation of simple and compound bars - Thermal stresses - Elastic constants - Volumetric strains -Stresses on inclined planes - principal stresses and principal planes - Mohr's circle of stress.

### UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM

**9**

Beams - types transverse loading on beams - Shear force and bending moment in beams - Cantilevers - Simply supported beams and over - hanging beams. Theory of simple bending-bending stress distribution - Load carrying capacity - Proportioning of sections - Flitched beams - Shear stress distribution.

### UNIT III TORSION

**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 - Deflection of helical springs, carriage springs.

### UNIT IV DEFLECTION OF BEAMS

**9**

Double Integration method - Macaulay's method - Area moment method for computation of slopes and deflections in beams Conjugate beam and strain energy - Maxwell's reciprocal theorems.

### 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 – Lamé's theorem.

**TOTAL (L:45+T:15): 60 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students can able to apply mathematical knowledge to calculate the deformation behavior of simple structures.
- Critically analyse problem and solve the problems related to mechanical elements and analyse the deformation behavior for different types of loads.

**TEXT BOOKS:**

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2007
2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2007

**REFERENCES:**

1. Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2001
2. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2007.
3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2007
4. Ferdinand P. Beer, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2005.

**ME6301**

**ENGINEERING THERMODYNAMICS**

**L T P C**

**3 0 0 3**

**OBJECTIVES:**

To familiarize the students to understand the fundamentals of thermodynamics and to perform thermal analysis on their behavior and performance.

(Use of Standard and approved Steam Table, Mollier Chart, Compressibility Chart and Psychrometric Chart permitted)

**UNIT I BASIC CONCEPTS AND FIRST LAW**

**9**

ME6301 Basic concepts - concept of continuum, comparison of microscopic and macroscopic approach. Path and point functions. Intensive and extensive, total and specific quantities. System and their types. Thermodynamic Equilibrium State, path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer, definition and comparison, sign convention. Displacement work and other modes of work .P-V diagram. Zeroth law of thermodynamics – concept of temperature and thermal equilibrium– relationship between temperature scales –new temperature scales. First law of thermodynamics –application to closed and open systems – steady and unsteady flow processes.

**UNIT II SECOND LAW AND AVAILABILITY ANALYSIS**

**9**

Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat pump. Statements of second law and its corollaries. Carnot cycle Reversed Carnot cycle, Performance. Clausius inequality. Concept of entropy, T- s diagram, Tds Equations, entropy change for - pure substance, ideal gases - different processes, principle of increase in entropy. Applications of II Law. High and low grade energy. Available and non- available energy of a source and finite body. Energy and irreversibility. Expressions for the energy of a closed system and open systems. Energy balance and entropy generation. Irreversibility. I and II law Efficiency.

**UNIT III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE**

**9**

Formation of steam and its thermodynamic properties, p-v, p-T, T- v, T-s, h- s diagrams. p- v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles, [pg. 24](#)



Economiser, preheater, Binary and Combined cycles.

**UNIT IV IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS 9**

Properties of Ideal gas- Ideal and real gas comparison- Equations of state for ideal and real gases-Reduced properties-.Compressibility factor-.Principle of Corresponding states. -Generalised Compressibility Chart and its use-. Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius Clapeyron equation, Phase Change Processes. Simple Calculations.

**UNIT V GAS MIXTURES AND PSYCHROMETRY 9**

Mole and Mass fraction, Dalton's and Amagat's Law. Properties of gas mixture – Molar mass, gas constant, density, change in internal energy, enthalpy, entropy and Gibbs function. Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications

**TOTAL : 45 PERIODS**

**OUTCOMES:**

Upon completion of this course, the students can able to apply the Thermodynamic Principles to Mechanical Engineering Application.

Apply mathematical fundamentals to study the properties of steam, gas and gas mixtures.

**TEXT BOOKS :**

Nag.P.K., "Engineering Thermodynamics", 4<sup>th</sup> Edition, Tata McGraw-Hill, New Delhi, 2008.

Natarajan E., "Engineering Thermodynamics: Fundamentals and Applications", Anuragam Publications, 2012.

**REFERENCES :**

Cengel. Y and M.Boles, "Thermodynamics - An Engineering Approach", 7<sup>th</sup> Edition, Tata McGraw Hill, 2010.

Holman.J.P., "Thermodynamics", 3<sup>rd</sup> Edition, McGraw-Hill, 1995.

Rathakrishnan. E., "Fundamentals of Engineering Thermodynamics", 2<sup>nd</sup> Edition, Prentice-Hall of India Pvt. Ltd, 2006

Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2010.

Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.

Van Wylen and Sonntag, "Classical Thermodynamics", Wiley Eastern, 1987

Venkatesh. A, "Basic Engineering Thermodynamics", Universities Press (India) Limited, 2007.

Kau-Fui Vincent Wong, "Thermodynamics for Engineers", CRC Press, 2010 Indian Reprint.

Prasanna Kumar: Thermodynamics "Engineering Thermodynamics" Pearson Education, 2013

**CE6451**

**FLUID MECHANICS AND MACHINERY**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- The applications of the conservation laws to flow through pipes and hydraulic machines are studied
- To understand the importance of dimensional analysis.
- To understand the importance of various types of flow in pumps and turbines.

**UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 8**

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristics – concept of control volume- application of continuity equation, energy equation and momentum equation.

**UNIT II FLOW THROUGH CIRCULAR CONDUITS 8**

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli-Boundary layer concepts - types of boundary layer thickness - Darcy Weisbach equation -friction factor- Moody diagram- commercial pipes- minor losses - Flow through pipes in series and parallel.

**UNIT III DIMENSIONAL ANALYSIS 9**

Need for dimensional analysis - methods of dimensional analysis - Similitude -types of similitude Dimensionless parameters- application of dimensionless parameters - Model analysis.

**UNIT IV PUMPS 10**

Impact of jets - Euler's equation - Theory of roto-dynamic machines – various efficiencies- velocity components at entry and exit of the rotor- velocity triangles - Centrifugal pumps- working principle - work done by the impeller - performance curves - Reciprocating pump- working principle – Rotary pumps -classification.

**UNIT V TURBINES 10**

Classification of turbines - heads and efficiencies - velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working principles - work done by water on the runner - draft tube. Specific speed - unit quantities - performance curves for turbines - governing of turbines.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students can able to apply mathematical knowledge to predict the properties and characteristics of a fluid.
- Can critically analyse the performance of pumps and turbines.

**TEXT BOOK:**

1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi 2004.

**REFERENCES:**

1. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010
2. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2004
3. Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, "Fluid Mechanics and Machinery", 2011.
4. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011

ME6302

MANUFACTURING TECHNOLOGY – I

L T P C  
3 0 0 3

**OBJECTIVES:**

- To introduce the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and manufacture of plastic components.

**UNIT I METAL CASTING PROCESSES 9**  
**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 CO<sub>2</sub> process - Stir casting; **Defects in Sand casting**

**UNIT II JOINING PROCESSES 9**  
**Operating principle, basic equipment, merits and applications of** : Fusion welding processes : Gas welding Types - Flame characteristics; Manual metal arc welding - 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 - Friction welding and Friction Stir Welding; Brazing and soldering; **Weld defects**: types, causes and cure.

**UNIT III METAL FORMING PROCESSES 9**  
Hot working and cold working of metals - Forging processes - Open, impression and closed die forging - forging operations. Rolling of metals- Types of Rolling - Flat strip rolling - shape rolling operations - Defects in rolled parts. Principle of rod and wire drawing - Tube drawing - Principles of Extrusion - Types - Hot and Cold extrusion.

**UNIT IV SHEET METAL PROCESSES 9**  
Sheet metal characteristics - shearing, bending and drawing operations - Stretch forming operations – Formability of sheet metal - Test methods -special forming processes-Working principle and applications - Hydro forming - Rubber pad forming - Metal spinning- Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming - Micro forming

**UNIT V MANUFACTURE OF PLASTIC COMPONENTS 9**  
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 - introduction to blow moulding -Rotational moulding - Film blowing - Extrusion - Thermoforming - Bonding of Thermoplastics.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Hajra Choudhary S.K and Hajra Choudhury. AK., "Elements of workshop Technology", volume I and II, Media promoters and Publishers Private Limited, Mumbai, 1997
2. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India Edition, 2006

**REFERENCES:**

1. Gowri P. Hariharan, A.Suresh Babu, "Manufacturing Technology I", Pearson Education, 2008
2. Roy. A. Lindberg, "Processes and Materials of Manufacture", PHI / Pearson education, 2006
3. Paul Degarma E, Black J.T and Ronald A. Kosher, "Materials and Processes, in Manufacturing" Eight Edition, Prentice - Hall of India, 1997.
4. Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., 2004.
5. Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", 2<sup>nd</sup>Edition, TMH-2003; 2003

**EE6351**

**ELECTRICAL DRIVES AND CONTROL**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To understand the basic concepts of different types of electrical machines and their performance.
- To study the different methods of starting D.C motors and induction motors.
- To study the conventional and solid-state drives

**UNIT I INTRODUCTION**

**8**

Basic Elements - Types of Electric Drives - factors influencing the choice of electrical drives - heating and cooling curves - Loading conditions and classes of duty - Selection of power rating for drive motors with regard to thermal overloading and Load variation factors

**UNIT II DRIVE MOTOR CHARACTERISTICS**

**9**

Mechanical characteristics - Speed-Torque characteristics of various types of load and drive motors - Braking of Electrical motors - DC motors: Shunt, series and compound--single phase and three phase induction motors.

**UNIT III STARTING METHODS**

**8**

Types of D.C Motor starters - Typical control circuits for shunt and series motors - Three phase squirrel cage and slip ring induction motors.

**UNIT IV CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES**

**10**

Speed control of DC series and shunt motors - Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers -applications.

**UNIT V CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES**

**10**

Speed control of three phase induction motor - Voltage control, voltage / frequency control, slip power recovery scheme - Using inverters and AC voltage regulators - applications.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Upon Completion of this subject, the students can able to explain different types of electrical machines and their performance

**TEXT BOOKS:**

1. Vedam Subrahmaniam, "Electric Drives (Concepts and Applications)", Tata McGraw-Hill, 2001
2. Nagrath .I.J. & Kothari .D.P, "Electrical Machines", Tata McGraw-Hill, 1998

**REFERENCES:**

1. Pillai.S.K "A First Course on Electric Drives", Wiley Eastern Limited, 1998
2. Singh. M.D., K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 1998
3. Partab. H., "Art and Science and Utilisation of Electrical Energy", Dhanpat Rai and Sons, 1994

**ME6311**

**MANUFACTURING TECHNOLOGY LABORATORY – I**

**L T P C**  
**0 0 3 2**

**OBJECTIVES:**

- To Study and practice the various operations that can be performed in lathe, shaper, drilling, milling machines etc. and to equip with the practical knowledge required in the core industries.

**LIST OF EXPERIMENTS**

Machining and Machining time estimations for :

1. Taper Turning
2. External Thread cutting
3. Internal Thread Cutting
4. Eccentric Turning
5. Knurling
6. Square Head Shaping
7. Hexagonal Head Shaping

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students can able to demonstrate and fabricate different types of components using the machine tools

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

S. NO.	NAME OF THE EQUIPMENT	Qty.
1	Centre Lathes	7 Nos.
2	Horizontal Milling Machine	1 No
3	Vertical Milling Machine	1 No
4	Shaper	1 Nos.

**CE6461**

**FLUID MECHANICS AND MACHINERY LABORATORY**

**L T P C**  
**0 0 3 2**

**OBJECTIVES:**

- 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 EXPERIMENTS**

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Rota meter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump/ submergible pump
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Ability to use the measurement equipments for flow measurement
- Ability to do performance test on different fluid machinery

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

<b>S. NO.</b>	<b>NAME OF THE EQUIPMENT</b>	<b>Qty.</b>
1	Orifice meter setup	1
2	Venturi meter setup	1
3	Rotameter setup	1
4	Pipe Flow analysis setup	1
5	Centrifugal pump/submergible pump setup	1
6	Reciprocating pump setup	1
7	Gear pump setup	1
8	Pelton wheel setup	1
9	Francis turbine setup	1
10	Kaplan turbine setup	1

**EE6365**

**ELECTRICAL ENGINEERING LABORATORY**

**L T P C**  
**0 0 3 2**

**OBJECTIVES:**

- To validate the principles studied in theory by performing experiments in the laboratory

**LIST OF EXPERIMENTS**

1. Load test on DC Shunt & DC Series motor
2. O.C.C & Load characteristics of DC Shunt and DC Series generator
3. Speed control of DC shunt motor (Armature, Field control)
4. Load test on single phase transformer
5. O.C & S.C Test on a single phase transformer
6. Regulation of an alternator by EMF & MMF methods.
7. V curves and inverted V curves of synchronous Motor
8. Load test on three phase squirrel cage Induction motor
9. Speed control of three phase slip ring Induction Motor
10. Load test on single phase Induction Motor.
11. Study of DC & AC Starters

**OUTCOMES**

- Ability to perform speed characteristic of different electrical machine

**TOTAL: 45 PERIODS**

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

S.No.	NAME OF THE EQUIPMENT	Qty.
1	DC Shunt motor	2
2	DC Series motor	1
3	DC shunt motor-DC Shunt Generator set	1
4	DC Shunt motor-DC Series Generator set	1
5	Single phase transformer	2
6	Three phase alternator	2
7	Three phase synchronous motor	1
8	Three phase Squirrel cage Induction motor	1
9	Three phase Slip ring Induction motor	1
10	Single phase Induction motor	1

**MA6452**

**STATISTICS AND NUMERICAL METHODS**

**L T P C**  
**3 1 0 4**

**OBJECTIVES:**

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.

**UNIT I TESTING OF HYPOTHESIS**

**9+3**

Large sample test based on Normal distribution for single mean and difference of means **31 Tests** based on  $t, \chi^2$  and F distributions for testing means and variances - Contingency table (Test for Independency) - Goodness of fit.

**UNIT II DESIGN OF EXPERIMENTS**

**9+3**

One way and two way classifications - Completely randomized design - Randomized block design - Latin square design -  $2^2$  factorial design.

**UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS**

**9+3**

Newton Raphson method - Gauss elimination method - pivoting - Gauss Jordan methods - Iterative methods of Gauss Jacobi and Gauss Seidel - Matrix inversion by Gauss Jordan method - Eigen values of a matrix by power method.

**UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION**

**9+3**

Lagrange's and Newton's divided difference interpolations - Newton's forward and backward difference interpolation - Approximation of derivatives using interpolation polynomials - Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

**UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**

**9+3**

Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order equations - Milne's predictor corrector methods for solving first order equations - Finite difference methods for solving second order equations.

**TOTAL (L:45+T:15): 60 PERIODS**

**OUTCOMES**

- It helps the students to have a clear perception of the power of statistical and numerical techniques, ideas and would be able to demonstrate the applications of these techniques to problems drawn from industry, management and other engineering fields.

**TEXT BOOKS**

1. Johnson. R.A., and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers", 11<sup>th</sup> Edition, Pearson Education, , Asia, 2011.
2. Grewal. B.S., and Grewal. J.S., "Numerical Methods in Engineering and Science", 9<sup>th</sup> Edition, Khanna Publishers, New Delhi, 2007.



## REFERENCES

1. Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineers and Scientists", 8<sup>th</sup> Edition, Pearson Education, Asia, 2007.
2. Spiegel. M.R., Schiller. J., and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics", Tata McGraw Hill Edition, 2004.
3. Chapra. S.C., and Canale. R.P., "Numerical Methods for Engineers", 5<sup>th</sup> Edition, Tata McGraw Hill, New Delhi, 2007.
4. Gerald. C.F., and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 2006.

**ME6401**

**KINEMATICS OF MACHINERY**

**L T P C**  
**3 0 0 3**

### OBJECTIVES:

- To understand the basic components and layout of linkages in the assembly of a system / machine.
- To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
- To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.

### UNIT I            **BASICS OF MECHANISMS**

**9**

Classification of mechanisms - Basic kinematic concepts and definitions - Degree of freedom, Mobility - Kutzbach criterion, Gruebler's criterion - Grashof's Law - Kinematic inversions of four-bar chain and slider crank chains - Limit positions - Mechanical advantage - Transmission Angle - Description of some common mechanisms - Quick return mechanisms, Straight line generators, Universal Joint - rocker mechanisms.

### UNIT II            **KINEMATICS OF LINKAGE MECHANISMS**

**9**

Displacement, velocity and acceleration analysis of simple mechanisms - Graphical method- Velocity and acceleration polygons - Velocity analysis using instantaneous centres - kinematic analysis of simple mechanisms - Coincident points - Coriolis component of Acceleration - Introduction to linkage synthesis problem.

### UNIT III            **KINEMATICS OF CAM MECHANISMS**

**9**

Classification of cams and followers - Terminology and definitions - Displacement diagrams -Uniform velocity, parabolic, simple harmonic and cycloidal motions - Derivatives of follower motions - Layout of plate cam profiles - Specified contour cams - Circular arc and tangent cams - Pressure angle and undercutting - sizing of cams.

### UNIT IV            **GEARS AND GEAR TRAINS**

**9**

Law of toothed gearing - Involute and cycloidal tooth profiles -Spur Gear terminology and definitions -Gear tooth action - contact ratio - Interference and undercutting. Helical, Bevel, Worm, Rack and Pinion gears [Basics only]. Gear trains - Speed ratio, train value - Parallel axis gear trains - Epicyclic Gear Trains.

## **UNIT V          FRICTION IN MACHINE ELEMENTS**

**9**

Surface contacts - Sliding and Rolling friction - Friction drives - Friction in screw threads -Bearings and lubrication - Friction clutches - Belt and rope drives - Friction in brakes- Band and Block brakes.

**TOTAL: 45 PERIODS**

### **OUTCOMES:**

- Upon completion of this course, the students can able to apply fundamentals of mechanism for the design of new mechanisms and analyse them for optimum design.

### **TEXT BOOKS:**

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 3<sup>rd</sup> Edition, Oxford University Press, 2009.
2. Rattan, S.S, "Theory of Machines", 3<sup>rd</sup> Edition, Tata McGraw-Hill, 2009.

### **REFERENCES:**

1. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.
2. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2005
3. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
4. Allen S. Hall Jr., "Kinematics and Linkage Design", Prentice Hall, 1961
5. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., New Delhi, 1988.
6. Rao.J.S. and Dukupati.R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
7. John Hannah and Stephens R.C., "Mechanics of Machines", Viva Low-Prices Student Edition, 1999.
8. Ramamurthi. V, "Mechanics of Machines", Narosa Publishing House, 2002.
9. Khurmi, R.S., "Theory of Machines", 14<sup>th</sup> Edition, S Chand Publications, 2005
10. Sadhu Sigh : Theory of Machines, "Kinematics of Machine", Third Edition, Pearson Education, 2012

**ME6402**

**MANUFACTURING TECHNOLOGY – II**

**L T P C  
3 0 0 3**

### **OBJECTIVES:**

- To understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and broaching.
- To understand the basic concepts of Computer Numerical Control (CNC) of machine tools and CNC Programming

## **UNIT I          THEORY OF METAL CUTTING**

**9**

Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools – nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

## **UNIT II          TURNING MACHINES**

**9**

Centre lathe, constructional features, specification, operations - taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes- tool layout - automatic lathes: semi automatic - single spindle : Swiss type, automatic screw type - multi spindle:

**UNIT III SHAPER, MILLING AND GEAR CUTTING MACHINES 9**  
Shaper - Types of operations. Drilling, reaming, boring, Tapping. Milling operations-types of milling cutter. Gear cutting - forming and generation principle and construction of gear milling, hobbing and gear shaping processes -finishing of gears.

**UNIT IV ABRASIVE PROCESS AND BROACHING 9**  
Abrasive processes: grinding wheel - specifications and selection, types of grinding process-cylindrical grinding, surface grinding, centreless grinding and internal grinding- Typical applications - concepts of surface integrity, broaching machines: broach construction - push, pull, surface and continuous broaching machines

**UNIT V CNC MACHINING 9**  
Numerical Control (NC) machine tools - CNC types, constructional details, special features, machining centre, part programming fundamentals CNC - manual part programming - micromachining - wafer machining

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students can able to understand and compare the functions and applications of different metal cutting tools and also demonstrate the programming in CNC machining.

**TEXT BOOKS:**

1. Hajra Choudhury, "Elements of Workshop Technology", Vol.II., Media Promoters
2. Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools", Tata McGraw-Hill, New Delhi, 2003.

**REFERENCES:**

1. Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J.White "Machine Tool Practices", Prentice Hall of India, 1998
2. HMT, "Production Technology", Tata McGraw Hill, 1998.
3. Geoffrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", Mc Graw Hill, 1984
4. Roy. A.Lindberg, "Process and Materials of Manufacture," Fourth Edition, PHI/Pearson Education 2006.

**ME6403**

**ENGINEERING MATERIALS AND METALLURGY**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for various engineering applications.

**UNIT I ALLOYS AND PHASE DIAGRAMS 9**

Constitution of alloys - Solid solutions, substitutional and interstitial - phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron - carbon equilibrium diagram. Classification of steel and cast Iron microstructure, properties and application.

**UNIT II HEAT TREATMENT 10**

Definition - Full annealing, stress relief, recrystallisation and spheroidising - normalising, hardening and Tempering of steel. Isothermal transformation diagrams - cooling curves superimposed on I.T. diagram CCR - Hardenability, Jominy end quench test - Austempering, martempering - case hardening, carburizing, Nitriding, cyaniding, carbonitriding - Flame and Induction hardening - Vacuum and Plasma hardening. .

**UNIT III FERROUS AND NON-FERROUS METALS 9**

Effect of alloying additions on steel-  $\alpha$  and  $\beta$  stabilisers- stainless and tool steels - HSLA, Maraging steels - Cast Iron - Grey, white, malleable, spheroidal - alloy cast irons, Copper and copper alloys - Brass, Bronze and Cupronickel - Aluminium and Al-Cu - precipitation strengthening treatment - Bearing alloys, Mg-alloys, Ni-based super alloys and Titanium alloys.

**UNIT IV NON-METALLIC MATERIALS 9**

Polymers - types of polymer, commodity and engineering polymers - Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers - Urea and Phenol formaldehydes)- Engineering Ceramics - Properties and applications of  $Al_2O_3$ , SiC,  $Si_3N_4$ , PSZ and SIALON -Composites-Classifications- Metal Matrix and FRP Applications of Composites.

**UNIT V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS 8**

Mechanisms of plastic deformation, slip and twinning - Types of fracture - Testing of materials under tension, compression and shear loads - Hardness tests (Brinell, Vickers and Rockwell), hardness tests, Impact test Izod and Charpy, fatigue and creep failure mechanisms.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students can able to apply the different materials, their processing, heat treatments in suitable application in mechanical engineering fields.

**TEXT BOOKS:**

1. Avner, S.H., "Introduction to Physical Metallurgy", McGraw Hill Book Company, 1994.
2. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian Edition 2007

**REFERENCES:**

1. Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd., 1999.
2. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint 2002.

3. Upadhyay. G.S. and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt.

- Ltd., New Delhi, 2006.
4. U.C.Jindal : Material Science and Metallurgy, "Engineering Materials and Metallurgy", First Edition, Dorling Kindersley, 2012

**GE6351 ENVIRONMENTAL SCIENCE AND ENGINEERING**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

To the study of nature and the facts about environment.

To finding and implementing scientific, technological, economic and political solutions to environmental problems.

To study the interrelationship between living organism and environment.

To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.

To study the dynamic processes and understand the features of the earth's interior and surface.

To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

**UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY**

**12**

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In- situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds Field study of simple ecosystems – pond, river, hill slopes, etc.

**UNIT II ENVIRONMENTAL POLLUTION**

**10**

Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry-Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry; - Mitigation procedures- Control of particulate and gaseous emission, Control of SO<sub>2</sub>, NO<sub>x</sub>, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f)

Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

### **UNIT III NATURAL RESOURCES**

**10**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Introduction to Environmental Biochemistry: Proteins –Biochemical degradation of pollutants, Bioconversion of pollutants. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

### **UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT**

**7**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization-environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labeling of environmentally friendly products (Ecomark). enforcement machinery involved in environmental legislation- central and state pollution control boards- disaster management: floods, earthquake, cyclone and landslides. Public awareness.

### **UNIT V HUMAN POPULATION AND THE ENVIRONMENT**

**6**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)- -GIS-remote sensing-role of information technology in environment and human health – Case studies.

**TOTAL : 45 PERIODS**

### **OUTCOMES:**

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

Public awareness of environmental is at infant stage.

Ignorance and incomplete knowledge has lead to misconceptions

Development and improvement in std. of living has lead to serious environmental disasters

### **TEXT BOOKS :**

Gilbert M.Masters, "Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education, 2004.

Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006.

### **REFERENCES :**

Trivedi.R.K., "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media, 3<sup>rd</sup> edition, BPB publications, 2010.

Cunningham, W.P. Cooper, T.H. Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.

Dharmendra S. Sengar, "Environmental law", Prentice hall of India PVT LTD, New Delhi, 2007.  
Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 2005.

**ME6404**

**THERMAL ENGINEERING**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes
- To apply the thermodynamic concepts into various thermal application like IC engines, Steam Turbines, Compressors and Refrigeration and Air conditioning systems

(Use of standard refrigerant property data book, Steam Tables, Mollier diagram and Psychrometric chart permitted)

**UNIT I GAS POWER CYCLES**

**8**

Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure, and air standard efficiency - Comparison of cycles.

**UNIT II INTERNAL COMBUSTION ENGINES**

**10**

Classification - Components and their function. Valve timing diagram and port timing diagram--actual and theoretical p-V diagram of four stroke and two stroke engines. Simple and complete Carburettor. MPFI, Diesel pump and injector system. Battery and Magneto Ignition System---Principles of Combustion and knocking in SI and CI Engines. Lubrication and Cooling systems. Performance calculation.

**UNIT III STEAM NOZZLES AND TURBINES**

**9**

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow. Impulse and Reaction principles, compounding, velocity diagram for simple and multi-stage turbines, speed regulations -Governors.

**UNIT IV AIR COMPRESSOR**

**9**

Classification and working principle of various types of compressors, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors, Multistage air compressor and inter cooling -work of multistage air compressor

**UNIT V REFRIGERATION AND AIR CONDITIONING**

**9**

Refrigerants Vapour compression refrigeration cycle- super heat, sub cooling - Performance calculations working principle of vapour absorption system, Ammonia -Water, Lithium bromide - water systems (Description only) . Air conditioning system --Processes, Types and Working Principles -- Concept of RSHF, GSHF, ESHF- Cooling Load calculations.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students can able to apply the different gas power cycles and use of them in IC and R&AC applications.

**TEXT BOOKS:**

1. Rajput. R. K., "Thermal Engineering" S.Chand Publishers, 2000
2. Kothandaraman.C.P., Domkundwar. S,Domkundwar. A.V., "A course in thermal Engineering", Fifth Edition, "Dhanpat Rai & sons , 2002



**REFERENCES:**

1. Sarkar, B.K, "Thermal Engineering" Tata McGraw-Hill Publishers, 2007
2. Arora.C.P, "Refrigeration and Air Conditioning ," Tata McGraw-Hill Publishers 1994
3. Ganesan V.." Internal Combustion Engines" , Third Edition, Tata Mcgraw-Hill 2007
4. Rudramoorthy, R, "Thermal Engineering ",Tata McGraw-Hill, New Delhi,2003
5. Ramalingam. K.K., "Thermal Engineering", SCITECH Publications (India) Pvt. Ltd., 2009.

**ME6411**

**MANUFACTURING TECHNOLOGY LABORATORY – II**

**L T P C**  
**0 0 3 2**

**OBJECTIVES:**

- To Study and acquire knowledge on various basic machining operations in special purpose machines and its applications in real life manufacture of components in the industry

**LIST OF EXPERIMENTS:**

1. Contour milling using vertical milling machine
2. Spur gear cutting in milling machine
3. Helical Gear Cutting in milling machine
4. Gear generation in hobbing machine
5. Gear generation in gear shaping machine
6. Plain Surface grinding
7. Cylindrical grinding
8. Tool angle grinding with tool and Cutter Grinder
9. Measurement of cutting forces in Milling / Turning Process

**CNC Part Programming.**

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to use different machine tools to manufacturing gears.
- Ability to use different machine tools for finishing operations
- Ability to manufacture tools using cutter grinder
- Develop CNC part programming

ME6412

**THERMAL ENGINEERING LABORATORY – I**

**L T P C**  
**0 0 3 2**

**OBJECTIVES:**

- To study the value timing-V diagram and performance of IC Engines
- To Study the characteristics of fuels/Lubricates used in IC Engines
- To study the Performance of steam generator/ turbine

**LIST OF EXPERIMENTS**

**I.C. ENGINE LAB**

**30**

1. Valve Timing and Port Timing diagrams.
2. Actual p-v diagrams of IC engines.
3. Performance Test on 4 - stroke Diesel Engine.
4. Heat Balance Test on 4 - stroke Diesel Engine.
5. Morse Test on Multi-cylinder Petrol Engine.
7. Retardation Test on a Diesel Engine.
8. Determination of Flash Point and Fire Point of various fuels / lubricants.

**STEAM LAB**

**15**

1. Study on Steam Generators and Turbines.
2. Performance and Energy Balance Test on a Steam Generator.
3. Performance and Energy Balance Test on Steam Turbine.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Ability to conduct experiment on IC engine to study the characteristic and performance of IC design/ steam turbines.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

S.No.	NAME OF THE EQUIPMENT	Qty.
1	I.C Engine - 2 stroke and 4 stroke model	1 set
2	Apparatus for Flash and Fire Point	1 No.
3	4-stroke Diesel Engine with mechanical loading.	1 No
4	4-stroke Diesel Engine with hydraulic loading.	1 No.
5	4-stroke Diesel Engine with electrical loading.	1 No.
6	Multi-cylinder Petrol Engine	1 No.
7	Single cylinder Petrol Engine	1 No.
8	Data Acquisition system with any one of the above engines	1 No.
9	Steam Boiler with turbine setup	1 No.

**CE6315**

**STRENGTH OF MATERIALS LABORATORY**

**L T P C**  
**0 0 3 2**

**OBJECTIVES**

To supplement the theoretical knowledge gained in Mechanics of Solids with practical testing for determining the strength of materials under externally applied loads. This would enable the student to have a clear understanding of the design for strength and stiffness

**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
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
9. Effect of hardening- Improvement in hardness and impact resistance of steels.
10. Tempering- Improvement Mechanical properties Comparison
  - (i) Unhardened specimen
  - (ii) Quenched Specimen and
  - (iii) Quenched and tempered specimen.
11. Microscopic Examination of
  - (i) Hardened samples and
  - (ii) Hardened and tempered samples.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Ability to perform different destructive testing
- Ability to characteristic materials

**LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS**

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Universal Tensile Testing machine with double 1 shear attachment - 40 Ton Capacity	1
2	Torsion Testing Machine (60 NM Capacity)	1
3	Impact Testing Machine (300 J Capacity)	1
4	Brinell Hardness Testing Machine	1
5	Rockwell Hardness Testing Machine	1
6	Spring Testing Machine for tensile and compressive loads (2500 N)	1
7	Metallurgical Microscopes	3
8	Muffle Furnace (800 C)	1

**ME6501**

**COMPUTER AIDED DESIGN**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To provide an overview of how computers are being used in mechanical component design

**UNIT I FUNDAMENTALS OF COMPUTER GRAPHICS 9**

Product cycle- Design process- sequential and concurrent engineering- Computer aided design - CAD system architecture- Computer graphics - co-ordinate systems- 2D and 3D transformations- homogeneous coordinates - Line drawing Clipping- viewing transformation

**UNIT II GEOMETRIC MODELING 9**

Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves-Techniques for surface modeling - surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep

**UNIT III VISUAL REALISM 9**

Hidden - Line-Surface-Solid removal algorithms - shading - colouring - computer animation.

**UNIT IV ASSEMBLY OF PARTS 9**

Assembly modelling - interferences of positions and orientation - tolerance analysis-massproperty calculations - mechanism simulation and interference checking.

**UNIT V CAD STANDARDS 9**

Standards for computer graphics- **Graphical Kernel System (GKS)** standards for exchange images- **Open Graphics Library (OpenGL)** - Data exchange standards - IGES, STEP, CALSetc ---- communication standards.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students can able to use computer and CAD software's for modeling of mechanical components

**TEXT BOOKS:**

- Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill Publishing Co.2007

**REFERENCES:**

- Chris McMahan and Jimmie Browne "CAD/CAM Principles", "Practice and Manufacturing management " Second Edition, Pearson Education, 1999.
- William M Neumann and Robert F.Sproul "Principles of Computer Graphics", McGraw Hill Book Co. Singapore, 1989.
- Donald Hearn and M. Pauline Baker "Computer Graphics". Prentice Hall, Inc, 1992.
- Foley, Wan Dam, Feiner and Hughes - "Computer graphics principles & practice" Pearson Education - 2003.
- 

**ME6502**

**HEAT AND MASS TRANSFER**

**L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To understand the mechanisms of heat transfer under steady and transient conditions.
  - To understand the concepts of heat transfer through extended surfaces.
  - To learn the thermal analysis and sizing of heat exchangers and to understand the basic concepts of mass transfer.
- (Use of standard HMT data book permitted)

## **UNIT I CONDUCTION**

9

**General Differential equation of Heat Conduction– Cartesian and Polar Coordinates** – One Dimensional Steady State Heat Conduction — plane and Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids – Use of Heisler's charts.

## **UNIT II CONVECTION**

9

Free and Forced Convection - Hydrodynamic and Thermal Boundary Layer. Free and Forced Convection during external flow over Plates and Cylinders and Internal flow through tubes .

## **UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS**

9

Nusselt's theory of condensation - Regimes of Pool boiling and Flow boiling. Correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors - Analysis – LMTD method - NTU method.

## **UNIT IV RADIATION**

9

Black Body Radiation – Grey body radiation - Shape Factor – Electrical Analogy – Radiation Shields. Radiation through gases.

## **UNIT V MASS TRANSFER**

9

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy –Convective Mass Transfer Correlations.

### **TOTAL : 45 PERIODS**

### **OUTCOMES:**

Upon completion of this course, the students can able to understand and apply different heat and mass transfer principles of different applications.

### **TEXT BOOK:**

Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 2010

### **REFERENCE BOOKS:**

Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 1998.  
Venkateshan. S.P., "Heat Transfer", Ane Books, New Delhi, 2004.  
Ghoshdastidar, P.S, "Heat Transfer", Oxford, 2004,  
Nag, P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 2002  
Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2000  
Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.  
Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 1998.  
Yadav, R., "Heat and Mass Transfer", Central Publishing House, 1995.  
M.Thirumaleshwar : Fundamentals of Heat and Mass Transfer, "Heat and Mass Transfer", First Edition, Dorling Kindersley, 2009

**ME6503**

**DESIGN OF MACHINE ELEMENTS**

**L T P C**  
**3 0 0 3**

**OBJECTIVES**

- To familiarize the various steps involved in the Design Process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data
- To learn to use catalogues and standard machine components  
(Use of P S G Design Data Book is permitted)

**UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 10**

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties Preferred numbers, fits and tolerances - Direct, Bending and torsional stress equations - Impact and shock loading - calculation of principle stresses for various load combinations, eccentric loading - curved beams - crane hook and 'C' frame- Factor of safety - theories of failure - Design based on strength and stiffness - stress concentration - Design for variable loading.

**UNIT II SHAFTS AND COUPLINGS 8**

Design of solid and hollow shafts based on strength, rigidity and critical speed - Keys, keyways and splines - Rigid and flexible couplings.

**UNIT III TEMPORARY AND PERMANENT JOINTS 9**

Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints - Welded joints, riveted joints for structures - theory of bonded joints.

**UNIT IV ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 9**

Various types of springs, optimization of helical springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines- Connecting Rods and crank shafts.

**UNIT V BEARINGS 9**

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi and Boyd graphs, -- Selection of Rolling Contact bearings.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students can able to successfully design machine components

**TEXT BOOK:**

1. Bhandari V, "Design of Machine Elements", 3<sup>rd</sup> Edition, Tata McGraw-Hill Book Co, 2010.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8<sup>th</sup> Edition, Tata McGraw-Hill, 2008.

**REFERENCES:**

1. Sundararajamoorthy T. V. Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
2. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4<sup>th</sup> Edition, Wiley, 2005
3. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", Tata McGraw-Hill BookCo.(Schaum's Outline), 2010
4. Bernard Hamrock, Steven Schmid,Bo Jacobson, "Fundamentals of Machine Elements",2<sup>nd</sup>

Edition, Tata McGraw-Hill Book Co., 2006.

5. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
6. Ansel Ugural, "Mechanical Design - An Integral Approach", 1<sup>st</sup> Edition, Tata McGraw-Hill Book

**ME6504**

**METROLOGY AND MEASUREMENTS**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To provide knowledge on various Metrological equipments available to measure the dimension of the components.
- To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.

**UNIT I .BASICS OF METROLOGY**

**5**

Introduction to Metrology - Need - Elements - Work piece, Instruments - Persons - Environment - their effect on Precision and Accuracy - Errors - Errors in Measurements - Types - Control - Types of standards.

**UNIT II LINEAR AND ANGULAR MEASUREMENTS**

**10**

Linear Measuring Instruments - Evolution - Types - Classification - Limit gauges - gauge design - terminology - procedure - concepts of interchange ability and selective assembly - Angular measuring instruments - Types - Bevel protractor clinometers angle gauges, spirit levels sine bar - Angle alignment telescope - Autocollimator - Applications.

**UNIT III ADVANCES IN METROLOGY**

**12**

Basic concept of lasers Advantages of lasers - laser Interferometers - types - DC and AC Lasers interferometer - Applications - Straightness - Alignment. Basic concept of CMM - Types of CMM - Constructional features - Probes - Accessories - Software - Applications - Basic concepts of Machine Vision System - Element - Applications.

**UNIT IV FORM MEASUREMENT**

**10**

Principles and Methods of straightness - Flatness measurement - Thread measurement, gear measurement, surface finish measurement, Roundness measurement - Applications.

**UNIT V MEASUREMENT OF POWER, FLOW AND TEMPERATURE**

**8**

Force, torque, power - mechanical , Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube - Temperature: bimetallic strip, thermocouples, electrical resistance thermometer - Reliability and Calibration - Readability and Reliability.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the Students can demonstrate different measurement technologies and use of them in Industrial Components

**TEXT BOOKS:**

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

**REFERENCES:**

1. Charles Reginald Shotbolt, "Metrology for Engineers", 5<sup>th</sup> edition, Cengage Learning EMEA, 1990.
2. Backwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education , 2006.



ME6505

**DYNAMICS OF MACHINES**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
- To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
- To understand the effect of Dynamics of undesirable vibrations.
- To understand the principles in mechanisms used for speed control and stability control.

**UNIT I FORCE ANALYSIS**

**9**

Dynamic force analysis - Inertia force and Inertia torque- D Alembert's principle -Dynamic Analysis in reciprocating engines - Gas forces - Inertia effect of connecting rod- Bearing loads - Crank shaft torque - Turning moment diagrams -Fly Wheels - Flywheels of punching presses- Dynamics of Cam-follower mechanism.

**UNIT II BALANCING**

**9**

Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder engine - Balancing of Multi-cylinder inline, V-engines - Partial balancing in engines - Balancing of linkages - Balancing machines-Field balancing of discs and rotors.

**UNIT III SINGLE DEGREE FREE VIBRATION**

**9**

Basic features of vibratory systems - Degrees of freedom - single degree of freedom - Free vibration - Equations of motion - Natural frequency - Types of Damping - Damped vibration- Torsional vibration of shaft - Critical speeds of shafts - Torsional vibration - Two and three rotor torsional systems.

**UNIT IV FORCED VIBRATION**

**9**

Response of one degree freedom systems to periodic forcing - Harmonic disturbances -Disturbance caused by unbalance - Support motion -transmissibility - Vibration isolation vibration measurement.

**UNIT V MECHANISM FOR CONTROL**

**9**

Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors - Characteristics - Effect of friction - Controlling force curves. Gyroscopes -Gyroscopic forces and torques - Gyroscopic stabilization - Gyroscopic effects in Automobiles, ships and airplanes.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the Students can able to predict the force analysis in mechanical system and related vibration issues and can able to solve the problem

**TEXT BOOK:**

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms" ,3<sup>rd</sup> Edition, Oxford University Press, 2009.
2. Rattan, S.S, "Theory of Machines", 3<sup>rd</sup> Edition, Tata McGraw-Hill, 2009

**REFERENCES:**

1. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.
2. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2005
3. Benson H. Tongue, "Principles of Vibrations", Oxford University Press, 2<sup>nd</sup> Edition, 2007

4. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
5. Allen S. Hall Jr., "Kinematics and Linkage Design", Prentice Hall, 1961
6. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., New Delhi, 1988.
7. Rao.J.S. and Dukkupati.R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
8. John Hannah and Stephens R.C., "Mechanics of Machines", Viva Low-Prices Student Edition, 1999.
9. Grover. G.T., "Mechanical Vibrations", Nem Chand and Bros., 1996
10. William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan, "Theory of Vibration with Application", 5th edition, Pearson Education, 2011
11. V.Ramamurthi, "Mechanics of Machines", Narosa Publishing House, 2002.
12. Khurmi, R.S., "Theory of Machines", 14<sup>th</sup> Edition, S Chand Publications, 2005.

**GE6075**

**PROFESSIONAL ETHICS IN ENGINEERING**

**LTPC**

**3 0 0 3**

**OBJECTIVES:**

To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

**UNIT I HUMAN VALUES**

**10**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

**UNIT II ENGINEERING ETHICS**

**9**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

**UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION**

**9**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

**UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS**

**9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

**UNIT V GLOBAL ISSUES**

**8**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate Social Responsibility

**TOTAL: 45 PERIODS**

**OUTCOMES :**

Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society

**TEXTBOOKS:**

Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.  
Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

**REFERENCES:**

- Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.  
Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009  
John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003  
Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001  
Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd., New Delhi 2013.  
World Community Service Centre, " Value Education", Vethathiri publications, Erode, 2011

**Web sources:**

- [www.onlineethics.org](http://www.onlineethics.org)  
[www.nspe.org](http://www.nspe.org)  
[www.globalethics.org](http://www.globalethics.org)  
[www.ethics.org](http://www.ethics.org)

ME6511

**DYNAMICS LABORATORY**

**L T P C0  
 03  
 2**

**OBJECTIVES:**

- To supplement the principles learnt in kinematics and Dynamics of Machinery.
- To understand how certain measuring devices are used for dynamic testing.

**LIST OF EXPERIMENTS**

- a) Study of gear parameters.  
 b) Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.
- a) Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms.  
 b) Kinematics of single and double universal joints.
- a) Determination of Mass moment of inertia of Fly wheel and Axle system.  
 b) Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.  
 c) Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
- Motorized gyroscope – Study of gyroscopic effect and couple.
- Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell,
- Cams – Cam profile drawing, Motion curves and study of jump phenomenon
- a) Single degree of freedom Spring Mass System – Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination.  
 b) Multi degree freedom suspension system – Determination of influence coefficient.
- a) Determination of torsional natural frequency of single and Double Rotor systems.-Undamped and Damped Natural frequencies.  
 b) Vibration Absorber – Tuned vibration absorber.
- Vibration of Equivalent Spring mass system – undamped and damped vibration.
- Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
- a) Balancing of rotating masses. (b) Balancing of reciprocating masses.
- a) Transverse vibration of Free-Free beam – with and without concentrated masses.  
 b) Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.  
 c) Determination of transmissibility ratio using vibrating table.

**TOTAL : 45 PERIODS**

**OUTCOME**

- Ability to demonstrate the principles of kinematics and dynamics of machinery
- Ability to use the measuring devices for dynamic testing.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Cam follower setup.	1 No.
2	Motorised gyroscope.	1 No.
3	Governor apparatus - Watt, Porter, Proell and Hartnell governors.	1 No.
4	Whirling of shaft apparatus.	1 No.
5	Dynamic balancing machine.	1 No.
6	Two rotor vibration setup.	1 No.
7	Spring mass vibration system.	1 No.
8	Torsional Vibration of single rotor system setup.	1 No.
9	Gear Models	1 No.
10	Kinematic Models to study various mechanisms.	1 No.

11	Turn table apparatus.	1 No.
12	Transverse vibration setup of a) cantilever	1 No.
	b) Free-Free beam c) Simply supported beam.	

ME6512

**THERMAL ENGINEERING LABORATORY – II**

**L T P C**  
**0 0 3 2**

**OBJECTIVES**

- To study the heat transfer phenomena predict the relevant coefficient using implementation
- To study the performance of refrigeration cycle / components

**LIST OF EXPERIMENTS:**

**HEAT TRANSFER LAB:**

**30**

1. Thermal conductivity measurement using guarded plate apparatus.
2. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
3. Determination of heat transfer coefficient under natural convection from a vertical cylinder.
4. Determination of heat transfer coefficient under forced convection from a tube.
5. Determination of Thermal conductivity of composite wall.
6. Determination of Thermal conductivity of insulating powder.
7. Heat transfer from pin-fin apparatus (natural & forced convection modes)
8. Determination of Stefan - Boltzmann constant.
9. Determination of emissivity of a grey surface.
10. Effectiveness of Parallel / counter flow heat exchanger.

**REFRIGERATION AND AIR CONDITIONING LAB**

**15**

1. Determination of COP of a refrigeration system
2. Experiments on Psychrometric processes
3. Performance test on a reciprocating air compressor
4. Performance test in a HC Refrigeration System
5. Performance test in a fluidized Bed Cooling Tower

**TOTAL: 45 PERIODS**

**OUTCOMES**

- Ability to demonstrate the fundamentals of heat and predict the coefficient used in that transfer application and also design refrigeration cycle.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Guarded plate apparatus	1 No.
2	Lagged pipe apparatus	1 No.
3	Natural convection-vertical cylinder apparatus	1 No.
4	Forced convection inside tube apparatus	1 No.
5	Composite wall apparatus	1 No.
6	Thermal conductivity of insulating powder apparatus	1 No.
7	Pin-fin apparatus	1 No.
8	Stefan-Boltzmann apparatus	1 No.
9	Emissivity measurement apparatus	1 No.
10	Parallel/counter flow heat exchanger apparatus	1 No.
11	Single/two stage reciprocating air compressor	1 No.
12	Refrigeration test rig	1 No.
13	Air-conditioning test rig	1 No.
14	HC Refrigeration System	1 No.
15.	Fluidized Bed Cooling Tower	1 No.

ME6513

**METROLOGY AND MEASUREMENTS LABORATORY**

**L T P C**  
**0 0 3 2**

**OBJECTIVES**

- To familiar with different measurement equipments and use of this industry for quality inspection

**LIST OF EXPERIMENTS**

1. Tool Maker's Microscope
2. Comparator
3. Sine Bar
4. Gear Tooth Vernier Caliper
5. Floating gauge Micrometer
6. Co ordinate Measuring Machine
7. Surface Finish Measuring Equipment
8. Vernier Height Gauge
9. Bore diameter measurement using telescope gauge
10. Bore diameter measurement using micrometer
11. Force Measurement
12. Torque Measurement
13. Temperature measurement
14. Autocollimator

**TOTAL: 45 PERIODS**

**OUTCOMES**

- Ability to handle different measurement tools and perform measurements in quality inspection

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Micrometer	5
2	Vernier Caliper	5
3	Vernier Height Gauge	2
4	Vernier depth Gauge	2
5	Slip Gauge Set	1
6	Gear Tooth Vernier	1
7	Sine Bar	1
8	Floating Carriage Micrometer	1
9	Profile Projector / Tool Makers Microscope	1
10	Parallel / counter flow heat exchanger apparatus	1
11	Mechanical / Electrical / Pneumatic Comparator	1
12	Autocollimator	1
13	Temperature Measuring Setup	1
14	Force Measuring Setup	1

15	Torque Measuring Setup	1
16	Coordinate measuring machine	1
17	Surface finish measuring equipment	1
18	Bore gauge	1
19	Telescope gauge	1

**ME6601**

**DESIGN OF TRANSMISSION SYSTEMS**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
- To understand the standard procedure available for Design of Transmission of Mechanical elements
- To learn to use standard data and catalogues  
 (Use of P S G Design Data Book permitted)

**UNIT I DESIGN OF FLEXIBLE ELEMENTS 9**  
 Design of Flat belts and pulleys Selection of V belts and pulleys - Selection of hoisting wire ropes and pulleys - Design of Transmission chains and Sprockets.

**UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 9**  
 Speed ratios and number of teeth-Force analysis -Tooth stresses Dynamic effects - Fatigue strength - Factor of safety Gear materials - Design of straight tooth spur & helical gears based on strength and wear considerations - Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces for helical gears.

**UNIT III BEVEL, WORM AND CROSS HELICAL GEARS 9**  
 Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits-terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears.

**UNIT IV GEAR BOXES 9**  
 Geometric progression - Standard step ratio - Ray diagram, kinematics layout Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. - Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.

**UNIT V CAMS, CLUTCHES AND BRAKES 9**  
 Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses. Design of plate clutches -axial clutches-cone clutches-internal expanding rim clutches-Electromagnetic clutches. Band and Block brakes external shoe brakes - Internal expanding shoe brake.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students can able to successfully design transmission



components used in Engine and machines

**TEXT BOOKS:**

1. Bhandari V, "Design of Machine Elements", 3rd Edition, Tata McGraw-Hill Book Co, 2010.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008.

**REFERENCES:**

1. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
2. Gitin Maitra, L. Prasad "Hand book of Mechanical Design", 2nd Edition, Tata McGraw-Hill, 2001.
3. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.
4. C.S.Sharma, Kamlesh Purohit, "Design of Machine Elements", Prentice Hall of India, Pvt. Ltd., 2003.
5. Bernard Hamrock, Steven Schmid, Bo Jacobson, "Fundamentals of Machine Elements", 2nd Edition, Tata McGraw-Hill Book Co., 2006.
6. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4<sup>th</sup> Edition, Wiley, 2005
7. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", Tata McGraw-Hill BookCo.(Schaum's Outline), 2010
8. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
9. Ansel Ugural, "Mechanical Design - An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co, 2003.
10. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" 8<sup>th</sup> Edition, Printice Hall, 2003.
11. U.C.Jindal : Machine Design, "Design of Transmission System", Dorling Kindersley, 2010

**MG6851**

**PRINCIPLES OF MANAGEMENT**

**LTPC**

**3 0 0 3**

**OBJECTIVES:**

To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization .

**UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS**

**9**

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

**UNIT II PLANNING**

**9**

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

**UNIT III ORGANISING**

**9**

Nature and purpose – Formal and informal organization – organization chart – organization structure

– types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

**UNIT IV DIRECTING**

**9**

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and IT.

**UNIT V CONTROLLING**

**9**

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management

**TEXTBOOKS:**

Stephen P. Robbins & Mary Coulter, "Management", Prentice Hall (India) Pvt. Ltd., 10<sup>th</sup> Edition, 2009.  
JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson Education, 2004.

**REFERENCES:**

Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management" 7<sup>th</sup> Edition, Pearson Education, 2011.  
Robert Kreitner & Mamata Mohapatra, " Management", Biztantra, 2008.  
Harold Koontz & Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, 1998.  
Tripathy PC & Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999

**ME6602**

**AUTOMOBILE ENGINEERING**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To understand the construction and working principle of various parts of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system

**UNIT I VEHICLE STRUCTURE AND ENGINES**

**9**

Types of automobiles, vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines -components- functions and materials, variable valve timing (VVT).

**UNIT II ENGINE AUXILIARY SYSTEMS**

**9**

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

**UNIT III TRANSMISSION SYSTEMS**

**9**

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints ,Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

**UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS 9**

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

**UNIT V ALTERNATIVE ENERGY SOURCES 9**

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required -Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels Electric and Hybrid Vehicles, Fuel Cell  
Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students will be able to identify the different components in automobile engineering.
- Have clear understanding on different auxiliary and transmission systems usual.

**TEXT BOOKS:**

1. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 1997.
2. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.

**REFERENCES:**

1. Newton ,Steeds and Garet, "Motor Vehicles", Butterworth Publishers, 1989.
2. Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999.
3. Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart -Will Cox Company Inc, USA ,1978.
4. Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
5. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2007.

**ME6603**

**FINITE ELEMENT ANALYSIS**

**L T P C  
3 0 0 3**

**OBJECTIVES:**To introduce the concepts of Mathematical Modeling of Engineering Problems.

- To appreciate the use of FEM to a range of Engineering Problems.

**UNIT I INTRODUCTION 9**

Historical Background - Mathematical Modeling of field problems in Engineering - Governing Equations - Discrete and continuous models - Boundary, Initial and Eigen Value problems- Weighted Residual Methods - Variational Formulation of Boundary Value Problems - RitzTechnique - Basic concepts of the Finite Element Method.

**UNIT II ONE-DIMENSIONAL PROBLEMS 9**

One Dimensional Second Order Equations - Discretization - Element types- Linear and Higher order Elements - Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation -Transverse deflections and Natural frequencies of beams.

**UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS 9**

Second Order 2D Equations involving Scalar Variable Functions - Variational formulation -Finite Element formulation - Triangular elements - Shape functions and element matrices and vectors.

Application to Field Problems Thermal problems - Torsion of Non circular shafts -Quadrilateral elements - Higher Order Elements.

**UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS 9**

Equations of elasticity - Plane stress, plane strain and axisymmetric problems - Body forces and temperature effects - Stress calculations Plate and shell elements.

**UNIT V ISOPARAMETRIC FORMULATION 9**

Natural co-ordinate systems - Isoparametric elements - Shape functions for iso parametric elements – One and two dimensions - Serendipity elements - Numerical integration and application to plane stress problems--Matrix solution techniques - Solutions Techniques to Dynamic problems - Introduction to Analysis Software.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students can able to understand different mathematical Techniques used in FEM analysis and use of them in Structural and thermal problem

**TEXT BOOK:**

1. Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2005
2. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

**REFERENCES:**

1. Rao, S.S., "The Finite Element Method in Engineering", 3rd Edition, Butterworth Heinemann, 2004
2. Logan, D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002
3. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2002.
4. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice Hall College Div, 1990
5. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013)\*

**ME6604**

**GAS DYNAMICS AND JET PROPULSION**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To understand the basic difference between incompressible and compressible flow.
- To understand the phenomenon of shock waves and its effect on flow. To gain some basic knowledge about jet propulsion and Rocket Propulsion.

(Use of Standard Gas Tables permitted)

**UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 6**

Energy and momentum equations of compressible fluid flows - Stagnation states, Mach waves and Mach cone - Effect of Mach number on compressibility - Isentropic flow through variable ducts - Nozzle and Diffusers

**UNIT II FLOW THROUGH DUCTS 9**

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) - variation of flow properties.

**UNIT III NORMAL AND OBLIQUE SHOCKS 10**

Governing equations - Variation of flow parameters across the normal and oblique shocks - Prandtl - Meyer relations - Applications.

**UNIT IV JET PROPULSION 10**

Theory of jet propulsion - Thrust equation - Thrust power and propulsive efficiency - Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines

**UNIT V SPACE PROPULSION 10**

Types of rocket engines - Propellants-feeding systems - Ignition and combustion - Theory of rocket propulsion - Performance study - Staging - Terminal and characteristic velocity - Applications - space flights

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students can able to successfully apply gas dynamics principles in the Jet and Space Propulsion

**TEXT BOOKS:**

1. Anderson, J.D., "Modern Compressible flow", 3<sup>rd</sup> Edition, McGraw Hill, 2003.
2. Yahya, S.M. "Fundamentals of Compressible Flow", New Age International (P) Limited, New Delhi, 1996.

**REFERENCES:**

1. Hill. P. and C. Peterson, "Mechanics and Thermodynamics of Propulsion", Addison - Wesley Publishing company, 1992.
2. Zucrow. N.J., "Aircraft and Missile Propulsion", Vol.1 & II, John Wiley, 1975.
3. Zucrow. N.J., "Principles of Jet Propulsion and Gas Turbines", John Wiley, New York, 1970.
4. Sutton. G.P., "Rocket Propulsion Elements", John wiley, New York, 1986,.
5. Shapiro. A.H., " Dynamics and Thermodynamics of Compressible fluid Flow", John wiley, New York, 1953.
6. Ganesan. V., "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 1999.
7. Somasundaram. PR.S.L., "Gas Dynamics and Jet Propulsions", New Age International Publishers, 1996.
8. Babu. V., "Fundamentals of Gas Dynamics", ANE Books India, 2008.
9. Cohen. H., G.E.C. Rogers and Saravanamutto, "Gas Turbine Theory", Longman Group Ltd.,

**ME6004**

**UNCONVENTIONAL MACHINING PROCESSES**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications

**UNIT I INTRODUCTION**

**6**

Unconventional machining Process – Need – classification – Brief overview

**UNIT II MECHANICAL ENERGY BASED PROCESSES**

**9**

Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining - Ultrasonic Machining.(AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR- Applications.

**UNIT III ELECTRICAL ENERGY BASED PROCESSES**

**9**

Electric Discharge Machining (EDM)- working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications.

**UNIT IV CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES**

**11**

Chemical machining and Electro-Chemical machining (CHM and ECM) -Etchants – Maskant - techniques of applying maskants - Process Parameters – Surface finish and MRR- Applications. Principles of ECM-equipments-Surface Roughness and MRR Electrical circuit-Process Parameters-ECG and ECH - Applications.

**UNIT V THERMAL ENERGY BASED PROCESSES**

**10**

Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon completion of this course, the students can able to demonstrate different unconventional machining processes and know the influence of difference process parameters on the performance and their applications.

**TEXT BOOKS:**

Vijay.K. Jain “Advanced Machining Processes” Allied Publishers Pvt. Ltd., New Delhi, 2007  
Pandey P.C. and Shan H.S. “Modern Machining Processes” Tata McGraw-Hill, New Delhi, 2007.

**REFERENCES:**

Benedict. G.F. “Nontraditional Manufacturing Processes”, Marcel Dekker Inc., New York, 1987.  
Mc Geough, “Advanced Methods of Machining”, Chapman and Hall, London, 1998.  
Paul De Garmo, J.T.Black, and Ronald.A.Kohser, “Material and Processes in Manufacturing” Prentice Hall of India Pvt. Ltd., 8thEdition, New Delhi , 2001.

**ME6611**

**CAD / CAM LABORATORY**

**L T P C**  
**0 0 3 2**

**OBJECTIVES:**

- To gain practical experience in handling 2D drafting and 3D modelling software systems.
- To study the features of CNC Machine Tool.
- To expose students to modern control systems (Fanuc, Siemens etc.)
- To know the application of various CNC machines like CNC lathe, CNC Vertical Machining centre, CNC EDM and CNC wire-cut and studying of Rapid prototyping.

**LIST OF EXPERIMENTS**

**1. 3D GEOMETRIC MODELLING**

**24 PERIODS**

**List of Experiments**

1. Introduction of 3D Modelling software

**Creation of 3D assembly model of following machine elements using 3D Modelling software**

2. Flange Coupling
3. Plummer Block
4. Screw Jack
5. Lathe Tailstock
6. Universal Joint
7. Machine Vice
8. Stuffing box
9. Crosshead
10. Safety Valves
11. Non-return valves
12. Connecting rod
13. Piston
14. Crankshaft

\* Students may also be trained in manual drawing of some of the above components

**2. Manual Part Programming.**

**21 PERIODS**

- (i) Part Programming - CNC Machining Centre
  - a) Linear Cutting.
  - b) Circular cutting.
  - c) Cutter Radius Compensation.
  - d) Canned Cycle Operations.
- (ii) Part Programming - CNC Turning Centre
  - a) Straight, Taper and Radius Turning.
  - b) Thread Cutting.
  - c) Rough and Finish Turning Cycle.
  - d) Drilling and Tapping Cycle.

**3. Computer Aided Part Programming**

- e) CL Data and Post process generation using CAM packages.
- f) Application of CAPP in Machining and Turning Centre.



**TOTAL: 45 PERIODS**

**OUTCOMES**

- Ability to develop 2D and 3D models using modeling softwares.
- Ability to understand the CNC control in modern manufacturing system.
- Ability to prepare CNC part programming and perform manufacturing.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

S.No.	Description of Equipment	Qty
<b>HARDWARE</b>		
1.	Computer Server	1
2.	Computer nodes or systems (High end CPU with atleast 1 GB main memory) networked to the server	30
3.	A3 size plotter	1
4.	Laser Printer	1
5.	CNC Lathe	1
6.	CNC milling machine	1
<b>SOFTWARE</b>		
7.	Any High end integrated modeling and manufacturing CAD / CAM software	15 licenses
8.	CAM Software for machining centre and turning centre (CNC Programming and tool path simulation for FANUC / Sinumeric and Heidenhain controller)	15 licenses
9.	Licensed operating system	Adequate
10.	Support for CAPP	Adequate

**ME6612**

**DESIGN AND FABRICATION PROJECT**

**L T P C  
0 0 4 2**

**OBJECTIVES:**

- The main objective is to give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.

**GUIDELINE FOR REVIEW AND EVALUATION**

The students may be grouped into 2 to 4 and work under a project supervisor. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

**TOTAL : 60 PERIODS**

**OUTCOMES:**

- Use of design principles and develop conceptual and engineering design of any components.
- Ability to fabricate any components using different manufacturing tools.

**GE6674 COMMUNICATION AND SOFT SKILLS- LABORATORY BASED**

**L T P C**  
**0 0 4 2**

**OBJECTIVES:**

To enable learners to,

- Develop their communicative competence in English with specific reference to speaking and listening
- Enhance their ability to communicate effectively in interviews.
- Strengthen their prospects of success in competitive examinations.

**UNIT I LISTENING AND SPEAKING SKILLS 12**

Conversational skills (formal and informal)- group discussion- making effective presentations using computers, listening/watching interviews conversations, documentaries. Listening to lectures, discussions from TV/ Radio/ Podcast.

**UNIT II READING AND WRITING SKILLS 12**

Reading different genres of texts ranging from newspapers to creative writing. Writing job applications- cover letter- resume- emails- letters- memos- reports. Writing abstracts- summaries- interpreting visual texts.

**UNIT III ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS AND PLACEMENTS 12**

International English Language Testing System (IELTS)-- Test of English as a Foreign Language (TOEFL) Civil Service(Language related)- Verbal Ability.

**UNIT IV INTERVIEW SKILLS 12**

Different types of Interview format- answering questions- offering information- mock interviews-body language( paralinguistic features)- articulation of sounds- intonation.

**UNIT V SOFT SKILLS 12**

**Motivation- emotional intelligence**-Multiple intelligences- emotional intelligence- managing changes-time management-stress management-leadership traits-team work- career planning -- intercultural communication- creative and critical thinking

**TOTAL: 60 PERIODS**

**TEACHING METHODS:**

1. To be totally learner-centric with minimum teacher intervention as the course revolves around practice.
2. Suitable audio/video samples from Podcast/YouTube to be used for illustrative purposes.
3. Portfolio approach for writing to be followed. Learners are to be encouraged to blog, tweet, text and email employing appropriate language.
4. GD/Interview/Role Play/Debate could be conducted off the laboratory (in a regular classroom) but learners are to be exposed to telephonic interview and video conferencing.
5. Learners are to be assigned to read/write/listen/view materials outside the classroom as well for gaining proficiency and better participation in the class.

**Lab Infrastructure:**

S. No.	Description of Equipment (minimum configuration)	Qty Required
1	<b>Server</b>	1 No.
	• PIV System	
	• 1 GB RAM / 40 GB HDD	

	<ul style="list-style-type: none"> <li>● OS: Win 2000 server</li> <li>● Audio card with headphones</li> <li>● JRE 1.3</li> </ul>	
2	<b>Client Systems</b> <ul style="list-style-type: none"> <li>● PIII or above</li> <li>● 256 or 512 MB RAM / 40 GB HDD</li> <li>● OS: Win 2000</li> <li>● Audio card with headphones</li> <li>● JRE 1.3</li> </ul>	60 Nos.
3	Handicam	1 No.
4	Television 46"	1 No.
5	Collar mike	1 No.
6	Cordless mike	1 No.
7	Audio Mixer	1 No.
8	DVD recorder/player	1 No.
9	LCD Projector with MP3/CD/DVD provision for Audio/video facility	1 No.

### Evaluation:

#### Internal: 20 marks

Record maintenance: Students should write a report on a regular basis on the activities conducted, focusing on the details such as the description of the activity, ideas emerged, learning outcomes and so on. At the end of the semester records can be evaluated out of 20 marks.

#### External: 80 marks

Online Test	- 35 marks
Interview	- 15 marks
Presentation	- 15 marks
Group Discussion	- 15 marks

#### Note on Internal and External Evaluation:

1. Interview - mock interview can be conducted on one-on-one basis.
2. Speaking – example for role play:
  - a. Marketing engineer convincing a customer to buy his product.
  - b. Telephonic conversation- fixing an official appointment / placing an order / enquiring and so on.
3. Presentation - should be extempore on simple topics.
4. Discussion - topics of different kinds; general topics, and case studies.

### OUTCOMES:

#### At the end of the course, learners should be able to

- Take international examination such as IELTS and TOEFL
- Make presentations and Participate in Group Discussions.
- Successfully answer questions in interviews.

### REFERENCES:

1. **Business English Certificate Materials**, Cambridge University Press.
2. **Graded Examinations in Spoken English and Spoken English for Work** downloadable materials from Trinity College, London.
3. **International English Language Testing System Practice Tests**, Cambridge University Press.
4. Interactive Multimedia Programs on **Managing Time and Stress**.
5. **Personality Development (CD-ROM)**, Times Multimedia, Mumbai.

**ME6701**

**POWER PLANT ENGINEERING**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.

**UNIT I COAL BASED THERMAL POWER PLANTS 10**  
Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants - Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

**UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 10**  
Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

**UNIT III NUCLEAR POWER PLANTS 7**  
Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : *Boiling Water Reactor (BWR)*, *Pressurized Water Reactor (PWR)*, *CANada Deuterium-Uranium reactor (CANDU)*, Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

**UNIT IV POWER FROM RENEWABLE ENERGY 10**  
Hydro Electric Power Plants - Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, *Solar Photo Voltaic (SPV)*, Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

**UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 8**  
Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students can able to understand different types of power plant, and its functions and their flow lines and issues related to them.
- Analyse and solve energy and economic related issues in power sectors.

**TEXT BOOK:**

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw - Hill Publishing Company Ltd., 2008.

**REFERENCES:**

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw - Hill Publishing Company Ltd., 2010.
2. Black & Veatch, Springer, "Power Plant Engineering", 1996.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw - Hill, 1998.
4. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.

**ME6702**

**MECHATRONICS**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To impart knowledge about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.

**UNIT I INTRODUCTION**

**12**

Introduction to Mechatronics - Systems - Concepts of Mechatronics approach - Need for Mechatronics - Emerging areas of Mechatronics - Classification of Mechatronics. Sensors and Transducers: Static and dynamic Characteristics of Sensor, Potentiometers - LVDT - Capacitance sensors - Strain gauges - Eddy current sensor - Hall effect sensor - Temperature sensors - Light sensors

**UNIT II 8085 MICROPROCESSOR AND 8051 MICROCONTROLLER**

**10**

Introduction - Architecture of 8085 - Pin Configuration - Addressing Modes -Instruction set, Timing diagram of 8085 - Concepts of 8051 microcontroller - Block diagram,.

**UNIT III PROGRAMMABLE PERIPHERAL INTERFACE**

**8**

Introduction - Architecture of 8255, Keyboard interfacing, LED display -interfacing, ADC and DAC interface, Temperature Control - Stepper Motor Control - Traffic Control interface.

**UNIT IV PROGRAMMABLE LOGIC CONTROLLER**

**7**

Introduction - Basic structure - Input and output processing - Programming - Mnemonics - Timers, counters and internal relays - Data handling - Selection of PLC.

**UNIT V ACTUATORS AND MECHATRONIC SYSTEM DESIGN**

**8**

Types of Stepper and Servo motors - Construction - Working Principle - Advantages and Disadvantages. Design process-stages of design process - Traditional and Mechatronics design concepts - Case studies of Mechatronics systems - Pick and place Robot - Engine Management system - Automatic car park barrier.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students can able to design mechatronics system with the help of Microprocessor, PLC and other electrical and Electronics Circuits.

**TEXT BOOKS:**

1. Bolton, "Mechatronics", Printice Hall, 2008
2. Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", 5th Edition, Prentice Hall, 2008.

**REFERENCES:**

1. Michael B.Histand and Davis G.Alciatore, "Introduction to Mechatronics and Measurement systems", McGraw Hill International edition, 2007.
2. Bradley D.A, Dawson D, Buru N.C and Loader A.J, "Mechatronics", Chapman and Hall, 1993.
3. Smaili.A and Mrad.F , "Mechatronics Integrated Technologies for Intelligent Machines", Oxford University Press, 2007.
4. Devadas Shetty and Richard A. Kolk, "Mechatronics Systems Design", PWS publishing company, 2007.

5. Krishna Kant, "Microprocessors & Microcontrollers", Prentice Hall of India, 2007.
6. Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print, 2013

**ME6703                      COMPUTER INTEGRATED MANUFACTURING SYSTEMS                      L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

**UNIT I                      INTRODUCTION                      10**

Brief introduction to CAD and CAM - Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM - Concurrent Engineering-CIM concepts - Computerised elements of CIM system -Types of production Manufacturing models and Metrics - Mathematical models of Production Performance - Simple problems - Manufacturing Control - Simple Problems - Basic Elements of an Automated system - Levels of Automation - Lean Production and Just-In-Time Production.

**UNIT II                      PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING                      10**

Process planning - **Computer Aided Process Planning (CAPP)** - Logical steps in Computer Aided Process Planning - Aggregate Production Planning and the Master Production Schedule - Material Requirement planning - Capacity Planning- Control Systems-Shop Floor Control-Inventory Control - Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) Simple Problems.

**UNIT III                      CELLULAR MANUFACTURING                      9**

Group Technology(GT), Part Families - Parts Classification and coding - Simple Problems in Opitz Part Coding system - Production flow Analysis - Cellular Manufacturing - Composite part concept - Machine cell design and layout - Quantitative analysis in Cellular Manufacturing - Rank Order Clustering Method - Arranging Machines in a GT cell - Hollier Method - Simple Problems.

**UNIT IV                      FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS)                      8**

Types of Flexibility - FMS - FMS Components - FMS Application & Benefits - FMS Planning and Control- Quantitative analysis in FMS - Simple Problems. Automated Guided Vehicle System (AGVS) - AGVS Application - Vehicle Guidance technology - Vehicle Management & Safety.

**UNIT V                      INDUSTRIAL ROBOTICS                      8**

Robot Anatomy and Related Attributes - Classification of Robots- Robot Control systems - End Effectors - Sensors in Robotics - Robot Accuracy and Repeatability - Industrial Robot Applications - Robot Part Programming - Robot Accuracy and Repeatability - Simple Problems.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the student can able to understand the use of computers in process planning and use of FMS and Robotics in CIM

**TEXT BOOK:**

1. Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
2. Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age

International (P) Ltd, New Delhi, 2000.

**REFERENCES:**

1. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003.
2. Gideon Halevi and Roland Weill, "Principles of Process Planning - A Logical Approach" Chapman & Hall, London, 1995.
3. Rao. P, N Tewari &T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000.

**GE6757**

**TOTAL QUALITY MANAGEMENT**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To facilitate the understanding of Quality Management principles and process.

**UNIT I INTRODUCTION**

**9**

Introduction - Need for quality - Evolution of quality - Definitions of quality-- Dimensions of product and service quality - Basic concepts of TQM - TQM Framework Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus--Customer orientation, Customer satisfaction, Customer complaints, Customer retention Costs of quality.

**UNIT II TQM PRINCIPLES**

**9**

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

**UNIT III TQM TOOLS AND TECHNIQUES I**

**9**

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

**UNIT IV TQM TOOLS AND TECHNIQUES II**

**9**

Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) Taguchi quality loss function - TPM - Concepts, improvement needs Performance measures.

**UNIT V QUALITY SYSTEMS**

**9**

Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors..

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

**TEXT BOOK:**

1. Dale H. Besterfield, et at., "Total quality Management", Third Edition, Pearson Education Asia, Indian Reprint, 2006.

**REFERENCES:**

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8<sup>th</sup> Edition, First Indian Edition, Cengage Learning, 2012.

2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
3. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

**ME6005**

**PROCESS PLANNING AND COST ESTIMATION**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To introduce the process planning concepts to make cost estimation for various products after process planning

**UNIT I INTRODUCTION TO PROCESS PLANNING**

**10**

Introduction- methods of process planning-Drawing interpretation-Material evaluation - steps in process selection-.Production equipment and tooling selection

**UNIT II PROCESS PLANNING ACTIVITIES**

**10**

Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies

**UNIT III INTRODUCTION TO COST ESTIMATION**

**8**

Importance of costing and estimation -methods of costing-elements of cost estimation -Types of estimates - Estimating procedure- Estimation labor cost, material cost- allocation of over head charges- Calculation of depreciation cost

**UNIT IV PRODUCTION COST ESTIMATION**

**8**

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

**UNIT V MACHINING TIME CALCULATION**

**9**

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations ,Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students can able to use the concepts of process planning and cost estimation for various products.

**TEXT BOOKS:**

1. Peter scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2002.

**REFERENCES:**

1. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9<sup>th</sup> Edition, John Wiley, 1998.
2. Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2003.
3. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.



**ME6010**

**ROBOTICS**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To understand the functions of the basic components of a Robot.
- To study the use of various types of End of Effectors and Sensors
- To impart knowledge in Robot Kinematics and Programming
- To learn Robot safety issues and economics.

**UNIT I FUNDAMENTALS OF ROBOT**

**6**

Robot - Definition - Robot Anatomy Co ordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.

**UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS**

**9**

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

**UNIT III SENSORS AND MACHINE VISION**

**12**

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors, binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data-Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications- Inspection, Identification, Visual Serving and Navigation.

**UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING**

**13**

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

**UNIT V IMPLEMENTATION AND ROBOT ECONOMICS**

**5**

RGV, AGV; Implementation of Robots in Industries-Variou Steps; Safety Considerations for Robot Operations Economic Analysis of Robots.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students can able to apply the basic engineering knowledge for the design of robotics

**TEXT BOOKS:**

1. Klafter R.D., Chmielewski T.A and Negin M., "Robotic Engineering - An Integrated Approach", Prentice Hall, 2003.

2. Groover M.P., "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2001.

**REFERENCES:**

1. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2008.
2. Deb S.R., "Robotics Technology and Flexible Automation" Tata McGraw Hill Book Co., 1994.
3. Koren Y., "Robotics for Engineers", Mc Graw Hill Book Co., 1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co., 1987.
5. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill, 1995.
6. Rajput R.K., "Robotics and Industrial Automation", S.Chand and Company, 2008.
7. Surender Kumar, "Industrial Robots and Computer Integrated Manufacturing", Oxford and IBH Publishing Co. Pvt. Ltd., 1991.

ME6711

**SIMULATION AND ANALYSIS LABORATORY**

**L T P C**  
**0 0 3 2**

**OBJECTIVES:**

- To give exposure to software tools needed to analyze engineering problems.
- To expose the students to different applications of simulation and analysis tools.

**LIST OF EXPERIMENTS**

**A. SIMULATION**

1. MATLAB basics, Dealing with matrices, Graphing-Functions of one variable and two variables
2. Use of Matlab to solve simple problems in vibration
3. Mechanism Simulation using Multibody Dynamic software

**B. ANALYSIS**

1. Force and Stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi - symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the Students can model, analyse and simulate experiments to meet real world system and evaluate the performance.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

S. NO.	NAME OF THE EQUIPMENT	Qty.
1	Computer Work Station	15
2	Color Desk Jet Printer	01
3	Multibody Dynamic Software Suitable for Mechanism simulation and analysis	15 licenses
4	C / MATLAB	5 licenses

**ME6712**

**MECHATRONICS LABORATORY**

**L T P C**  
**0 0 3 2**

**OBJECTIVES:**

- To know the method of programming the microprocessor and also the design, modeling & analysis of basic electrical, hydraulic & pneumatic Systems which enable the students to understand the concept of mechatronics.

**LIST OF EXPERIMENTS:**

1. Assembly language programming of 8085 - Addition - Subtraction - Multiplication - Division - Sorting - Code Conversion.
2. Stepper motor interface.
3. Traffic light interface.
4. Speed control of DC motor.
5. Study of various types of transducers.
6. Study of hydraulic, pneumatic and electro-pneumatic circuits.
7. Modelling and analysis of basic hydraulic, pneumatic and electrical circuits using Software.
8. Study of PLC and its applications.
9. Study of image processing technique.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students can able to design mechatronics system with the help of Microprocessor, PLC and other electrical and Electronics Circuits.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

<b>Sl. No.</b>	<b>NAME OF THE EQUIPMENT</b>	<b>Qty.</b>
1	Basic Pneumatic Trainer Kit with manual and electrical controls/ PLC Control each	1 No.
2	Basic Hydraulic Trainer Kit	1 No
3	Hydraulics and Pneumatics Systems Simulation Software	10 No
4	8051 - Microcontroller kit with stepper motor and drive circuit sets	2 No
	Image processing system with hardware & software	1 No.

**ME6713**

**COMPREHENSION**

**L T P C**

**0 0 2 1**

**OBJECTIVES:**

- To encourage the students to comprehend the knowledge acquired from the first Semester to Sixth Semester of B.E Degree Course through periodic exercise.

**METHOD OF EVALUATION:**

The students will be assessed 100% internally through weekly test with objective type questions on all the subject related topics

**TOTAL : 30 PERIODS**

**OUTCOMES:**

- ability to understand and comprehend any given problem related to mechanical engineering field.

**MG6863**

**ENGINEERING ECONOMICS**

**L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To enable students to understand the fundamental economic concepts applicable to engineering and to learn the techniques of incorporating inflation factor in economic decision making.

**UNIT I INTRODUCTION TO ECONOMICS**

**8**

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics - Engineering efficiency, Economic efficiency, Scope of engineering economics-- Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis V ratio, Elementary economic Analysis - Material selection for product Design selection for a product, Process planning.

**UNIT II VALUE ENGINEERING**

**10**

Make or buy decision, Value engineering - Function, aims, Value engineering procedure. Interest formulae and their applications -Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor - Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

**UNIT III CASH FLOW**

**9**

Methods of comparison of alternatives - present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

**UNIT IV REPLACEMENT AND MAINTENANCE ANALYSIS**

**9**

Replacement and Maintenance analysis - Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset - capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

## UNIT V DEPRECIATION

9

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

**TOTAL: 45 PERIODS**

### OUTCOMES :

- Upon successful completion of this course, students will acquire the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions.

### TEXT BOOKS:

1. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.

### REFERENCES:

1. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2011.
2. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2010.
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 2011.
4. Zahid A khan: Engineering Economy, "Engineering Economy", Dorling Kindersley, 2012

ME6016

## ADVANCED I.C ENGINES

L T P C

3 0 0 3

### OBJECTIVES:

- To understand the underlying principles of operation of different IC Engines and components.
- To provide knowledge on pollutant formation, control, alternate fuel etc.

### UNIT I SPARK IGNITION ENGINES

9

Mixture requirements – Fuel injection systems – Monopoint, Multipoint & Direct injection - Stages of combustion – Normal and Abnormal combustion – Knock - Factors affecting knock – Combustion chambers.

### UNIT II COMPRESSION IGNITION ENGINES

9

Diesel Fuel Injection Systems - Stages of combustion – Knocking – Factors affecting knock – Direct and Indirect injection systems – Combustion chambers – Fuel Spray behaviour – Spray structure and spray penetration – Air motion - Introduction to Turbocharging.

### UNIT III POLLUTANT FORMATION AND CONTROL

9

Pollutant – Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, Selective Catalytic Reduction and Particulate Traps – Methods of measurement – Emission norms and Driving cycles.

### UNIT IV ALTERNATIVE FUELS

9

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits - Engine Modifications.

### UNIT V RECENT TRENDS

9

Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – Common Rail Direct Injection Systems - Hybrid Electric Vehicles – NOx Adsorbers - Onboard Diagnostics.

**OUTCOME:**

Upon completion of this course, the students can able to compare the operations of different IC Engine and components and can evaluate the pollutant formation, control, alternate fuel

**TEXT BOOKS:**

Ramalingam. K.K., "Internal Combustion Engine Fundamentals", Scitech Publications, 2002.  
Ganesan, "Internal Combustion Engines", II Edition, TMH, 2002.

**REFERENCES:**

1. Mathur. R.B. and R.P. Sharma, "Internal Combustion Engines"., Dhanpat Rai & Sons 2007.
2. Duffy Smith, "Auto Fuel Systems", The Good Heart Willcox Company, Inc., 1987.
3. Eric Chowenitz, "Automobile Electronics", SAE Publications, 1995

**IE6605**

**PRODUCTION PLANNING AND CONTROL**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.
- To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

**UNIT I INTRODUCTION**

**9**

Objectives and benefits of planning and control-Functions of production control-Types of production-job- batch and continuous-Product development and design-Marketing aspect Functional aspects-Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration-Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

**UNIT II WORK STUDY**

**9**

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development -- Implementation - Micro motion and memo motion study - work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data -- Predetermined motion time standards.

**UNIT III PRODUCT PLANNING AND PROCESS PLANNING**

**9**

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning-Steps in process planning-Quantity determination in batch production-Machine capacity, balancing-Analysis of process capabilities in a multi product system.

**UNIT IV PRODUCTION SCHEDULING**

**9**

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems Line of balance - Flow production scheduling-Batch production scheduling-Product sequencing - Production Control systems-Periodic batch control-Material requirement planning kanban - Dispatching-Progress reporting and expediting-Manufacturing lead time-Techniques for aligning completion times and due dates.

**UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC**

**9**

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system Ordering cycle system-Determination of Economic order quantity and economic lot size-ABC analysis-Recorder procedure-Introduction to computer integrated production planning systems-elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

**OUTCOMES:**

- Upon completion of this course, the students can able to prepare production planning and control activities such as work study, product planning, production scheduling, Inventory Control.
- They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

**TEXT BOOKS:**

1. Martand Telsang, "Industrial Engineering and Production Management", First edition, S. Chand and Company, 2000.
2. James.B.Dilworth,"Operations management - Design, Planning and Control for manufacturing and services" Mcgraw Hill International edition 1992.

**REFERENCES:**

1. Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn.1984
2. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8<sup>th</sup> Edition, John Wiley and Sons, 2000.
3. Kanishka Bedi, " Production and Operations management", 2<sup>nd</sup> Edition, Oxford university press, 2007.
4. Melyn, Denzler, " Operations management - A value driven approach" Irwin Mcgraw hill.
5. Norman Gaither, G. Frazier, "Operations Management", 9th edition, Thomson learning IE, 2007
6. Jain. K.C & L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers, 1990.
7. Chary. S.N. "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995.
8. Upendra Kachru, "Production and Operations Management - Text and cases", 1<sup>st</sup> Edition, Excel books 2007.

**ME6811**

**PROJECT WORK**

**L T P C  
0 0 12 6**

**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.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

**TOTAL: 180 PERIODS**

**OUTCOMES:**

- 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.



