

**DEPARTMENT OF MECHANICAL ENGINEERING
SCHEME OF INSTRUCTION AND EXAMINATION**

With Effect from 2010 – 2011

I / IV B.TECH. :: First SEMESTER

Code No.	Subject	Periods per week			Cre-dits	Maximum Marks		Total Marks
		Lec-ture-s	Tutorial	Lab/Practice		Internal	External	
FY 1001	Engineering Mathematics – I	4	1	-	4	30	70	100
FY 1002 P	Engineering Physics	3	1	-	3	30	70	100
FY 1003 E	Technical English & Communication skills	2	-	2	3	30	70	100
FY 1004 EM	Engineering Mechanics-I	4	1	-	4	30	70	100
FY 1005	Introduction to Computing	2	-	-	2	30	70	100
FY 1006 G	Engineering Graphics	2	-	6	5	30	70	100
FY 1051 P	Engineering Physics Lab	-	-	3	2	25	50	75
FY 1052	Basic Computing Lab	-	-	3	2	25	50	75
Total		17	3	14	25	230	520	750

I / IV B.TECH. :: Second SEMESTER

Code No.	Subject	Periods per week			Cre-dits	Maximum Marks		Total Marks
		Lec-ture-s	Tutorial	Lab/Practice		Internal	External	
FY 2001	Engineering Mathematics – II	4	1	-	4	30	70	100
FY 2002 C	Engineering Chemistry	3	1	-	3	30	70	100
FY 2003 B	Basics of Civil & Mech. Engg.	4	-	-	4	30	70	100
FY 2004 EM	Engineering Mechanics-II	3	1	-	3	30	70	100
FY 2005	Programming in C	3	1	-	3	30	70	100
FY 2006PE	Professional Ethics	2	-	-	2	30	70	100
FY 2051 C	Chemistry Lab	-	-	3	2	25	50	75
FY 2052	C Programming Lab			3	2	25	50	75
FY 2053 W	Basic Workshop	-	-	3	2	25	50	75
Total		19	4	9	25	255	570	825

SCHEME OF INSTRUCTION AND EXAMINATION

With Effect from 2010 – 2011 (Semester System)

II / IV B.TECH. (Mech) :: Third SEMESTER

Code No.	Subject	Periods per week			Credits	Maximum Marks		Total Marks
		Lecture	Tutorial	Lab/ Practice		Internal	External	
ME 3001	Mathematics –III	4	1	-	4	30	70	100
ME 3002	Mechanics of Materials	4	1	-	4	30	70	100
ME 3003	Kinematics of Machines	4	1	-	4	30	70	100
ME 3004	Basic Thermodynamics	4	1	-	4	30	70	100
ME 3005	Manufacturing Processes	3	1	-	3	30	70	100
ME 3006	Environmental Science	3	-	-	3	30	70	100
ME 3051	Computer Aided Drafting Lab	-	-	3	2	25	50	75
ME 3052	Work shop Practice	-	-	3	2	25	50	75
Total		22	5	6	26	230	520	750

II / IV B.TECH. (Mech) :: Fourth SEMESTER

Code No.	Subject	Periods per week			Credits	Maximum Marks		Total Marks
		Lecture	Tutorial	Lab/ Practice		Internal	External	
ME 4001	Mathematics –IV	4	1	-	4	30	70	100
ME 4002	Advanced Mechanics of Materials	4	1	-	4	30	70	100
ME 4003	Applied Thermodynamics	4	1	-	4	30	70	100
ME 4004	Fluid Mechanics	4	1	-	4	30	70	100
ME 4005	Material science & metallurgy	4	-	-	4	30	70	100
ME 4006	Basic Electronics Engineering	3	-	-	3	30	70	100
ME 4051	S.M & F.M. Lab	-	-	3	2	25	50	75
ME 4052	Communication Skills Lab	-	-	2	1	25	50	75
Total		23	4	5	26	230	520	750

SCHEME OF INSTRUCTION AND EXAMINATION
 With Effect from 2010 – 2011 (Semester System)
 III / IV B.TECH. (Mech) :: Fifth SEMESTER

Code No.	Subject	Periods per week			Credits	Maximum Marks		Total Marks
		Lecture	Tutorial	Lab/ Practice		Internal	External	
ME 5001	Hydraulic Machines	4	1	-	4	30	70	100
ME 5002	Design of Machine Elements	4	1	-	4	30	70	100
ME 5003	Machine Dynamics	4	1	-	4	30	70	100
ME 5004	I.C. Engines and Gas Turbines	4	1	-	4	30	70	100
ME 5005	Metal Cutting & Machine Tools	3	1	-	3	30	70	100
ME 5006	Electrical Technology	3	-	-	3	30	70	100
ME 5051	Modeling & Simulation Lab.	-	-	3	2	25	50	75
ME 5052	Electrical & Electronics Lab	-	-	3	2	25	50	75
Total		22	5	6	26	230	520	750

III / IV B.TECH. (Mech) :: Sixth SEMESTER

Code No.	Subject	Periods per week			Credits	Maximum Marks		Total Marks
		Lecture	Tutorial	Lab/ Practice		Internal	External	
ME 6001	Engg. Economics & Management	3	1	-	3	30	70	100
ME 6002	Design of transmission Elements	4	1	-	4	30	70	100
ME 6003	Advanced Manufacturing Processes	4	-	-	4	30	70	100
ME 6004	Heat Transfer	4	1	-	4	30	70	100
ME 6005	Engineering Metrology & Measurements	4	-	-	4	30	70	100
ME 6051	Fuels & IC Engines Lab	-	-	3	2	25	50	75
ME 6052	Machine Tool lab	-	-	3	2	25	50	75
ME 6053	Computational Methods Lab	-	-	3	2	25	50	75
ME 6054	Term Paper	-	1	-	1	25	50	75
Total		19	4	9	26	250	550	800

SCHEME OF INSTRUCTION AND EXAMINATION

With Effect from 2010 – 2011 (Semester System)

IV / IV B.TECH. (Mech) :: Seventh SEMESTER

Code No.	Subject	Periods per week			Credits	Maximum Marks		Total Marks
		Lecture	Tutorial	Lab/ Practice		Internal	External	
ME 7001	Operations Research	3	1	-	3	30	70	100
ME 7002	Design of Automobile Components	4	1	-	4	30	70	100
ME 7003	Finite Element Method	4	1	-	4	30	70	100
ME 7004	Manufacturing Management	3	1	-	3	30	70	100
ME 7005	Elective – I	3	1	-	3	30	70	100
ME 7006	Elective – II	4	-	-	4	30	70	100
ME 7051	Heat Transfer Lab	-	-	3	2	25	50	75
ME 7052	Design & Metrology Lab.	-	-	3	2	25	50	75
ME 7053	Mini Project	-	1	-	1	25	50	75
Total		21	6	6	26	255	570	825

ELECTIVE – I :

MEE 7005 / 1 :Mechatronics
MEE 7005 / 2 :Automatic Control Engineering
MEE 7005 / 3 :Hydraulic and Pneumatic Systems
MEE 7005 / 4 :Optimization Techniques
MEE 7005 / 5 :IT based elective
MEE 7005 / 6 :Industry need based elective

ELECTIVE – II:

MEE 7006 / 1 :Energy Resources Utilization
MEE 7006 / 2 :Refrigeration & Air Conditioning
MEE 7006 / 3 :Computational Fluid Dynamics
MEE 7006 / 4 :Gas Dynamics & Rocket Propulsion
MEE 7006 / 5 : Industry need based elective

SCHEME OF INSTRUCTION AND EXAMINATION

With Effect from 2010 – 2011 (Semester System)

IV / IV B.TECH. (Mech) :: Eighth SEMESTER

Code No.	Subject	Periods per week			Credits	Maximum Marks		Total Marks
		Lecture	Tutorial	Lab/Practice		Internal	External	
ME 8001	Computer Aided Manufacturing	4	-	-	4	30	70	100
ME 8002	Elective – III	4	-	-	4	30	70	100
ME 8003	Elective – IV	4	-	-	4	30	70	100
ME 8051	CAD & CAM Lab.	-	-	3	2	25	50	75
ME 8052	Project Work	2	6	10	12	50	100	150
Total		14	6	13	26	165	360	525

ELECTIVE – III:

- MEE 8003 / 1 : Computer Aided Design
- MEE 8003 / 2 : Automobile Engineering
- MEE 8003 / 3 : Experimental Stress Analysis
- MEE 8003 / 4 : Mechanics of Composite Materials

ELECTIVE – IV :

- MEE 8004 / 1 : Robotics
- MEE 8004 / 2 : Flexible Manufacturing Systems & Group Technology
- MEE 8004 / 3 : Machine Tool Design
- MEE 8004 / 4 : Design for Manufacturing & Assembly

FY 1001
ENGINEERING MATHEMATICS – I

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	4

Objectives: The study of the course provides an understanding of ordinary and partial differential equations and give different methods for solving them. Linear algebra in the course cover material which is essential to any one who does mathematical computation in Engineering and sciences.

Learning Outcomes:

1. Upon completing this course students should be able to solve system of Linear equations, be familiar with properties of matrices, find the inverse, eigen values and eigen vectors and use them in diagonalization, reductive to quadratic form and identifying matrix of a quadratic form, understanding the concept of convergences and finding the sum of infinite series.
2. Upon completing this course students should be able to solve first order seperable and linear differential equations and use these methods to solve applied problems. Solve higher order constant linear coefficient and system of differential equations and use these methods to solve applied problems. Formation of Partial differential equations and solution to partial differential equations.

UNIT – I

Matrices: Rank of a matrix, Elementary transformations, Echelon-form of a matrix, normal form of a matrix, Inverse of a matrix by elementary transformations(Gauss – Jordan method). Solution of system of linear equations: Non homogeneous linear equations and homogeneous linear equations. Linear dependence and linear independence of vectors. Characteristic equation – Eigen values – Eigen vectors – properties of Eigen values. Cayley-Hamilton theorem (without proof). Inverse of a matrix by using Cayley-Hamilton theorem.

UNIT – II

Reduction to diagonal form – Modal matrix orthogonal transformation. Reduction of quadratic form to canonical form by orthogonal transformations. Nature of a quadratic form – Hermitian and skew-Hermitian matrices.

SEQUENCES AND SERIES : Convergence of series – comparison test – D’Alemberts Ratio test – Cauchy’s Root Test – Alternating series – Absolute convergence – Leibnitz’s Rule.

UNIT – III

Ordinary differential equations – Formation – separable equations – exact equations – integrating factors – linear first order differential equations – Bernoulli’s equation - orthogonal trajectories. Newtons Law of Cooling, Heat Flow - Linear equations of higher order with constant coefficients.

UNIT – IV

Linear dependence of solutions, method of variation of parameters – equations reducible to linear equations – Cauchy’s homogeneous linear equation – Legendre’s linear equation simultaneous linear equations with constant coefficients.

Partial Differential Equations : Formation of Partial Differential Equations, Solutions of a Partial Differential Equation – Equations solvable by direct integration – Linear Equation of First order.

Learning Resources:

Text Books:

- A text book of Higher Engineering Mathematics by Dr.B.S.Grewal, 40th Edition. (Prescribed), Khanna Publishers
- A Text book o Engineering Mathematics by N.P.Bali, Manish Goyal, Laxmi Publications(P) Limited.
- A text book of mathematics by B.V.Ramana, Tata MC Graw Hill.

Reference Books:

- Advanced Engineering Mathematics by Krezig., 8th Edition, John Wiley & Sons
- Advanced Engineering Mathematics by Peter.V.O.Neil, Thomson, Canada
- Advanced Engineering Mathematics by R.K.Jain and S.R.K.Iyengar, 3rd Edition - Narosa Publishers.

FY 1002P
ENGINEERING PHYSICS

Lecture : 3 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	3

Objectives: The contents of Engineering Physics have been designed to cater the needs of B.Tech students at freshmen level. "Engineering Physics" deals with the physics of substances that are of practical utility. It helps the students to gain a deep understanding of the key elements and the emerging like LASERS, SUPER CONDUCTIVITY, OPTICAL FIBERS AND NANO TECHNOLOGY.

Learning **UNIT-I**

Outcomes: The control of electricity is evident in many devices, from microwave ovens to computers.

In this technological age, it is important to understand the basics of electricity and of how these basic ideas are used to sustain and enhance our current comfort safety and prosperity. In this unit student will learn the relationship of electrical currents to magnetism.

UNIT-II

In pre-graduation level students studied the basics of classical mechanics. In this unit the students will know the differences between classical and quantum mechanics. And also they will learn how this quantum mechanics is useful for the fields like medicine and industry.

UNIT-III

In this unit the students will learn how materials behave at low temperatures, causes for the behaviour and its advantages. In this unit students also learn about the advanced topics like LASERS, OPTICAL FIBERS and their applications in modern communication system.

UNIT-IV

In this unit students will learn about the "NANOTECHNOLOGY" which is an emerging field of Science and Emerging.

"NANOTECHNOLOGY" has a multi-disciplinary dimension exhibiting stronger interdependence in various fields. In this unit student also learn about the useful applications of nanotechnology in the various branches like medicine, biological, chemical, industrial,....etc.

UNIT – I

Electricity, Electromagnetism and Semiconductors: Gauss law in electricity (Statement and proof) and its applications: Coulomb's law from Gauss law, spherically distributed charge, Hall effect, Biot-Savart's law: B due to a current carrying wire and a circular loop, Faraday's law of induction, Lenz's law, Induced electric fields, Gauss' law for magnetism, Maxwell equations (Qualitative treatment), Electromagnetic oscillations in LC circuit (quantitative), A.C. circuit containing series LCR circuit (Resonance condition).

Semiconductors: Carrier transport, Carrier drift, Carrier diffusion, generation and recombination process (qualitative), classification of materials based on energy diagram.

UNIT - II

Modern Physics: Dual nature of light, Matter waves and Debroglie's hypothesis, Davisson & Germer experiment, Heisenberg's uncertainty principle and its application (Non existence of

electron in nucleus, Finite width of spectral lines), Classical and quantum aspects of particle. One dimensional time independent Schrodinger's wave equation, physical significance of wave function, Particle in a box (One dimension)O.

Optoelectronic Devices: LED, LCD, Photo emission, Photo diode, Photo transistor and Solar cell and its applications.

UNIT – III

Superconductors and Advanced Physics:

Superconductivity: Introduction, Critical parameters, Flux quantization, Meissner effect, Types of Superconductors, BCS theory, Cooper pairs, London's equation-penetration depth, high temperature super conductors, Applications of superconductors.

Advanced physics: Lasers: Spontaneous emission, stimulated emission, population inversion, Solid state (Ruby) laser, Gas (He – Ne) laser, Semiconductor (Ga As) laser, Applications of lasers, applications of Infrared radiation.

Fiber optics: Propagation of light through optical fiber, types of optical fibers, Numerical aperture, Fiber optics in communications and its advantages.

UNIT - IV

Nanotechnology: Introduction, Physical & Chemical properties. Fabrication: AFM, SEM, TEM, STM, MRFM. Production of nanoparticles: Plasma Arcing, Sol-gel, Chemical vapour deposition. Carbon nanotubes: SWNT, MWNT. Formation of carbon nanotubes: Arc discharge, Laser ablation; Properties of carbon nanotubes, Applications of CNT's & Nanotechnology.

Learning Resources:

Text Books:

1. Physics Part-II-Halliday and Resnick
2. Engineering Physics – Gaur and Gupta

Reference Books:

1. Solid State Physics – S.O.Pillai
2. Engineering Physics – M.Armugam
3. Modern engineering physics – A.S.Vasudeva
4. Engineering Physics – P.K. Palanisamy

FY 1003E
TECHNICAL ENGLISH AND COMMUNICATION SKILLS

Lecture : 2 hrs/ Week	Internal Assessment:	30
Tutorial : -	Final Examination:	70
Practical : 2 hrs/ Week	Credits:	3

Objectives: This Course Endeavors to Refurbish and Fortify the Linguistic Awareness and Communicative Competence of the learners by offering insights into various Morphological, Semantic, Syntactic & Stylistic aspects of English Language. The ultimate aim of the course is to equip the learners with different forms of written and spoken communication in order that they withstand the competition at the transnational technical environment so as to enable them to undertake various professional operations.

Learning Outcomes: This course arms the students to face the challenges in communication primarily in a technical milieu as communicating formal and technical messages is essential for students. It enables the learner to take up all Oral and writing tasks with ease and confidence. It acts as a launching pad to students concerned with professional advancement

UNIT – I
WRITTEN COMMUNICATION SKILLS

This area exposes the learners to the basic tenets of writing; the style and format of different tools of written communication

- (I) Description (through Paragraph Writing)
- (II) Reflection (through Essay Writing)
- (III) Persuasion (through indented Letter Writing)
- (IV)

UNIT – II

Reading Comprehension:

This area exposes the learners to the techniques of deciphering and analyzing longer texts pertaining to various disciplines of study.

- (I) Types of Reading
- (II) Sub skills of Reading
- (III) Eye span – fixation
- (IV) Reading Aloud & Silent Reading
- (V) Vocalization & Sub-vocalization.

UNIT – III

A) Vocabulary and Functional English:

This area attempts at making the learners withstand the competition at the transnational technical environment so as to enable them to undertake various professional operations.

- (I) Vocabulary – a basic word list of one thousand words.
- (II) Functional grammar, with special focus on Common Errors in English.
- (III) Idioms & Phrasal verbs.

B) Listening and Speaking:

This area exposes the learners to the standard expressions including stress, rhythm and various aspects of isolated elements and connected speech.

- (I) The use of diphthongs
- (II) Elements of spoken expression
- (III) Varieties of English
- (IV) Towards accent neutralization

UNIT – IV

Technical Communication Skills:

This area falls under English for Specific Purposes (ESP) which trains the learner in Basic Technical Communication.

- (I) Technical Report Writing (Informational, Analytical & Special reports)
- (II) Technical Vocabulary

Learning Resources:

1. Use of English – Randolph Quirk, Longman, 2004.
2. Practical English Grammar– Thomson A.J & Martinet A.V, Oxford University Press, 2001
3. Common Errors in English – Thomas Eliot Berry, TMH, 2001.
4. Structural Patterns & Usage in English – B.S.Sarma, Poosha Series, th edition, 2007.
5. College Writing Skills - John Langan, McGraw Hill, 2004.
6. English for Academic and Technical Purposes – Sellinkar, Larry et. al., Newbury House Publishers, 1981.
7. Oxford guide to Plain English – Martin Cutts, Oxford University Press, 2004.
8. Phonetics and spoken English – V.Sethi and P.V. Dhamija, Orient Longman, 2004.
9. Technical Communication- Principles and Practice- Meenakshi Raman& Sangeet Sharma, Oxford University Press, 2009.

FY 1004 EM ENGINEERING MECHANICS – I

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : 1 Hr/Week	Final Examination:	70
Practical : -	Credits:	4

Objectives: Engineering mechanics is both a foundation and a framework for Civil and Mechanical engineering disciplines. This course provides a basic knowledge of rigid-body mechanics, elasticity and structural analysis. In particular, the principles of statics and their applications in engineering, the methods of static analysis, and techniques of engineering computation are expounded. This course is designed to enable students to acquire fundamental knowledge in engineering.

Learning After taking this course, the student acquires the knowledge and ability to:

- Outcomes:**
- 1) Solve for the resultants of any force systems;
 - 2) Determine equivalent force systems;
 - 3) Determine the internal forces in axial members and support reactions.
 - 4) Determine the centroids of plane and composite areas
 - 5] Determine the axial forces in the members of a given truss.
 - 6) Solve the problems associated with friction forces.

UNIT – I

Concurrent Forces in a Plane:

Principles of statics, Force, Addition of two forces: Parallelogram Law – Composition and resolution of forces – Constraint, Action and Reaction. Types of supports and support reactions. Free body diagram. Equilibrium of concurrent forces in a plane – Method of projections – Moment of a force, Theorem of Varignon, Method of moments.

UNIT –II

Parallel Forces in a Plane:

Introduction, Types of parallel forces, Resultant. Couple, Resolution of Force into force and a couple. General case of parallel forces in a plane.

Centroids:

Introduction, Determination of centroids by integration method, Centroids of composite plane figures.

UNIT – III

Moment of Inertia of Plane Figures: Moment of Inertia of a plane figure with respect to an axis in its plane – Moment of inertia with respect to an axis perpendicular to the plane of the figure – Parallel axis theorem

General Case of Forces in a Plane:

Composition of forces in a plane – Equilibrium of forces in a plane -Plane Trusses: Method of joints.

UNIT – IV

Friction: Introduction, Classification of friction, Laws of dry friction. Co-efficient of friction, Angle of friction, Angle of repose, Cone of friction, Frictional forces on wheel, Wedge friction.

Principle Of Virtual Work:

Equilibrium of ideal systems.

Learning Resources:**Textbooks:**

1. Engineering Mechanics by S.Timoshenko & D.H.Young, McGraw Hill International Edition. (For Concepts and symbolic Problems).
2. Engineering Mechanics Statics and dynamics by A.K.Tayal, Umesh Publication, Delhi, (For numerical Problems using S.I.System of Units).

Reference Books:

1. Vector Mechanics for Engineers Statics and Dynamics by Beer and Johnston, Tata McGraw Hill Publishing Company, New Delhi.
2. Engineering Mechanics by SS Bhavikatti and KG Rajasekharappa
3. Singer's Engineering Mechanics Statics and Dynamics by K.Vijaya Kumar Reddy and J Suresh Kumar (Third Edition SI Units-BS Publications.)

Web References:

http://openlibrary.org/books/OL22136590M/Basic_engineering_mechanics

http://en.wikibooks.org/wiki/Engineering_Mechanics

<http://nptel.iitm.ac.in/video.php?courseId=1048>

<http://imechanica.org/node/1551>

<http://emweb.unl.edu/>

<http://ebooks-freedownload.com/2009/11/engineering-mechanics-statics-12.html>

http://www.ebookee.com/Engineering-Mechanics-Statics_37859.html

FY 1005
INTRODUCTION TO COMPUTING

Lecture : 2 hrs/ Week	Internal Assessment:	30
Tutorial : -	Final Examination:	70
Practical : -	Credits:	2

Objectives: The objectives for Introduction to Computers will enable the student to use the computer effectively in a multitude of academic scenarios. The numbers in parentheses refer to the standards that are addressed.

- Understand the basic parts of a computer system and their relationships.
- Master the basic functions of the Windows operating System.
- Understand and use basic computer terminology. To equip the graduates with a broad foundation of basic engineering concepts and fundamentals of Computer Engineering.
- To develop in graduates the capability to apply these learned concepts in Engineering design and to implement such a career as a practicing engineer.
- To inculcate in graduates the importance of lifelong learning.
- To develop in graduates an appreciation of technology and determine its use in the advancement of society.
- Use and maintain a secure, efficient computer system.
- Use a computer system for interactive communications.

Learning Upon successfully completing this course, students will be able to:

- Outcomes:**
- Convert and calculate in binary, decimal, and hexadecimal number systems.
 - Use correct terminology associated with information processing.
 - Define CPU in terms of manufacturer, model number, speed, maximum addressable RAM, and bus size.
 - Describe an Information System using examples from business, education, and personal use.
 - Compare input and output devices found with a variety of PCs – sub-notebooks, notebooks, laptops, desktops, and etc.
 - List and describe classes of software available for use today.
 - Identify common elements in a graphical user interface.
 - Compare and contrast operating systems to include graphical user interface and non-graphical user interface environments.
 - Identify media, hardware, software, and procedural components linking telecommunications systems.
 - Evaluate options for connecting to the Internet.
 - Send e-mail, access remote servers, and identify resources available on the Web.
 - List, compare, and contrast high-level and fourth-generation computer languages.

UNIT I:

Introduction:

Algorithms, Simple model of a computer, Characteristics of a computer, Problem solving using

computers.

Data Representation: Representation of characters in computer, representation of Integers, fractions, number systems, binary system, octal system, hexadecimal system, organizing of memories, representation of numbers, alpha numeric characters, error detection codes.

Computer Generation and Classification: Computer generations, Classifications of computers.

UNIT II:

Computer Architecture:

Interconnection of units, Input Units: Keyboard, VDU, OMR, MICR, OCR and BAR Coding. Output Units: Types of Printers, Plotters,

Computer memory: Memory cell, Organization, Read-Only-Memory, Magnetic Hard Disk, CDROM.

UNIT III:

Computer Languages:

Why programming Language, Assembly language, Higher Level Programming Languages, Compiling High Level Languages.

Algorithm and Flowcharting:

Introductory programming techniques, Algorithms, Structure of Algorithms, Types of Algorithms, Structure of a Flowchart, Terminal Symbol Off page connector symbol, Modification Symbol, Group instruction symbol, Connection symbol, Drawing efficient flowcharts.

UNIT – IV

Introduction to operating system, functions of operating system, basic introduction to DOS, LINUX, WINDOWS –XP.

Definition and Applications of Computer Network, LAN, MAN and WAN, Intranet, Internet.

Learning Resources:

Text Book:

1. Fundamentals of Computers V. Rajaraman 4th Edition PHI.

Reference Books:

1. Introduction to Computer Science; S. Govindaraju, M. Chandrasekaran, A. Abdul Haq, T. R. Narayanan; Wiley Eastern Limited
2. Computer Fundamentals by PK Sinha; BPB Publications, New Delhi

FY 1006G
ENGINEERING GRAPHICS

Lecture : 2 hrs/ Week	Internal Assessment:	30
Tutorial : -	Final Examination:	70
Practical : 6 hrs/ Week	Credits:	5

Objectives: The primary objective of this course is to develop the students to visualize and communicate all geometrical elements and also understanding the fundamentals of geometry like engineering curves, planes, solids, sections, developments & isometric views and its applications in the daily life.

Learning Outcomes: Student gets thorough knowledge of various Geometrical Elements used in Engineering Practice. He gets the insight into the Concepts of all 2 D elements like Conic Sections and 3 D Objects like various Prisms, Cylinders, Pyramids and Cones. He also understands the Projections of various objects and their representation and dimensioning. The Concept of Isometric Projections is thoroughly taught which will be useful for the visualisation of any objects.

UNIT – I

General: Use of Drawing instruments, Lettering - Single stroke letters, Dimensioning, Representation of various type lines - Geometrical Constructions.

Scales: Construction and use of plain and diagonal scales.

Conic Sections: conic sections - general construction method for ellipse, parabola and hyperbola. Special methods for conic sections.

Curves: Curves used in Engineering practice - Cycloidal curves - Cycloid, Epicycloid and Hypocycloid; Involute of circle.

UNIT – II

Method of Projections: Principles of projection - First angle projection and third angle projection of points and straight lines.

Projection of Planes : Projections of planes of regular geometrical lamina.

UNIT – III

Projections of Solids: Projections of simple solids such as Cubes, Prisms, Pyramids, Cylinders and Cones with varying positions.

Sections of Solids: Sections of solids such as Cubes, Prisms, Pyramids, Cylinders and Cones. true shapes of sections. (Limited to the Section Planes perpendicular to one of the Principal Planes).

UNIT – IV

Development of Surfaces: Lateral development of cut sections of Cubes, Prisms, Pyramids, Cylinders and Cones.

Isometric Projections: Isometric Projection and conversion of Orthographic Projections into isometric views. (Treatment is limited to simple objects only). Introduction to Isometric Projections to Orthographic Projections.

Learning Resources:**Text Book:**

1. Elementary Engineering Drawing by N.D. Bhatt & V.M. Panchal. (Charotar Publishing House, Anand). Forty-Ninth Edition – 2006.

Reference Books:

1. Text Book on Engineering Drawing by Prof. K. L. Narayana & Prof. P. Kannaiah.
Scitech publications(India) Pvt. Ltd., Chennai Second Edition – fifth reprint 20006.

Website:

http://www.youtube.com/watch?v=XCWJ_XrkWco

<http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html#isodrawing>

FY 1051P
ENGINEERING PHYSICS LABORATORY

Lecture : ---	Internal Assessment:	25
Tutorial : ---	Final Examination:	50
Practical : 3 Hrs/week	Credits:	2

Objectives: The main objective is to provide students to learn about some important experimental techniques in physics with knowledge in theoretical aspects so that they can excel in that particular field.

Learning Outcomes: These experiments in the laboratory are helpful in understanding important concepts of physics through involvement in the experiments by applying theoretical knowledge. It helps to recognize where the ideas of the students agree with those accepted by physics and where they do not.

Minimum of 8 Experiments to be Completed out of the following

1. AC Sonometer – Verification of Laws
2. Sensitive Galvanometer –Figure of merit
3. Photo tube-study of V-I Characteristics,determination of work function
4. Torsional Pendulum-Rigidity modulus calculation
5. Variation of magnetic field along the axis of current-carrying circular coil
6. Fibre Optics-Numerical aperture calculation
7. Compound pendulum-Measurement of 'g'
8. Solar cell – Determination of Fill Factor
9. Losses in Optical Fibres
10. LCR circuit-Resonance
11. Newton's Rings-Radius of curvature of plano convex lens
12. Hall effect- Study of B & I Variation
13. Photovoltaic cell-Energy gap
14. Measurement of thickness of a foil using wedge method
15. Diffraction grating-Measurement of wavelength

Learning Resources:

1. A text book of practical physics by Indu Prakash & Rama Krishna, vol.1, Kitab Mahal, Allahabad.
2. University practical physics by J.C. Mohanty, D.K. Mishra, Kalyani publishers, Delhi.
3. A laboratory manual of Physics by D P Khandelwal, vani educational books, Delhi.
4. Laboratory manual of engineering Physics by Dr. Y.Aparna, Dr. K. Venkateswara Rao, VGS Publications,Vijayawada.

FY 1052 BASIC COMPUTING LABORATORY

Lecture : --	Internal Assessment:	25
Tutorial : -	Final Examination:	50
Practical : 3 hrs/ Week	Credits:	2

Objectives: The Basic Computing Lab for engineers is a training lab course spread over 42 hours. The modules include training on Productivity tools including Word, Excel, Power Point, access, Internet & World Wide Web and PC Hardware.

Productivity tools module would enable the students in crafting professional word documents, excel Spread sheets, power point presentations and access using the Microsoft suite of office tools.

Internet & World Wide Web module introduces the different ways of hooking the PC on to the internet from home and workplace and effectively usage of the internet. Usage of web browsers, email, newsgroups and discussion forums would be covered.

PC Hardware introduces the students to a personal computer and its basic peripherals, the process of assembling a personal computer, installation of system software like MS Windows, Linux and the required device drivers. In addition Accessing and Changing BIOS settings, tips and tricks would be covered.

Learning Outcomes: Information Technology has great influence on all aspects of life. Almost all work places and living environments are being computerized. In order to prepare Students to work in these environments, it is essential that they are exposed to various aspects of Information Technology such as understanding the concept of Information Technology and its Scope; Operating a Computer; use of various tools of MS-Office using Internet etc.

LIST OF PROGRAMS

1. Execution of Simple DOS Commands COPY, REN, DIR, TYPE, CD, MD, BACKUP
2. Create your Bio-Data in MSWord giving Educational and Personal Details.
3. Create an Excel Worksheet entering marks in 6 subjects of 10 Students. Give ranks on the basis of Total marks and also generate graphs.
4. Create a Database in MS-Access for Storing Library Information.
Ex Fields: Book name, author, book code, subject, rack no, price, volumes Enter Sample data of 15 books in to database.
5. Design a PowerPoint presentation with not less than 10 slides on any of your interesting topic.
Ex: Literacy, Freedom Struggle, Siddhartha Engineering College, Evolution of Computers, Internet etc.
6. Register for new Email address with any free Email provider and send Email using Internet to your friends, parents, teachers etc.
7. Search Internet using Search Engines like Google.com, Yahoo.com and

ask.com for files, pictures, power point presentations etc. Downloading files, EBooks, EContent from Internet.

- 8 Practice in installing a Computer System by giving connection and loading System Software and Application Software.
9. Accessing and Changing BIOS settings.
- 10 Installing Windows XP operating System.
- 11 Assembling of PC.
- 12 Disassembling of PC.

Learning Resources:

Text Books :

- Introduction to Computers with MSOffice, Alexis Leon and Mathews Leon TATA McGraw HILL.
- Internet for Every One by Alexis Leon and Mathews Leon; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi.
- Familiarity With the computer, Software, Internet and their uses.

Reference Books:

- Computers Today by SK Basandra, Galgotia Publication Pvt. Ltd., New Delhi
- Fundamentals of Information Technology by Leon and Leon, Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi.
- Surviving in an E-World, Anushka Wirasinha, Prentice Hall of India Pvt. Ltd., New Delhi

FY 2001
ENGINEERING MATHEMATICS – II

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	4

Objectives: By the study of this course the student is able to compare and contrast the idea of continuity and differentiability. Able to interpret the idea of optimization, locate and classify the extreme points. Also the students are taught interpolation and approximation of functions using finite difference technique.

Learning Based upon objectives the learning outcomes are

- Outcomes:**
- Understand the concept of limit, continuity, differentiability. Learn mean value theorems and apply them in approximating functions, maxima and minima of two variables with constraints and with without constraints, curvature, radius of curvature.
 - Evaluation of double, triple integrals by using change of order and finding area and volume in polar form and Cartesian form.
 - Define and understand the geometry of vector differential operators and line, surface, volume integrals. State and use the major theorems of vector analysis.
 - Understand the concept of finite difference technique for finding polynomial approximations for given $f(x)$ numerically.

UNIT – I

Differential Calculus: Limit, continuity, differentiability – Rolle’s Theorem – Lagrange’s Mean Value Theorem – Taylor’s Series (without proof) – Maxima and Minima of functions of two variables – Lagrange’s multipliers – Curvature – radius of curvature – Centre of curvature.

UNIT – II

Integral Calculus: Double integrals – Evaluation in Cartesian and Polar coordinates – Changing the order of integration – Evaluation of areas using double integrals – Evaluation of triple integrals – Evaluation of volume using triple integrals, change of variables.

UNIT – III

Vector Calculus: Scalar and Vector fields – Differentiation of scalar and vector point functions – gradient of Scalar fields – directional derivatives – divergence and curl of vector fields – vector identities

Line and surface integrals – Green’s theorem in a plane (without proof) – Gauss’ divergence theorem (without proof) – Stoke’s theorem (without proof).

UNIT – IV

Interpolation: Introduction, Finite Differences – Forward, Backward, Central Differences, Symbolic Relations, Differences of a polynomial, Newton’s formula for interpolation, Central difference interpolation formulae – Gauss’s, Sterling’s, Bessel’s formulae Interpolation with unequal intervals – Lagrange’s and Newton’s Interpolation formulae.

Learning Resources:**Text Books:**

- A text book of Higher Engineering Mathematics by Dr.B.S.Grewal, 40th Edition. (Prescribed), Khanna Publishers
- A Text book o Engineering Mathematics by N.P.Bali, Manish Goyal, Laxmi Publications(P) Limited.
- A text book of mathematics by B.V.Ramana, Tata Mc Graw Hill.

Reference Books:

- Advanced Engineering Mathematics by Krezig., 8th Edition, John Wiley & Sons
- Advanced Engineering Mathematics by Peter.V.O.Neil, Thomson, Canada
- Advanced Engineering Mathematics by R.K.Jain and S.R.K.Iyengar, 3rd Edition - Narosa Publishers.

FY 2002C
ENGINEERING CHEMISTRY

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	3

Objectives: Basic engineering principles in engineering education are not totally independent and they go along with the principles of chemistry. It is a well-known fact that the application of principles of chemistry emerges into technology. Hence, a broad knowledge of chemistry is essential for the undergraduate students of engineering in any branch. The present syllabus is designed by keeping everything related to the role played by chemistry in the field of engineering.

Learning The objectives of this course will have the following outcomes:

- Outcomes:**
1. Water being an important engineering material, its role in the industries and in particular boilers is to be thoroughly understood. The various boiler troubles encountered and the remedial measures will help the students especially when they want to set up an industry of their own. A lot of work is being done on purification of brackish water and hence one is supposed to be informed of the technology of purification of sea water.
 2. Conducting polymers are replacing metals in the field of technology and hence it is essential to know the mechanism associated with conducting polymers.
 3. Electrochemistry and electrochemical energy systems provide an insight into the electrical world that includes power generators, battery systems and electrical sensors that control various systems.
 4. Corrosion, the global problem can well be understood so that the contribution of the undergraduate engineers in terms of protecting metals can always be enhanced in the field of Research and Development.
 5. Any branch of engineering student requires analytical skills in handling various machines, instruments, apart from understanding the mechanism involved. Spectroscopy is such an analytical area that it imparts excellent knowledge of analytical work thereby it will provide broad path of understanding of any method that is taken up for study.

UNIT - I

Water technology: Water treatment for drinking purpose - sedimentation, coagulation, filtration, various methods of disinfection and concept of break-point chlorination.

Boiler troubles: scales, sludges, caustic embrittlement and boiler corrosion – causes and prevention.

Desalination of brackish water: Principle and process of electrodialysis and reverse osmosis,

Polymer technology: Conducting polymers – Examples, classification-intrinsically conducting polymers and extrinsically conducting polymers- mechanism of conduction of undoped, p-doped and n-doped polyacetylenes – applications of conducting polymers – structure, importance and applications of polyaniline.

UNIT - II

Electrochemistry and Electrochemical energy systems

Reference electrodes: Calomel electrode, silver-silver chloride electrode, quinhydrone electrode and glass electrode, determination of pH using glass electrode, concept of concentration cells.

Conductivity – Conductometric titrations and Potentiometric titrations.

Electrochemical energy systems: Types of electrochemical energy systems – Storage cells – Zinc-air battery, Ni-Cd battery, Lithium batteries – Li/MnO₂, Li/SOCl₂, Li/TiS₂ and Li_xC/LiCoO₂ – Advantages of lithium batteries – Electrochemical sensors – Principle, working and applications – Simple introduction to the terms – polarization, decomposition potential and overvoltage.

UNIT – III

Corrosion and its control

Introduction – chemical and electrochemical corrosion – electrochemical theory of corrosion – corrosion due to dissimilar metals, galvanic series – differential aeration corrosion – concept of passivity.

Forms of corrosion –pitting, crevice, stress corrosion cracking and microbiological corrosion.

Factors affecting corrosion: Relative anodic and cathodic areas, nature of corrosion product, concentration of D.O., pH and temperature.

Protection methods: Cathodic protection (impressed current and sacrificial anode), anodic protection, corrosion inhibitors – types and mechanism of inhibition.

Electrolytic methods in electronics: Electroplating – principle and process of electroplating of copper on iron – Electroless plating – principle and electroless plating of copper, Self assembled monolayers.

UNIT - IV

Instrumental techniques in chemical analysis

Introduction of spectroscopy – interaction of electromagnetic radiation with matter.

UV-visible (electronic) spectroscopy: Frank-Condon principle – types of electronic transitions.

Lambert-Beer's law, numericals (simple substitution) – Instrumentation-Single beam UV-visible spectrophotometer. Applications of UV-visible spectroscopy: qualitative analysis, quantitative analysis, detection of impurities, determination of molecular weight and dissociation constants.

Infrared (vibrational) spectroscopy: Principle of IR spectroscopy, types of molecular vibrations-stretching and bending vibrations, vibrational spectra diatomic molecules, selection rule for harmonic vibrational transition – Instrumentation. Applications of IR spectroscopy: Determination of force constant – numericals (simple substitution), detection of impurity and identification of nature of hydrogen bonding.

Learning Resources:

Text Books:

- Engineering Chemistry, *P.C. Jain*, 15th edition, Dhanpat Rai Publishing Company (P) Limited, New Delhi.

Reference Books:

- A text book of Engineering Chemistry, S.S. Dara, 10th edition, S. Chand & Company Limited, New Delhi.
- A text book of Engineering Chemistry, Shashi Chawla, Dhanpat Rai & Company Pvt. Ltd., New Delhi.
- Essentials of Physical Chemistry, B.S. Bahl and G. D. Tuli.
- Text book of analytical chemistry, Y.Anjaneyulu, K. Chandrasekhar and Valli Manickam
- Engineering Chemistry, O. G. Palanna, Tata McGraw Hill Education Pvt. Ltd., New Delhi.

Web References:

- <http://www.cip.ukcentre.com/steam.htm>

- <http://corrosion-doctors.org/Modules/mod-basics.htm>
- http://chemwiki.ucdavis.edu/Analytical_Chemistry/.htm
- <http://teaching.shu.ac.uk/hwb/chemistry/tutorials/molspec/uvvisab1.htm>
- <http://www.prenhall.com/settle/chapters/ch15.pdf>

FY 2003B
BASICS OF CIVIL AND MECHANICAL ENGINEERING

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : --	Final Examination:	70
Practical : -	Credits:	4

Objectives: Basic civil and Mechanical engineering is a foundation for Civil and Mechanical Engineering disciplines. This course is designed to enable the students to acquire fundamental knowledge in these two disciplines

Learning Outcomes: Will have an idea about knowledge of stress, strain, various building materials used in construction industry, sub-structure elements, superstructure elements, surveying, dams, road transportation, bridges and its components.

After completion of this course, the student acquires the knowledge about basic manufacturing processes, belt and gear drives for power transmission. They can have clear idea about the working of power plants, refrigeration, air conditioning and IC engines. They also acquire basic knowledge on roads and bridges along with principles of surveying and structures.

Part – A Civil Engineering

UNIT – I

Simple stress and strains: Definition of Mechanics- External and Internal forces-Stress and Strain-Elasticity and Hook's Law- Relations between elastic constants.

Civil Engineering Materials: Bricks, Stones, Cement, Steel and Cement Concrete.

Sub-structure and Super structure: Soil, Types of Foundations, Bearing capacity of Soil, Brick Masonry, Stone Masonry, Flooring, Roofing and Plastering.

UNIT – II

Surveying: Objectives, Types, Principles of Surveying. Measurement of distances, angles – Levelling.

Civil Engineering Structures: Roads- Classification, Cross section of roads.

Bridges- Necessity, Components, Classification.

Dams- Purpose, Classification

Part – B Mechanical Engineering

UNIT – III

Basic Manufacturing Methods : Principles of casting , green sand moulds , Advantages and applications of casting ; Principles of gas welding and arc welding, Soldering and Brazing ; Hot working – hot rolling , Cold working – cold rolling ; Description of basic machine tool- Lathe – operations – turning, threading, taper turning and drilling ;

Power Transmission : Introduction to belt and gears drives , types of gears , Difference between open belts and cross belts, power transmission by belt drives ; (theoretical treatment only) .

UNIT – IV

Power Plants : Introduction , , working principle of nuclear power plant and steam power plant, Alternate sources of energy – solar , wind and tidal power;

Refrigeration & Air Conditioning : Definition – COP , Unit of Refrigeration , Applications of

refrigeration system, vapour compression refrigeration system , simple layout of summer air conditioning system ;

IC Engines_: Introduction , Main components of IC engines , working of 4-stroke petrol engine and diesel engine , working of 2- stroke petrol engine and diesel engine , difference between petrol and diesel engine , difference between 4- stroke and 2- stroke engines.

Learning Resources:

Text Books

1. **Basic Civil Engineering** by M. S. Palanichamy, Tata Mc Graw-Hill Publishing Company Limited, New Delhi.(2002)
2. **Basic Mechanical Engineering,** by T S Rajan, Wiley Eastern Ltd., New Age International Ltd.(1993)

References:

1. **Refrigeration and Air Conditioning** by Zakria Baig, Radiant Publishing House, Hyd.
2. **Basic Civil and Mechanical Engineering** by G.Shanmugam and M S Palanichamy, Tata Mc Graw-Hill Publishing Company Limited, New Delhi.
3. **Thermal Engineering,** by R Rudramoorthy, Tata McGraw-Hill Publishing Company Ltd. New Delhi. (2003)

Web references :

www.result.khatana.net/2010/07/ge2152
www.engiblogger.com/mechanical/mechan
www.indiastudychannel.com/resources/5...
www.scribd.com/doc/15653381/Basic-Civ

**FY 2004EM
ENGINEERING MECHANICS - II**

Lecture : 3 hrs/ Week	Internal Assessment:	30
Tutorial : 1 Hr/Week	Final Examination:	70
Practical : -	Credits:	3

Objectives: This course introduces the Moment of inertia of plane areas and material bodies to the engineering students and mainly focused on the dynamics of particles and rigid bodies. Methods like kinematic relationships, Newton's laws, conservation of energy, momentum, and angular momentum for analyzing the motion of particles and rigid bodies are covered.

Learning After taking this course, student should have the ability to:

- Outcomes:**
- Obtain the Moment of inertia of plane figures and material bodies
 - Learn the fundamental concepts of engineering dynamics
 - Learn the mathematical formulations of dynamics problems
 - Analyze the dynamics of particles and rigid bodies with applications
 - Apply the laws of dynamics to analyze and interpret the dynamics of particles and rigid bodies.

UNIT – I

Kinematics of Rectilinear Translation: Introduction, displacement, velocity and acceleration. Motion with Uniform and Variable acceleration.

Kinetics of Rectilinear Translation: Equations of rectilinear motion. Equations of Dynamic Equilibrium: D'Alembert's Principle. Work and Energy, Conservation of energy, Impulse and Momentum, Impact-Direct central Impact.

UNIT – II

Kinematics of Curvilinear Motion: Introduction, rectangular components of velocity & acceleration. Normal and Tangential acceleration. Motion of projectiles.

Kinetics of Curvilinear Motion: D'Alembert's Principle in curvilinear motion – Work and energy.

UNIT –III

Moment of Inertia of Material Bodies: Moment of inertia of a rigid body – Moment of inertia of laminas- slender bar, rectangular plate, Circular plate, circular ring, Moment of inertia of 3D bodies- cone, solid cylinder, sphere & parallelepiped.

Rotation of a Rigid Body about a Fixed Axis: Kinematics of rotation, Equation of motion for a rigid body rotating about a fixed axis – Rotation under the action of a constant moment.

UNIT – IV

Kinematics of plane motion: Concepts of relative velocity and instantaneous center.

Kinetics of plane motion: Equations of motion, Dynamic equilibrium of symmetrical rolling bodies.

Learning Resources:

TEXTBOOKS:

1. Engineering Mechanics by S.Timoshenko & D.H.Young, McGraw Hill International Edition. (For Concepts and symbolic Problems).

2. Engineering Mechanics Statics and dynamics by A.K.Tayal, Umesh Publication, Delhi, (For numerical Problems using S.I.System of Units).

REFERENCE BOOKS:

1. Vector Mechanics for Engineers Statics and Dynamics by Beer and Johnston, Tata McGraw Hill Publishing Company, New Delhi.
2. Engineering Mechanics by SS Bhavikatti and KG Rajasekharappa.
3. Singer's Engineering Mechanics Statics and Dynamics by K.Vijaya Kumar Reddy and J Suresh Kumar (Third Edition SI Units-BS Publications.)

FY 2005 PROGRAMMING IN C

Lecture : 3 Hrs/week	Internal Assessment: 30	
Tutorial : 1 Hr/week	Final Examination: 70	
Practical : ---	Credits: 3	

Objectives: This course will give a solid grasp of the fundamental concepts of C programming, including some of the more challenging aspects of pointers, arrays, structures and defined types. This course also covers standard C libraries, as well as how to work with the GNU C compiler and debugger.

Learning Will learn following aspects of the C programming language

- Outcomes:**
- Implement variables.
 - List and describe common operators.
 - Implement conditional statements.
 - Implement looping constructs.
 - Implement procedures.
 - Handle errors.

UNIT – I

Constants, Variables and Data Types: Character Set, , Keywords and Identifiers, Constants, Variables, Data Types, Declaration of Variables, Assigning values to Variables, Declaring variable as a constant.

Operators and Expressions: Introduction, Arithmetic Operators, Relational Operators, Logical Operators, Increment and decrement operators, Conditional Operators, Bitwise Operators Special Operators. Precedence of Arithmetic Operators.

Managing Input and Output Operations: Introduction, reading a character, writing a character, formatted I/O.

UNIT – II

Decision Making and Branching: Introduction, Decision Making with IF statement. Simple IF Statement, the IF ELSE Statement, Nesting of IF ELSE Statement. The ELSE IF Ladder. The Switch Statement, the GOTO Statement, break and continue

Decision Making and Looping: Introduction, the WHILE statement, the DO Statement, the FOR statement, Jumps in Loops.

UNIT – III

Arrays: Introduction, One Dimensional Arrays, Declaration of one dimensional arrays, Initialization of one dimensional arrays, two-dimensional arrays, initializing two dimensional arrays, multi dimensional arrays.

Character Arrays and Strings: Introduction, Declaring and Initializing string variables. Reading strings from Terminal. Writing string to screen. Arithmetic operations on characters.

Putting strings together, Comparison of two strings, string handling functions.

User Defined functions: Introduction, user defined functions, storage classes, a multi function program, elements of user defined functions, definition of functions, return values and their types, function calls, function declaration, parameter passing techniques, recursion.

UNIT – IV

Structures and Unions: Introduction, defining a structure, declaring structure variables, accessing structure members, structure initialization, operations on individual members, Unions.

Pointers: Introduction, Understanding Pointers, accessing the address of the variable, declaring pointer variables, Initialization of pointer variables. Accessing a variable through its pointer.

File Management in C: Introduction, defining and opening a file, closing a file, Input/Output operations on files, pre processor directives and macros.

Learning Resources:**Text Book:**

1. Programming in ANSI C, E. Balagurusamy, 4 ed., TMH Publishers

Reference Books:

1. Programming with C (Schaum's Outlines) by Byron Gottfried, Tata Mcgraw-Hill.
2. The C programming language by Kernighan B W and Ritchie O M, Prentice Hall.
3. Programming with C by K R Venugopal & Sudeep R Prasad, TMH.

Electronic Materials, Websites

- www.cprogramming.com
- <http://en.wikiversity.org/wiki/Topic:C>
- <http://www.learn-c.com>

**FY 2006 PE
PROFESSIONAL ETHICS**

Lecture : 2Hrs/Week	Internal Assessment:	30
Tutorial : ---	Final Examination:	70
Practical : --	Credits:	2

Objectives: The study of the course provides an understanding of Morals, characterization.

Learning outcomes : Upon completing this course students should be able to know the morals, Human Values, Ethics, Safety, Responsibilities and Rights

UNIT – I

Engineering Ethics : Senses of 'Engineering Ethics' - variety of moral issued - 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 –II

Human Values :_Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation_ Commitment – Empathy – Self-Confidence – Character – Spirituality

UNIT –III

Engineering as Social Experimentation: Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study

Safety, Responsibilities and Rights: Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and chernobyl case studies.

Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

UNIT – IV

Global Issues: Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics (Specific to a particular Engineering Discipline).

Learning Resources:

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in engineering", McGraw Hill, New York 1996.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “ Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.

FY 2051C
ENGINEERING CHEMISTRY LABORATORY

Lecture : ---	Internal Assessment:	25
Tutorial : ---	Final Examination:	50
Practical : 3 Hrs/Week	Credits:	2

- Objectives:**
- To make students familiarize with the practical aspects of volumetric analysis of water samples and determine the parameters like alkalinity, chlorides and hardness.
 - To improve the knowledge of different types of titrations used in volumetric analysis
 - To make students develop in terms of practical skills required for analytical projects.
 - To imbibe the advantages of instrumental methods of chemical analysis
 - To make students observe practically the aspects of corrosion rate determination, preparation of plastics and process of electroplating.

Learning After performing the experiments listed in the syllabus, the students will be able to

- Outcomes:**
- Distinguish different types of titrations in the volumetric analysis
 - Assess the quality of water based on the analysis done by them.
 - Acquire practical knowledge related to the concepts like corrosion and its inhibition process, photochemical reactions, electroplating, etc.
 - Exhibit the skills in performing experiments based on the theoretical fundamentals available.

List of Experiments

1. Determination of total alkalinity of water sample
 - a) Standardisation of HCl solution
 - b) Determination of total alkalinity
2. Determination of chlorides in water sample
 - a) Standardisation of AgNO₃ solution
 - b) Determination of chlorides in the water sample
3. Determination of hardness of water sample
 - a) Standardization of EDTA solution
 - b) Determination of total hardness of water sample
4. Determination of available chlorine in bleaching powder
 - a) Standardisation of sodium thiosulphate
 - b) Determination of available chlorine
5. Estimation of Mohr's salt – Dichrometry
 - a) Standardization of K₂Cr₂O₇ solution
 - b) Estimation of Mohr's salt
6. Estimation of Mohr's salt – Permanganometry
 - a) Standardization of KMnO₄ solution
 - b) Estimation of Mohr's salt
7. Conductometric determination of a strong acid using a strong base
8. pH metric titration of a strong acid vs. a strong base
9. Determination of corrosion rate of mild steel in the absence and presence of an inhibitor
10. Electroplating of Nickel on iron article
11. Chemistry of Blue Printing

12. Colorimetric determination of potassium permanganate
13. Preparation of Phenol-Formaldehyde resin
14. Spectrophotometry

Learning Resources

- “Experiments in Applied Chemistry” by Sunitha Rattan, S.K.Kataria & Sons.
- “Laboratory Manual on Engineering Chemistry” by S.K.Bhasin and Sudha Rani, Dhanpak Rai publishing company, New Delhi

FY 2052
C-PROGRAMMING LABORATORY

Lecture : ---	Internal Assessment:	25
Tutorial : ---	Final Examination:	50
Practical : 3 Hrs/week	Credits:	2

Objectives: This course will give a solid grasp of the fundamental concepts of C programming, including some of the more challenging aspects of pointers, arrays, structures and defined types. This course also covers standard C libraries, as well as how to work with the GNU C compiler and debugger.

Learning

Outcomes: Will learn following aspects of the C programming language

- Implement variables.
- List and describe common operators.
- Implement conditional statements.
- Implement looping constructs.
- Implement procedures.
- Handle errors.

List of Lab Exercises

WEEK-I

- 1) Write a C-Program to perform the simple arithmetic operations.
- 2) Write a C-Program to calculate area and circumference of the triangle and rectangle.
- 3) Write a C-Program to swap the two numbers without using third variable.

WEEK-II

- 1) Write a C-Program to find the biggest of the given three numbers.
- 2) Write a C-Program to find the roots of the given quadratic equation.
- 3) Write a C-Program to implement the calculator application (using switch)

WEEK-III

- 1) Write a C-program to convert given Decimal number to Binary number.
- 2) Write a C-Program to check the given number is Palindrome or not.
- 3) Write a C-Program to check the given Armstrong or not.

WEEK-IV

- 1) Write a C-Program to find the sum first N natural numbers.

- 2) Write a C-Program to generate the Fibonacci series.

Ex: 0,1,1,2,3,5,8,13,21, n^i , n^{i+1} , $n^i + n^{i+1}$

- 3) Write a C-Program to print the prime numbers between 1 to N.

WEEK-V

- 1) Write a C-Program to find the biggest and smallest numbers in the given array.
- 2) Write a C-Program to find the sum, mean and standard deviation by using arrays.

WEEK-VI

- 1) Write a C-program to remove duplicate elements in the given array.
- 2) Write a C-program to insert an element at the specified location of the array.
- 3) Write a C-program to store the polynomial using arrays and differentiate it.

WEEK-VII

- 1) Write a C-Program to perform the Matrix addition, subtraction and multiplication using arrays.
- 2) Write a C-Program to print the transpose of the given Matrix without using the second matrix.

WEEK-VIII

- 1) Write a C-Program to find the given element is exist in the given list or not.
- 2) Write a C-Program to arrange the given elements in the ascending order.

WEEK-IX

- 1) Write a C-Program to check the given string is Palindrome or not.
- 2) Write a C-Program to perform the following operations with and without using String handling functions
 - i) Length of the string
 - ii) Concatenate the two strings
 - iii) Reverse the given string
 - iv) Compare the two strings

WEEK-X

- 1) Write a C-Program to swap the two number using call by value and call by reference.
- 2) Write a C-Program to find the factorial of the given number using recursion.
- 3) Write a Program to find NCR using functions.
- 4) Write a Program to find Mean and standard deviation of a given set of numbers.(Define functions for mean and standard deviation)

WEEK-XI

- 1) Write a 'C' program to read name of the student, roll number and marks obtained in subjects from keyboard and print name of the student, roll number, marks in 3 subjects, and total marks by using structures concept.
- 2) Write a C-program to count number of characters, spaces, words and lines in given file.
- 3) Write a 'C' Program to copy the contents of one file into another file.

**FY 2053W
BASIC WORKSHOP**

Lecture : --	Internal Assessment:	25
Tutorial : -	Final Examination:	50
Practical : 3 hrs/ Week	Credits:	2

Objectives: To provide the students with hands on experience on different trades of Engineering like Carpentry, Tin Smithy, Welding and House Wiring.

Learning To familiarize with

- Outcomes:**
1. The Basics of tools and equipment used in Carpentry, Tin Smithy, Welding and House Wiring.
 2. The production of simple models in the above four trades.

List of Experiments:

1. Carpentry

To make the following jobs with hand tools

- a) Lap joint
- b) Lap Tee joint
- c) Dove tail joint
- d) Mortise & Tenon joint
- e) Cross-Lap joint

2. Welding using electric arc welding process / gas welding.

The following joints to be welded.

- a) Lap joint
- b) Tee joint
- c) Edge joint
- d) Butt joint
- e) Corner joint

3. Sheet metal operations with hand tools.

- a) Saw edge
- b) wired edge
- c) lap seam
- d) grooved seam
- e) funnel

4. House wiring

- a) To connect one lamp with one switch
- b) To connect two lamps with one switch
- c) To connect a fluorescent tube
- d) Stair case wiring
- e) Go down wiring

Learning Resources:**Reference Books:**

1. Kannaiah P. & Narayana K. C., “Manual on Work Shop Practice”, Scitech Publications, Chennai.

ME 3001
ENGINEERING MATHEMATICS – III

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	4

Objectives: The main objective of this course is to introduce Laplace Transforms, Fourier Series, Fourier transforms and Numerical Methods.

Learning Outcomes: Upon completion of this course the student will be able to solve initial and boundary value problems easily using Fourier and Laplace transform technique, evaluate improper integrals, find the sum to infinite series and apply fourier series to solve wave equation, heat equation etc.,. With the advent of high speed digital computers and increasing demand for numerical answers to various problems, numerical techniques have become indispensable tool in the hands of engineers.

UNIT – I

LAPLACE TRANSFORMS: Definition and basic theory – Linearity property – condition for existence of Laplace transform. First & Second Shifting properties, Laplace Transform of derivatives and integrals; Unit step functions, Dirac delta-function. Differentiation and Integration of transforms, Convolution Theorem, Inversion. Periodic functions. Evaluation of integrals by Laplace Transform. Transforms of periodic function. Unit impulse function (Dirac delta function). Convolution and Duhamel formulae.

Applications to differential equations with constant coefficients, variable coefficients

UNIT – II

FOURIER SERIES: Introduction, Euler's Formulae, Conditions for a Fourier expansion, Functions having points of discontinuity, change of interval, odd and even functions, Expansions of odd and even periodic functions, Half - range series, Parseval's formula, complex form of Fourier series.

UNIT – III

FOURIER SERIES: Practical harmonic analysis.

FOURIER TRANSFORMS: Introduction, Definition, Fourier integrals, Fourier sine and cosine integrals - complex form of Fourier integrals. Fourier transforms, Fourier sine and cosine transforms - Finite Fourier sine and cosine transforms, Fourier transforms of the derivatives of a function.

UNIT – IV

NUMERICAL METHODS: Solution of Algebraic and Transcendental Equations : Introduction, Newton - Raphson method, Solution of simultaneous linear equations – Gauss Elimination Method - Gauss - Seidel iterative method.

NUMERICAL DIFFERENTIATION AND INTEGRATION : Finding first and second order differentials using Newton's formulae. Numerical solutions of ordinary and partial differential equations, Euler's method, Taylor's series method Picard's method. Runge - Kutta method of 4th order, Predictor and Corrector method, Milne's method, Adams - Bashforth method (for first order equations only). Boundary value problems, Solution of Laplace's and Poisson's equations by iteration.

Learning Resources:**Text books:**

- Higher Engineering Mathematics by B.S. Grewal , 40th edition – Khana Publishers, New Delhi for Unit –I, II, III
- Engineering Mathematics by N.P.Bali, Manish Goyal, 7th Edition – Laxmi Publications for Unit –I, II, III
- Introductory Methods of Numerical Analysis by S.S.Sastry for Unit –IV

Reference books:

- Advanced Engineering Mathematics by Erwin Kreyszig, 8th edition – Wiley Publishers
- Advanced Engineering Mathematics by Jain Iyengar, 3rd Edition – Narosa Publishers.
- A text book of Mathematics by B.V.Ramana, Tata MC GrawHill

ME 3002
MECHANICS OF MATERIALS

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	4

Objectives: This course provides the student an understanding of stresses and deflections in axial loading, torsion, shear and combined stresses.

Learning Outcomes: Students will be able to understand the concepts of stress and strain to deal with real time problems.

UNIT - I

TENSION, COMPRESSION AND SHEAR : Introduction, Normal Stress and Strain, Stress-Strain Diagrams, Elasticity and Plasticity, Linear Elasticity and Hooke's Law, Shear Stress and Strain, Allowable Stresses and Loads. Axially loaded members, Deflections of Axially loaded Members

STATICALLY INDETERMINATE STRUCTURES: Analysis, Temperature effects, Strain Energy of Axially Loaded Members subjected to static load.

UNIT - II

SHEAR FORCE AND BENDING MOMENT : Types of Beams, Shear Force and Bending Moment, Relationships between Load, Shear Force and Bending Moment, Shear Force and Bending Moment Diagrams.

STRESSES IN BEAMS: Introduction, Normal Strains in Beams, Normal Stresses in Beams, Shear Stresses in Rectangular Beams, Shear Stresses in Webs of Beams with flanges.

UNIT - III

TORSION : Introduction, Torsion of Circular Bars, Relationship between Moduli of Elasticity E and G, Transmission of power by circular shafts, Strain Energy in pure Shear and uniform Torsion for Statically determinate Members.

SHEAR CENTRE: Bending Axis and Shear Centre, Position of Shear Centre, Shear flow, Shear Centre of Channel section, Angle section, T- section and I – section.

UNIT - IV

ANALYSIS OF PLANE STRESS : Stresses on inclined Sections, Plane Stress, Principal Stresses and Maximum Shear Stress. Mohr's Circle for Plane Stress. Hooke's Law for Plane Stress.

BIAXIAL STRESSES: Thin Spherical and Cylindrical Pressure Vessels

Learning Resources:

Text Books:

- Mechanics of Materials by Gere and Timoshenko, C B S Publishers
- **Reference books:**
- Strength of Materials by Dr. Sadhu Singh, Khanna Publishers.
- Strength of Materials by R.K.Bansal, Laxmi Publishers.
- Strength of Materials by R.K. Rajput, S.Chand & Company.

- Strength of Materials by M.Chakraborti, S.K.Kataria & Sons.

Web References:

- http://www.engineersedge.com/strength_of_materials.html
- <http://www.tutorvista.com/bow/strength-of-materials-notes>
- <http://www.mypptsearch.com/search-ppt/strength+of+materials/>

ME 3003
KINEMATICS OF MACHINES

Lecture :	4 hrs/ Week	Internal Assessment:	30
Tutorial :	1 hr/ week	Final Examination:	70
Practical :	-	Credits:	4

Objectives: The study of kinematics is an applied field of mechanical engineering that is concerned with understanding the relationship between the geometry and the motions of the parts of a machine and the forces that produce the motion. The overall objective of this course is to learn how to analyze the motions of mechanisms, design mechanisms to have given motions. This includes relative motion analysis, design of gears, gear trains, cams and linkages, simultaneous graphical and analytical analysis of position, velocity and acceleration.

Learning Outcomes: Students will be able to understand the concepts of velocity and acceleration of simple mechanism, drawing the profile of cams and its analysis, gear train calculations.

UNIT – I

INTRODUCTION : Mechanisms and machines, Rigid and resistant bodies, Link, Kinematic pair, Degrees of Freedom, Classifications of Kinematic pairs, kinematic-chain, Linkage, Mechanism, and structure, Classification of mechanisms, Equivalent Mechanisms, Four - Link (bar) Mechanism, Inversions of Slider - Crank Chain, Double – Slider Chain. Instantaneous centre, Notation, Number of I - Centres, Kennedy's theorem, Locating I - Centres, Angular velocity by I - Centre Method.

UNIT - II

VELOCITY ANALYSIS: Introduction, Absolute and Relative Motion, Vectors, Addition and subtraction of Vectors, Motion of a Link, Four Link Mechanism, Angular Velocity of Links, Velocity of Rubbing, Slider - Crank Mechanism, Crank and Slotted Lever Mechanism.
ACCELERATION ANALYSIS : Acceleration, Four-Link Mechanism, Angular acceleration of Links, Acceleration of Intermediate and offset points, slider-Crank Mechanism, Coriolis acceleration component, Crank and slotted lever Mechanism.

UNIT – III

KINEMATIC SYNTHESIS: Stages of synthesis-Concepts of type, Number and dimensional synthesis - Tasks of dimensional synthesis, Concepts of function generation, Rigid body guidance and path generation, Freudenstein equation for function generation using three precision points.

CAMS: Introduction, Types of cams, Types of Followers, Definitions, Graphical synthesis of cam profile.(Knife Edge, Roller and Flat faced Followers).

UNIT - IV

GEARS : Introduction, Classification of gear terminology, Law of Gearing, Velocity of Sliding, Forms of Teeth, Cycloidal Profile Teeth, Involute Profile Teeth, Path of contact, Arc of contact, Number of pairs of Teeth in contact, Interference in Involute Gears, Minimum number of Teeth, Interference between Rack and Pinion, Undercutting, Comparison of Cycloidal and Involute tooth forms.

GEAR TRAINS: Introduction, simple Gear Train, Compound Gear Train, Reverted Gear train, Planetary or Epicyclic Gear Train, Analysis of Epicyclic Gear Train, Torques in Epicyclic Trains. Tabular and Algebraic Methods.

Learning Resources:

Text Books:

- Theory of Machines of by S.S.Rattan. TMH.
- Mechanism and Machine Theory by J.E. Shigley

Reference books:

- Theory of Mechanisms and Machines by C S Sharma and Kamlesh Purohit, Prentice Hall of India.
- Theory of Mechanisms and Machines by Ghosh and Mallik

Web references:

- http://nptel.iitg.ernet.in/Mech_Engg/IIT%20Delhi/Kinematics%20of%20Machines.htm
- <http://freevideolectures.com/Course/2359/Kinematics-of-Machines>
- <http://www.rapidmaniac.com/search/relevant/All/solution-manual-kinematics-and-dynamics-of-machines>

ME 3004 BASIC THERMODYNAMICS

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	4

Objectives: This course provides the basic knowledge about Thermodynamic laws and relations, their application to various processes.

Learning Outcomes: At the end of the course the student will be able to understand the Thermodynamic laws and their applications, know the concept of entropy and availability, know the thermodynamic relations, and understand the Performance of compressors

UNIT – I

FUNDAMENTAL CONCEPTS AND DEFINITIONS: Thermodynamic system and control volume, Macroscopic and microscopic points of view, properties and state of a substance, Thermodynamic equilibrium and Quasi-static Process, thermodynamic path, cycle, Zeroth law, concept of temperature, Perfect gases.

WORK AND HEAT: Definition of work, units, work done at the moving boundary of a system, work done in various non-flow processes, definition of heat, units, comparison of heat and work.

UNIT – II

FIRST LAW FOR NON-FLOW SYSTEMS: First law of thermodynamics for a system undergoing a cycle and for a change in state of system, internal energy and enthalpy, constant volume and constant pressure specific heats and their relation to internal energy and enthalpy of ideal gases.

FIRST LAW FOR FLOW SYSTEMS: Control mass and control volume, first law of thermodynamics for a control volume, steady state steady flow energy equation and application to engineering equipment.

UNIT – III

SECOND LAW OF THERMODYNAMICS: Heat engines and Refrigerators, Statements of Second law of Thermodynamics, Carnot cycle and the two propositions regarding the efficiency of Carnot cycle, Thermodynamic temperature scale, processes-reversible and irreversible, factors that render a process irreversible.

ENTROPY: Inequality of Clausius, Entropy change in reversible process, T.dS Relations, Entropy change of a system during an irreversible process, Principle of increase of entropy, Applications, Entropy change of an ideal gas, Availability, Maximum work.

UNIT – IV

PURE SUBSTANCE: Pure substance, vapor-liquid-solid phase equilibrium in a pure substance, Independent properties of a pure substance, Equations of state for vapor phase of a simple compressible substance, Tables of thermodynamic properties, thermodynamic surfaces.

VAPOR POWER CYCLES: Rankine cycle, Effect of pressure and temperature on the Rankine cycle, reheat cycle, regenerative cycle, Deviation of actual cycles from ideal cycles.

Learning Resources:**Text books:**

- Engineering Thermodynamics—P.K.NAG, MC Graw Hill Publications
- Engineering Thermodynamics—Cengel & Boles, MC Graw Hill Publications
- Thermal Engineering – Rajput, Lakshmi publications

Reference books:

- Fundamentals of Engineering Thermodynamics-Rathakrishnan-PHI
- Fundamentals of Classical Thermodynamics -- G.J.Van Wylen & Sonntag.
- Thermodynamics -- J.P.Holman.

Web references:

- <http://www.iscid.org/encyclopedia/Thermodynamics>.
- <http://www.transtutors.com/>

ME 3005
MANUFACTURING PROCESSES

Lecture : 3 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical :	Credits:	3

Objectives: This course provides the student the Concept of casting technology, Study of various ways of working of metals and Different types of welding techniques used for joining materials

Learning To make the students aware of different techniques in Metal casting and Metal

Outcomes: Forming. Acquiring knowledge and implementation of welding techniques

UNIT – I

METAL CASTING: Introduction, General method in making a Casting, pattern: types, materials and allowances. Moulding materials and equipment, Preparation, control and testing of moulding sands. Types of Cores, introduction to Gating system.

Cupola: Description, operation and zones.

UNIT – II

SPECIAL CASTING METHODS: Permanent Mould Casting, Die Casting: Hot chamber die casting, Cold chamber die casting, Air blown type die casting, Vacuum die casting. Centrifugal casting: True centrifugal casting, Semi-centrifugal casting. Investment casting, shell moulding, CO₂ process and continuous casting. Fettling of castings, casting defects: causes, remedies and testing.

UNIT – III

WELDING: Gas and arc welding, principles of oxy-acetylene welding, TIG, MIG, submerged arc welding. Resistance welding principles, Butt welding, Spot welding, Seam welding. Thermit Welding, Electroslag welding. Laserbeam welding. Brazing & Soldering, welding defects, causes and remedies

UNIT – IV

BULK FORMING PROCESSES: Introduction, Hot and Cold working of metals. Rolling, Forging, Extrusion, Tube making, and Wire drawing.

SHEET METAL WORKING OPERATIONS: Introduction, Sheet metal Blanking and Punching operations. Clearance and shear as applied to Punching/Blanking operations. simple related problems. Elastic recovery in bending operation.

Learning Resources:

Text books:

- Manufacturing Technology by PN Rao
- Principles of Metal Casting by Heine, Loper, Rosenthal.
- A course in Work shop technology Vol-I by V.S.Raghuwamshi, Dhanpat rai & sons.
- Mechanical Metallurgy by George. E. Dieter

Reference books:

- Welding Technology by Little
- Workshop Technology Vol.1 by S.K.Hazra Chowdary.

Web references:

- <http://nptel.iitm.ac.in>
- <http://www.egr.msu.edu>
- <http://www.engr.sjsu.edu>
- <http://mechatronic.me.hfu.edu.tw>
- <http://web.iitd.ac.in>

ME 3006
ENVIRONMENTAL SCIENCE

Lecture : 3Hrs/Week	Internal Assessment:	30
Tutorial : 1Hr/Week-	Final Examination:	70
Practical : --	Credits:	3

Objectives: Environmental science is an interdisciplinary academic field that integrates physical and biological sciences (including physics, chemistry, biology, soil science, geology, and geography) to the study of the environment, and the solution of environmental problems. Environmental science provides an integrated, quantitative, and interdisciplinary approach to the study of environmental systems

Learning outcomes : The focus of this course is to introduce students to thinking about environmental issues from an interdisciplinary perspective.

UNIT – I

Introduction:

Definition, Scope and Importance of Environmental Sciences

Present global issues

Natural resources management:

Forest resources – use and over exploitation, Mining and Dams their effects on Forest and Tribal people,

Water resources: Use and over utilization of surface and ground water, Floods, Droughts, Water logging and Salinity, Water conflicts.

Energy resources- Energy needs, renewable and Non renewable Energy sources, use of alternate Energy sources, Impact of Energy use on Environment;

UNIT – II

Ecosystems: Introduction, characteristic features, structure and functions of Ecosystem – Forest, Grass land, Desert, Aquatic.

Biodiversity and Conservation:

Value of Biodiversity- Consumptive and Productive use, Social, Ethical, aesthetic and option values, Bio-geographical classification of India- India as a mega diversity Habitat; Threats to Biodiversity- Hot spots, Habitat Loss, Poaching of Wildlife, loss of species, seeds, etc., In-situ and Ex-situ conservation of Biodiversity.

UNIT – III**Environmental Pollution**

Causes, effects and control measures of Air pollution, Indoor Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution,

Solid waste management Urban, Industrial, nuclear and e-waste management

UNIT – IV**Information technology and Environment**

Role of information technology in environmental sciences

Social issues and Environment

Effects of human activities on the Quality of Environment: Urbanization, Transportation, Industrialization, Green revolution; Water scarcity and Ground water depletion,

Population growth and Environment: Environmental Impact Assessment

Environmental Acts- Water (Prevention and control of pollution) act, air (prevention and control of pollution) act, Environmental Protection Act, Forest conservation act,

Learning Resources**Text Books:**

1. Anjaneyulu Y. Introduction to Environmental sciences, B S Publications PVT Ltd, Hyderabad
2. Anjireddy M Environmental science & Technology, BS Publications PVT Ltd, Hyderabad
3. Benny Joseph, 2005, Environmental Studies, The Tata McGraw- Hill publishing company limited, New Delhi.
4. Principles of Environmental Science. & Engg. P.Venu Gopala Rao, 2006, Prentice-Hall of India Pvt. Ltd., New Delhi.
5. Ecological and Environmental Studies – Santosh Kumar Garg, Rajeswari Garg (or) Rajani Garg, 2006, Khanna Publishers, New Delhi.
6. Essentials of Environmental Studies, Kurian Joseph & R Nagendran, Pearson Education publishers, 2005

Reference Books:

1. A.K Dee – Environmental Chemistry, New Age India Publications
2. Bharucha Erach- Biodiversity of India, Mapin Publishing Pvt.Ltd..

ME 3051
COMPUTER AIDED DRAFTING LAB

Lecture : -	Internal Assessment:	25
Tutorial : -	Final Examination:	50
Practical : 3 hrs/ Week	Credits:	2

Objectives: This laboratory course provides the basic knowledge to use the CAD software to produce different mechanical parts with 2D drafting

Learning After completion of this course the student is able to generate different views of an **Outcomes:** object using CAD software. Assembling and part drawing will also be analyzed detail.

Any Eight of the following

Part drawing (using CAD software)

1. Part drawing of Screw jack
2. Part drawing of stuffing box
3. Part drawing of Drill jig
4. Part drawing of Pipe vice
5. Part drawing of eccentric

Assembly drawing (using CAD software)

1. Assembly of Screw jack
2. Assembly of Stuffing box
3. Assembly of Drill jig
4. Assembly of Pipe vice
5. Assembly of eccentric

ME 3052
WORKSHOP PRACTICE

Lecture : -	Internal Assessment:	25
Tutorial : -	Final Examination:	50
Practical : 3 hrs/ Week	Credits:	2

Objectives: The workshop practice is fundamental to mechanical engineering. A mastery of these areas are essential for students to know the working of lathe machine tool, preparation of moulding sand and making of different shapes and sizes of mould cavities, and generating different shapes and sizes of the metal plates. Hence to help students learn, the lathe machine tool structure, concept of different methods to produce the products as per requirements.

Learning Outcomes: Implementation of techniques and methods for performing different lathe operations, fitting operations and producing castings of different shapes.

PATTERN MAKING: Solid – I no., Split – I no.

MOULDING: Stepped cone pulley, Hand wheel, Bush.

FITTING: T-Joint, Dovetail joint, Semi-Circular Joint, Hexagonal plate Jobs

TURNING: Plain, Step and Taper turning, Right-hand and Left-hand threads, and Knurling.

ME 4001
ENGINEERING MATHEMATICS – IV

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	4

Objectives: The main objective is to introduce Complex Analysis, Probability Densities, Sampling Distributions and Method of Least squares.

Learning Outcomes: Over the course of the semester the student can be able to treat two dimensional potential problems by the methods developed for analytic functions. Complex integration can help evaluating complicated complex and real integrals of practical interest. In solving the dirichlet problem of finding a potential with given boundary values we may often use conformal mapping. Student can be able to solve problems with situation refer to repeated trails and problems with situations involving an element of chance. Able to take appropriate decisions by application of probability distributions.

UNIT – I

COMPLEX ANALYSIS: Introduction, continuity, Cauchy-Riemann equations. Analytic functions, Harmonic functions, Orthogonal systems, Complex integration, Cauchy's integral theorem, Cauchy's integral formula

UNIT – II

Taylor's series, Laurent's series, Zeros and singularities. Residue theorem, calculation of residues, evaluation of real definite integrals (by applying the residue theorem).

Standard transformations : Translation - Magnification and Rotation – Inversion and reflection - Bilinear transformation.

UNIT – III

PROBABILITY DENSITIES: Continuous random variables – Normal distribution – Normal approximation to the binomial distribution – Other probability densities – Uniform distribution – Log – Normal distribution – Gamma distribution – Beta distribution – Weibull distribution – joint distributions – Discrete and continuous checking if the data are normal – Transforming observations to near normally.

UNIT – IV

SAMPLING DISTRIBUTIONS: Populations and samples – Sampling distribution of the mean (SD known) – Sampling distribution of the mean (SD unknown) – Sampling distribution of the variance.

Statistics: Method of Least Squares – correlation – Regression

Learning Resources:

Text books:

- Higher Engineering Mathematics by B.S. Grewal , 40th edition – Khana Publishers, New Delhi (Unit I and Unit II)
- Probability and statistics for Engineers by Richard A.Johnson – Prentice Hall of India (Unit III and Unit IV)

Reference books:

- Advanced Engineering Mathematics by Erwin Kreyszig, 8th edition – Wiley Publishers
- Advanced Engineering Mathematics by Jain Iyengar, 3rd Edition – Narosa Publishers
- A text book of Mathematics by B.V.Ramana, Tata Mc Graw Hill.
- Engineering Mathematics by N.P.Bali, Manish Goyal, 7th Edition – Laxmi Publications

ME 4002
ADVANCED MECHANICS OF MATERIALS

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	4

Objectives: This course provides the students an understanding of applied structures such as beams, pressure vessels, curved beams and columns for stresses and deflection.

Learning Outcomes: Students will be able to understand the concepts of stress, strain and deflection of beams, pressure vessels, columns and struts to deal with real time problems.

UNIT - I

DEFLECTIONS OF BEAMS : Introduction, Differential Equations of the Deflection Curve, Deflections by Integration of the Bending Moment Equation integration of the Shear Force and Load equations, Deflections by Moment Area Method and Macaulay's Method.

UNIT - II

STATICALLY INDETERMINATE BEAMS: Statically indeterminate Beams, Analysis by the differential equations of the Deflection curve, Moment Area Method.

CONTINUOUS BEAMS: Clapeyron's theorem of three moments, Beams with constant and varying moments of inertia.

UNIT – III

THICK PRESSURE VESSELS: Thick Cylinders: Lamé's theory, Radial Deflection, Compound Cylinder.

CURVED BEAMS: Stresses in Beams of small and large initial curvature, The Winkler-Bach theory, Stresses in Crane Hook and C-Clamp with Rectangular, Circular and Trapezoidal cross-sections.

UNIT - IV

CENTRIFUGAL STRESSES: Introduction, Rotating Ring, Rotating Disc, Rotating Disc of uniform strength.

COLUMNS : Buckling and Stability, Columns with Pinned ends, Columns with other support conditions, Limitations of Euler's Formula, Rankine's Formula, Columns with eccentric Axial Loads, Secant formula

Learning Resources:

Text Books:

- Mechanics of Materials by Gere and Timoshenko, C B S Publishers & Distributors.

Reference books:

- Strength of Materials by Dr. Sadhu Singh, Khanna Publishers.
- Strength of Materials by R.K.Bansal, Laxmi Publishers.
- Strength of Materials by R.K. Rajput, S.Chand & Company.
- Strength of Materials by M.Chakraborti, S.K.Kataria & Sons.

Web references:

- http://www.engineersedge.com/strength_of_materials.html
- <http://www.tutorvista.com/bow/strength-of-materials-notes>
- <http://www.mypptsearch.com/search-ppt/strength+of+materials/>

ME 4003
APPLIED THERMODYNAMICS

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	4

Objectives: The objective is to make the student understand the concepts and working of vapor power cycles, Main components of Steam Power plant, refrigeration and air conditioning systems.

Learning Outcomes: At the end of the course the student will be able to have clear idea about the properties of steam, the use of steam tables and applications, Knowledge of refrigeration and Air-Conditioning systems, psychometric properties, use of Mollier chart

UNIT – I

STEAM BOILERS: Function, classification, working of Cochran boiler and Babcock and Wilcox boiler, Mountings & Accessories.

STEAM NOZZLES: Types of nozzles, isentropic flow through nozzles, Effect of friction, Nozzle efficiency, Critical pressure ratio and maximum discharge, calculation of throat and exit areas using Mollier diagram.

UNIT - II

STEAM TURBINES: Types of steam turbines, Impulse turbines, pressure and velocity compounding, velocity diagrams, work output, power, blade efficiency and stage efficiency, Reaction turbines, velocity diagrams, degree of reaction, work output, power, blade efficiency and stage efficiency, Governing of turbines, Overall efficiency and reheat factor.

STEAM CONDENSERS: Jet and Surface condensers, condenser vacuum and vacuum efficiency, Condenser efficiency, Thermodynamic analysis, Air pumps, Capacity of air extraction pump.

UNIT – III

RECIPROCATING AIR COMPRESSORS: Classification, Operation, Effect of clearance volume, compression ratio, volumetric efficiency, indicated power, Single-stage and Multi-stage compressors, Effect of inter-cooling, optimum intermediate pressure in a two-stage compressor.

ROTARY COMPRESSORS: Introduction, Types and their applications, principles of working, static and total head values, Centrifugal compressor- velocity vector diagrams, pressure coefficient, pre whirl, Axial flow compressor - polytrophic efficiency, Surging, Choking and Stalling, Centrifugal compressor versus axial flow compressor.

UNIT - IV

REFRIGERATION: Need for Refrigeration, Definitions, Methods of refrigeration, Working of Refrigerator & Heat pump, Reversed Carnot and Bell - Coleman cycles, Refrigerating effect, COP, vapor compression refrigeration system, influence of various parameters on cycle performance, Vapor absorption refrigeration cycle.

PSYCHROMETRY AND AIR CONDITIONING: Introduction, psychrometric properties, Psychrometric relations, Psychrometric chart, psychrometric processes, Comfort conditions, Air conditioning systems.

Learning Resources:**Textbooks:**

- Engineering Thermodynamics-Cengel and Boles, MC Graw Hill publications
- Thermal Engineering ---Rajput, Lakshmi publications

Reference books:

- Treatise on Heat Engineering - V.P. Vasandani and D.S. Kumar.
- Refrigeration and Air Conditioning - C.P. Arora
- Refrigeration and Air Conditioning – S.C.Arora & Domakundwar
- Engineering Thermodynamics-Achuthan—PHI

Note: Use of Steam Tables and Refrigeration and Air-Conditioning Tables are permitted in Examinations.

Web references:

- [http://www.iscid.org/encyclopedia/Tthermodynamics.](http://www.iscid.org/encyclopedia/Tthermodynamics)
- <http://www.transtutors.com/>

ME 4004
FLUID MECHANICS

Lecture :	4 hrs/ Week	Internal Assessment:	30
Tutorial :	1 hr/ Week	Final Examination:	70
Practical :	-	Credits:	4

Objectives: To be familiar with all the basic concepts of fluids and fluid flow phenomenon, conservation equations and their applications to simple problems and basic boundary layer concepts.

Learning Outcomes: Students are familiarized with all fluid properties and flow patterns, conservation equations with its applications for both incompressible and compressible flows, boundary layer concepts.

UNIT – I

INTRODUCTION: Definition of fluid, properties of fluid – density, specific weight, specific gravity, viscosity, compressibility, surface tension, capillarity, Classification of fluids, vapor pressure.

FLUID STATICS: Pressure, variation of pressure in fluid, pressure head, Pascal’s law, measurement of pressure- simple and differential manometers, Total pressure and center of pressure on plane and curved surfaces, Buoyancy and Metacentric height.

UNIT – II

FLUID KINEMATICS: Description of fluid flow, Velocity and acceleration of fluid particle, type of fluid flow, Description of flow pattern, Rotation and irrotational flow, velocity potential, stream function, continuity equation in Cartesian coordinates.

FLUID DYNAMICS: Introduction, Control volume & control surface, Euler’s equation of motion along a stream line, Bernoulli’s equation and applications, Pitot tube, Venturimeter, orifice meter, coefficient of discharge.

UNIT – III

IMPULSE MOMENTUM EQUATION: Impulse momentum Principle, Equation and Applications-Force on pipe bend

FLOW THROUGH PIPES: Types, Reynolds experiment, laws of fluid friction, Darcy-Wiesbach equation, minor losses, hydraulic gradient, Total energy lines, pipes in series and parallel, transmission of power through a pipe, water hammer, flow through a circular pipe, Hagen-Poiseuille law.

UNIT – IV

BOUNDARY LAYER THEORY: Introduction, boundary layer thickness, displacement thickness, momentum thickness, energy thickness, boundary layer growth on a flat plate, separation of boundary layer, Method of controlling boundary layer.

FLOW OF COMPRESSIBLE FLUIDS: Equation of state, Gas laws, Equation of motion, Equation of Continuity and Equation of Energy, Propagation of elastic waves, Mach number, Mach cone, Shock waves, Stagnation point, flow of compressible fluid through Venturi meter, concept of lift and drag.

Learning Resources:**Text books:**

- Hydraulics and fluid mechanics - P.N. Modi & S.M.Seth, Standard Book House
- Fluid Mechanics and Hydraulic machines - R.K.Bansal, Laxmi Publications

Reference books:

- Fluid mechanics and fluid power engineering - D.S.Kumar, Laxmi Publications
- Fluid mechanics including Hydraulic machines - A.K.Jain,khanna Publishers
- Fluid Mechanics-K.L..Kumar,S.Chand

Web references:

- http://www.iscid.org/encyclopedia/Fluid_Mechanics.
- <http://www.efluids.com/>
- <http://fluid.power.net/>
- www.mastep.sjsu.edu/resources/engineer.htm

ME 4005
MATERIAL SCIENCE AND METALLURGY

Lecture :	4 hrs/ Week	Internal Assessment:	30
Tutorial :	-	Final Examination:	70
Practical :		Credits:	4

Objectives: This course provides students an understanding of basic structure and crystal arrangement of materials, the phase diagrams, advantages of heat treatment and the method of heat treatment processes, powder metallurgy processes, the need and application of composite materials.

Learning Outcomes: The purpose of this course is to develop comprehensive study of the rapidly changing technological scenario and the requisite expertise for appropriate selection of materials for specific engineering applications.

UNIT – I

PROPERTIES OF MATERIALS: Physical properties - Mechanical properties – Electrical properties, Magnetic Properties and Chemical properties.

CRYSTALLOGRAPHY: Classification of crystals – Bravi's lattices – Miller Indices – Packing factor in cubic systems – coordination number – crystal imperfections – crystal deformation – Slip and Twinning.

UNIT – II

PHASE DIAGRAMS: Binary phase diagrams – Phase rule – one component system, two component system, isomorphous, eutectic, eutectoid, peritectic and peritectoid systems, Fe-Fe₃C equilibrium diagram.

HEAT TREATMENT OF STEELS: TTT diagrams for eutectoid, hypo and hyper eutectoid steels.

UNIT – III

HEAT TREATMENT PROCESSES: Annealing, normalizing, hardening, tempering, austempering, martempering, flame Hardening, Induction Hardening & Chemical hardening techniques, hardenability concept and experimental determination.

STRENGTHENING MECHANISMS: Strain hardening, solid solution strengthening, grain refinement, dispersion strengthening.

UNIT – IV

POWDER METALLURGY: Powder metallurgy process, preparation of powders, characteristics of metal powders, mixing, compacting, sintering, Applications of Powder Metallurgy.

COMPOSITE MATERIALS:

Classification of composites, various methods of component manufacture of composites, particle reinforced materials, fiber reinforced composite materials, and metal matrix composites.

Learning Resources:**Text books:**

- Introduction to Physical Metallurgy - Avenner.
- Material Science and Engineering - R. K. Rajput
- Material Science and Metallurgy - Dr.V.D.Kodgirie.

Reference books:

- Material Science and Metallurgy - V. Raghavan

Web references:

- <http://nptel.iitm.ac.in/courses.php?branch=Mechanical>
- <http://nptel.iitm.ac.in/courses.php?branch=Metallurgy>
- http://en.wikipedia.org/wiki/Materials_science

ME 4006
BASIC ELECTRONICS ENGINEERING

Lecture :	3 hrs/ Week	Internal Assessment:	30
Tutorial :	-	Final Examination:	70
Practical :	-	Credits:	3

Objectives: To understand, Semiconductor Devices like Diode, BJT , FET & UJT Construction features and operation with characteristic plots, Applications, Amplifiers circuits Feedback concept and Oscillators, Operational amplifier and applications, Boolean Algebra Combinational and Sequential logic circuits

Learning Outcomes: Students will have familiar knowledge about the Semiconductor Devices, Diode, BJT Uni-polar devices viz. JFET, MOSFET, UJT construction and operations, Basic BJT & FET configuration, Oscillators , Opamp applications and Digital circuits

UNIT – I

Semiconductor Diodes: Semiconductor Diode, Diode Equivalent circuits, Zener diodes, Load line Analysis, Half-Wave rectification, Full-Wave rectification, Clippers and Clampers.

Bipolar Junction Transistor: Transistor construction, Transistor operation, Common base configuration, Common emitter configuration, Common collector configuration, Operating Point, Biasing circuits. Transistor as an amplifier.

UNIT –II

Unipolar Devices: Construction and characteristics of JFETs, Depletion type MOSFETs, Enhancement type MOSFETs, Fixed bias configuration, Self-bias configuration, Source Follower Circuit, Common Gate circuit, Unijunction Transistor.

UNIT – III

Feedback And Oscillator Circuits: Feedback concepts, Feedback topologies, Barkhausen Criteria, Phase-Shift Oscillator, Wien Bridge Oscillator, Hartley Oscillator, Colpitts Oscillator.

Operational amplifiers and Linear ICs: Differential amplifier, Introduction to Op amps, Inverting and Non inverting amplifier, Comparators, Instrumentation amplifier, Summing amplifier, Voltage follower

UNIT – IV

Digital Electronics: Decimal, Binary, Octal, Hexadecimal, Conversions, Codes – BCD, Excess – 3 code, Logic gates, Truth tables. Combinational logic circuits, Adders, Subtractors, Encoders, Decoders, Multiplexer and Demultiplexers. Flip Flops, SR, JK, T, D and Master slave JK flip Flop, Counters, Shift registers, Study of semi conductor memories.

Learning Resources:**Textbooks:**

- Bell A.D., Electronic Devices and Circuits, PHI.
- M.Morris mano, Digital Logic and Computer Design , PHI
- N.N. Bhargava, D.L. Kulshreshtha, S.C. Gupta, Basic Electronics and Linear Circuits
T.T.T.I. Chandigrah

Reference books:

- S.Salivahanan & Vallavaraj, 'Electronic Devices & Circuits', Tata McGraw Hill
Pubs..Milliman & Halkies, 'Integrated Electronics', Tata McGraw Hill Publications

ME 4051
SM & FM LABORATORY

Lecture : -	Internal Assessment:	25
Tutorial : -	Final Examination:	50
Practical : 3 hrs/ Week	Credits:	2

Objectives: The main objective of the course is to familiarize the students with the use of stress, strain measuring instruments and to enable the students to acquire knowledge of flow meters. The course will give the student an insight into working of various fluid machines and be able to compare performance of fluid machines under different working conditions.

Learning Outcomes: By the end of this course the students will be able to understand the procedures for conducting tensile, torsion tests on mild steel specimens and will be able to determine the Young's modulus using deflection test on beams and tensile test on rods, tension and compression test on springs, bricks, concrete, and impact tests on steel. The students will gain knowledge on working of centrifugal pumps, positive displacement pumps, hydraulic turbines centrifugal blowers and steam turbines and will be Able to compare performance of various machines at different operating points.

Any TEN experiments out of following

STRENGTH OF MATERIALS LAB:

1. Load vs Deflection - Determination of Young's modulus on cantilever beam and propped cantilever beam.
2. Load vs deflection on simply supported and overhanging beams. Determination of Young's modulus of the beam material
3. (a) Rockwell Hardness test - Determination of Hardness Number for different metal specimens such as mildsteel, cast iron, Brass, Aluminum (b) Brinnell's Hardness Test
4. Impact Test - (a) Charpy and (b) Izod: Determination of impact strength of mild steel and cast iron specimens
5. Torsion test - Determination of Modulus of Rigidity of the material.
6. Double shear Test - Determination of shear strength of mild steel / Torsteel specimens.
7. Tension Test on UTM - Determination of mechanical properties of mild steel and cast iron specimens.
8. Tests on helical spring - Determination of stiffness of Helical springs.

FLUID MECHANICS LAB:

1. Orifice / mouthpiece - Determination of coefficient of discharge
2. Venturimeter / Orifice meter - Determination of coefficient of discharge
3. Pipe friction - Determination of friction factor and size of roughness of a given pipe.
4. Single - stage centrifugal pump - To draw the operating characteristics of the pump and to determine the designed discharge and designed head from it.
5. Single - acting reciprocating pump - To draw the operating characteristic curves at constant speed and determination of efficiency.

6. Gear pump - To draw the operating characteristic curves and determination of overall efficiency
7. Pelton turbine - To draw the performance characteristic curves and determination of overall efficiency
8. Francis / Kaplan turbine - To draw the performance characteristic curves and determination of overall efficiency.
9. Wind tunnel a) Determination of pressure distribution on car/truck/ airfoil models - b)Lift and drag measurement - c) Pitot tube - Velocity distribution and calibration. d) Boundary - Layer profile.

ME 4052
COMMUNICATION SKILLS LAB

Lecture : -	Internal Assessment:	25
Tutorial : -	Final Examination:	50
Practical : 2 hrs/ Week	Credits:	1

Objectives: This course endeavors the learners to develop communicative competence in the light of the Global expectations, Functional aspects of spoken expression, phonetic standardization based on the sounds of English and their combinations , trains the learners to career-oriented communication, offers opportunity to develop Group dynamics and expose the learners academic and competitive examinations.

Learning Outcomes: At the end of the course students would be able to refurbish and fortify their linguistic abilities and develops familiarity with different linguistic patterns including forms of writing

I. ORAL COMMUNICATION:

(A) FLENCY VS ACCURACY

- (i) Constructing authentic sentences
- (ii) Contextual use of Rhetoric
- (iii) Audience Orientation
- (iv) Contextual Determination of Scope and extent of speech acts, including job interviews

(B) Pre-Programmed presentation vs Spontaneous delivery of expressions

- (i) Sentence Patterns(Technical & Semi Technical)
- (ii) Modes of Reference
- (iii) Process of Argumentation & Substantiation

(C) Discourse Analysis

- (i) Across the table discussion
- (ii) Interactive Presentation
- (iii) Modeling

PRACTICALS:

Brief & interludes, Group Discussion, MOCK Press, MOCK Interviews, Seminar Presentations.

II. WRITING COMMUNICATION

(A) LETTER WRITING

- (i) Letters of persuasion
- (ii) Letters of Direction
- (iii) Letters of Corporate Interaction
- (iv) Announcements

(B) ARTICLES

- (i) Types of Articles
- (ii) Means of Literature Search
- (iii) Administering Questionnaires
- (iv) Personal Interviews
- (v) Triangulation of Data & Composition
- (vi) Linguistic representation including punctuation
- (vii) Graphic Representation
- (viii) Syntactic Felicitators & Semantic signals.

PRACTICALS:

Compilation of

- (i) Letters & Announcement: Business Letters, Letters of enquiry, acceptance & refusal, job Applications.
- (ii) Articles: Technical, semi technical & popular articles

III. PREPARATIONS OF

- (i) Visual aids like Transparencies
- (ii) Electronic presentations using power point, flash etc

IV. PROJECT

Technical Paper/Report Writing

V. EVALUATION:

Presentation of Technical Paper & 15min. Duaration using OHP/LCD.

Learning Resources:

References:

- Better English Pronunciation JOD CONNOR 2001,CUP
- English Pronouncing Dictionary, Daniel Jones (EPD) 2001,CUP
- Strengthen your writing, VR Narayanan Swamy,2004,Orient Longman
- Text, Context, Pretext, Critical issues in Discourse Analysis,2004,Blackwell

ME 5001 HYDRAULIC MACHINES

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	4

Objectives: To be familiar with the momentum and angular momentum principles, Impact of jets, hydraulic turbines, centrifugal and reciprocating pumps and hydraulic systems.

Learning Outcomes: Students are familiarized with the practical applications of fluid with momentum and angular momentum principles and utilization of fluid power.

UNIT – I

INTRODUCTION, Classification of fluid machines, impulse action, linear impulse momentum and angular momentum principles.

IMPACT OF JETS: Introduction, Force exerted by a fluid jet on stationary and moving flat plate and curved vanes, flow over radial curved vanes.

UNIT – II

HYDRAULIC TURBINES: Elements of hydroelectric power plants, Heads and efficiencies of a turbine, Classification- Pelton, Francis and Kaplan turbines, working proportions of turbines.

PERFORMANCE OF TURBINES: Unit quantities, Specific speed, Comparison and selection of turbines, Numerical problems. Draft tube theory, Oil pressure Governing, Performance characteristics.

UNIT – III

CENTRIFUGAL PUMPS: Types, Working, Reciprocating vs. Centrifugal pump, Work done by impeller, Head of a pump, losses and efficiencies, Minimum starting speed, Specific speed, Multistage pumps, Pumps in parallel, Performance characteristic curves, limitation of suction lift, NPSH, Cavitation.

UNIT – IV

RECIPROCATING PUMPS: Introduction, main components, working, types work done by Reciprocating pump, coefficient of discharge, slip, percentage slip, negative slip.

HYDRAULIC SYSTEMS: Hydraulic-press, accumulator, lift, intensifier, crane and coupling.

PUMPING DEVICES: Hydraulic ram, Airlift pump, rotary pumps and jet pump

Learning Resources:

Text books:

- Hydraulics and Fluid Mechanics --P.N.Modi & S.M. Seth., Standard Book House
- Fluid Mechanics & Hydraulic Machines - by R.K.Bansal, Laxmi Publications

Reference books:

- Fluid Mechanics & Hydraulic Machines – by R.K.Rajput, S.Chand
- Fluid Mechanics & Fluid Power Engineering - by D.S.Kumar, Laxmi Publications

Web references:

- <http://www.efluids.com/>
- <http://fluid.power.net/>
- www.hydraulicspneumatics.com/
- www.waterenr.com/
- www.pumps.org/

ME 5002
DESIGN OF MACHINE ELEMENTS

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	4

Objectives: The course introduces the fundamental Knowledge about the design of some Machine elements. A mastery of these concepts is essential for a mechanical engineer to know the various stresses acting on a machine member and how the members are designed. Hence to help the students learn, the different phases and procedure for designing has been introduced. The student is introduced with the basic principles of design for some machine elements such as screw jack, riveted joints, welded joints, bolted joints etc.

Learning Outcomes: This course provides the knowledge about the basics and procedure for the design of machine elements and enables them to do simple design calculations and design some machine elements.

UNIT - I

BASICS: Phases of design, Types of designs, standardization in design, preferred numbers and significance.

DESIGN FOR STATIC STRENGTH: Simple Stresses - Combined stresses - Torsion and bending stresses - stress strain relation, various theories of failure - Factor of safety and its importance in design.

UNIT - II

DESIGN FOR FATIGUE STRENGTH: Stress concentration - Theoretical stress concentration factor - Fatigue stress concentrations factor, Design for fluctuating stresses, Fatigue strength and endurance limit, Goodman diagram, Soderberg line, Endurance limit - Approximate estimation.

POWER SCREWS: Types - Mechanics of power screws, efficiency, Design of Screw Jack.

UNIT - III

FASTENERS: Riveted joints, Design of joints under eccentric loading, Welded joints, eccentrically loaded welded joints.

UNIT - IV

Bolted joints, Design of joints under eccentric loading, cotter joint.

Learning Resources:

Text Books:

- Design of machine elements by Bhandari, Tata McGraw Hill book Co.
- Machine Design by P.C. Sharma & D.K. Agarwal.

Reference books:

- Design of Machine Elements by Sharma & Purohit ,PHI
- Machine Design by Robert L.Norton.
- Design of Machine Elements by Kannaiah.

DATA BOOKS TO BE ALLOWED IN EXAMINATION:

- Design data book, P.S.G. College of Technology, Coimbatore
- Design data book, Mahadevan & Balaveera Reddy - CBS Publishers.

Web resources:

- www.sgbau.ac.in
- www.niceindia.com
- www.onesmartclick.com
- www.indiastudychannel.com
- www.blockwise.com

ME 5003 MACHINE DYNAMICS

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	4

Objectives: To understand the force-motion relationship in components subjected to Forces, force-motion analysis of standard machines, effects of unbalances resulting from prescribed motions, effect of Dynamics of undesirable vibrations and principles in mechanisms used for governing of machines.

Learning Outcomes: Students will be able to understand the concepts of velocity and acceleration of mechanism, balancing of machine, gyroscope of airplanes, naval ships and automobiles, study on governors. Students will be able to understand the concepts of vibration to analyze the Single Degree, of Freedom Systems of different modes and to understand the case studies on the field of Vibration.

UNIT – I

BALANCING : Introduction, Static balancing, Dynamic balancing, Transferring of a Force from one plane to another, Balancing of Several Masses in Different planes, Balancing of Reciprocating Mass, Balancing of locomotives, Effects of partial balancing in locomotives.

UNIT - II

GOVERNORS: Introduction, Watt Governor, Porter Governor, Proell Governor, Hartnell Governor, Sensitiveness of a Governor, Hunting, Isochronism, Stability, Effort of a Governor, Power of a Governor.

GYROSCOPES: Angular Velocity, Angular Acceleration, Gyroscopic Torque, Gyroscopic Effect on Naval Ships, Stability of an Automobile, Stability of a Two Wheel vehicle.

UNIT – III

FREE VIBRATION: Introduction, Definitions, Types of vibrations, Basic features of vibrating systems, Degree of freedom, free longitudinal vibrations, displacement, velocity and acceleration, damped vibrations.

FORCED VIBRATION: Introduction, forced damped vibrations, magnification factor, vibration isolation and transmissibility, forcing due to unbalance, forcing due to support motion.

UNIT - IV

TRANSVERSE VIBRATION: Single concentrated load, uniformly loaded shaft, shaft carrying several loads, whirling of shafts

TORSIONAL VIBRATIONS: Free torsional vibration, multifilar system, single, two, three rotor systems, torsion ally equivalent shaft, free torsional vibration of geared system.

Learning Resources:

Text books:

- Theory of Machines by S.S.Rattan

- Theory of Machines by R.K.Bansal

Reference books:

- Theory of Machines by R.S. Khurmi & J. K. Gupta
- Mechanical vibrations by V.P.Singh

ME 5004
I.C. ENGINES & GAS TURBINES

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ Week	Final Examination:	70
Practical : -	Credits:	4

Objectives: To impart the knowledge of engine components, auxiliary systems and combustion aspects of SI and CI engines in addition to engine emissions. They will also be exposed to the latest developments in the field of IC engines like MPFI, use of alternate fuels etc.

Learning Outcomes: On completion of this course, the students are expected to understand the principle of operation, working and performance of IC engines and use of alternative fuels.

UNIT – I

GAS POWER CYCLES: Air standard Carnot cycle, Otto cycle, Diesel cycle, Dual Combustion cycle, Air standard efficiency and MEP.

I.C.ENGINES: Introduction, Basic engine nomenclature, Review and classification of I.C. Engines, working principles of S.I. and C.I. Engines (both 4 stroke and 2-stroke) - valve timing diagram - Differences between S.I. & C. I. and 2 stroke & 4 stroke engines. Concepts of Wankel, Stirling and Free Piston engines.

UNIT – II

FUEL SUPPLY SYSTEMS: S.I. Engines- Carburetion, injection system, chemically correct air-fuel ratio, Air-fuel mixture requirements, Simple float type carburetor,

C. I. Engines- Fuel supply and injection systems, Bosch fuel pump, air fuel requirements

TESTING OF I.C.ENGINES: Indicator diagram, evaluation of Indicated Power, Brake power, Fuel consumption, SFC, Mechanical & thermal efficiencies, mean effective pressure, air-fuel ratio, Heat balance, Engine performance curves, Variables affecting engine performance for both S.I. & C.I. Engines.

UNIT – III

COMBUSTION PROCESSES: S.I. Engines- Normal combustion, abnormal combustion, C.I. Engines- Ignition delay, combustion knock in C.I. engines, Knock rating of fuels- Octane number and Cetane number.

ALTERNATE FUELS: Liquid fuels – Alcohols - Methanol, Ethanol, Alcohols for SI and CI engines, Gaseous fuels – Hydrogen, Natural gas, CNG and LPG, other possible fuels.

UNIT – IV

GAS TURBINES: Closed and Open Brayton cycle gas turbines, analysis of closed cycle gas turbine, Compressor and turbine efficiencies, Gas turbine cycles with inter cooling, reheat and regeneration.

JET & ROCKET PROPULSION: Basic principles of Jet propulsion - specific thrust, propulsive efficiency and overall thermal efficiency of a jet engine; Concepts of Turbo shaft, Turbo Prop, Turbo Fan; Principles of Rocket propulsion, Types of rocket propulsion.

Learning Resources:**Text books:**

- I.C. Engines - V.Ganesan - T.M.H Publications New Delhi.
- Thermal Engineering- Rajput-Laxmi Publications, Delhi

Reference books:

- Fundamentals of I.C.Engines - P.W. Gill, J.H. Smith & Ziurys- IBH & Oxford pub.
- A Course in I.C. Engines - M.L. Mathur & R.P. Sharma - Dhanpat Rai & Sons – New Delhi.
- Treatise on heat Engineering - Vasandani & Kumar-Metropolitan Book Company, Delhi.
- A Course in Internal Combustion Engines – V.M. Domakundwar, Dhanapat Rai

Web resources:

- College Intranet resource: 152.152.1.100
- <http://autoclub.rso.siuc.edu/frange.html>
- <http://www.howstuffworks.com/engine1.htm>
- <http://inventors.about.com/library/inventors/blinternalcombustion.htm>
- <http://www.animatedengines.com/>

ME 5005
METAL CUTTING AND MACHINE TOOLS

Lecture : 3 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ Week	Final Examination:	70
Practical :	Credits:	3

Objectives: The study of machine tools & metal cutting is fundamental to mechanical engineering. A mastery of these areas are essential for students to know the working of different mechanisms of various machine tools for generating different shapes and sizes of the products.

Learning Outcomes: The learning outcomes includes understanding the objectives of the machine tools, constructional details and mechanisms involved in each and every machine tool. Concept of theory of metal cutting, force analysis with the help of merchants circle diagram. The concept of heat generation zones and tool temperature measuring methods. This course aimed also to identify the different types of cutting tool materials, cutting fluids and their properties.

UNIT – I

MACHINING PROCESSES AND MACHINE TOOLS: Introduction, Primary and Auxiliary Motions in Machine Tools, Parameters. Defining working motions of a Machine tool.

LATHE: Constructional details, specifications, classification of lathes.

LATHE MECHANISMS: Spindle speed Mechanisms in Belt driven and All Geared Head stock Apron and Half-nut mechanisms. Lathe accessories. Lathe operations including taper turning and thread cutting and related problems.

UNIT – II

DRILLING MACHINES: Types and specifications, spindle feed mechanism, drilling operations, drilling time.

SHAPING AND PLANING: Constructional details, types of shapers and planers, specifications, tool holding and work holding devices, Quick Return Mechanism and automatic feed mechanisms.

GRINDING MACHINES: General Principles, Wheel materials, Selection and specifications, Truing and Dressing of grinding wheels, types of grinding machines, Honing and Lapping operations.

UNIT – III

MILLING MACHINES: Working Principle, Size and Specification, Up and Down Milling, Types of milling machines, Description and working of Universal Milling machine, Milling operations, Milling cutters, Indexing methods and Indexing Head, related problems.

BROACHING: Introduction to broaching, broaches, broaching methods and Machines.

UNIT – IV

THEORY OF METAL CUTTING: Introduction, Basic elements of machining, Nomenclature of single point cutting tool, Tool Geometry, Mechanics of chip formation, Types of chips. Determination of shear angle and chip thickness ratio, stress and strain in the chip,

velocity relations, Merchant's theory of orthogonal cutting forces, related simple problems. Tool wear, Tool life and Tool life criteria

Heat Generation and cutting tool temperature and its measurement, cutting fluids-types and required characteristics.

CUTTING TOOL MATERIALS: Requirements of Tool materials and types.

Learning Resources:

Text books:

- Workshop Technology Vol.11 by Hazra Chowdary
- Production Engineering by P.C. Sharma, S.Chand & Co

Reference books:

- Materials and Processes in Manufacturing by E.Paul De Garmo, J.T.Black and Ronald A.Kohser.
- Machine Tool Design and Numerical Control by N.K.Mehta.
- Manufacturing Science by Ghosh & Mallick

Web resources:

- www.hgfarley.com
- www.kennametal.com/ - United States
- www.mini-lathe.com/links.htm machinedesign.com/.../designer-s-guide-to-metalcutting-machinery-0608 –
- www.metalwebnews.com/wc.html
- www.britannica.com/EBchecked/topic/463000/planer
- www.americanmachinist.com
- www.machinetools.net.tw/parts/taiwan_voltage_regulator.htm

ME 5006 ELECTRICAL TECHNOLOGY

Lecture : 3 hrs/ Week	Internal Assessment:	30
Tutorial : -	Final Examination:	70
Practical : -	Credits:	3

Objectives: The aim of this course is to introduce the basic concepts of AC & DC circuits, use of three-phase system, the working principle, construction, applications of DC & AC machines and Transformers, fundamentals of electric measuring instruments. Utilize electrical energy for applications like heating and electric traction.

Learning Outcomes: To understand the basic electrical concepts like voltage, current, power and energy, Basic AC concepts, working principles of DC Machines. On the completion of this course work student is expected to understand basic electrical concepts like voltage, current and power. The student gains theoretical knowledge to work with AC & DC machines, transformers and measuring instruments.

UNIT – I

DC and AC circuits: Kirchoff's laws, simple circuits – Alternating current – Waveforms – RMS – Average values – simple R-L-C circuits, power factor, 3-phase balanced circuits.

D.C. Machines: Constructional features – Methods of excitation – Load characteristics of shunt, series and compound generators – Torque development in motor – Torque equation

UNIT –II

Load characteristics of shunt series and compound motors – losses and efficiency of motors and generators – principle of starters – 3 point starter only.

Transformers: E.M.F. equation – equivalent circuit – regulation – losses and efficiency – open and short circuit tests.

UNIT – III

Induction Machines: Constructional features – principle of operation – concept of rotating magnetic field, torque-slip characteristics – Principle of starters, Fundamentals of single-phase induction motors and their starting.

Synchronous machines: Principle – constructional features – E.M.F. equation – Applications of synchronous motors.

UNIT – IV

Measuring Instruments: Principle of operation of moving-coil and moving-iron instruments – Dynamometer –type watt meter.

Utilization: Principles of resistance and induction heating – principles of electrical traction – speed time characteristics.

Learning Resources:

Textbooks:

- Basic Electrical Engineering by VN Mittle and Arvind Mittal, TMH,2e
- Utilization of electrical energy by Openshaw and Taylor.

Reference Books:

- Electrical Technology by H. Cotton(Sir Issac Pittman & Sons Ltd., London).
- Electrical Technology by B. Hughes (ELBS)

Web resources:

- IIT, NPTEL video lessons
- MIT video lessons

ME 5051
MODELLING & SIMULATION LAB

Lecture : -	Internal Assessment:	25
Tutorial : -	Final Examination:	50
Practical : 3 hrs/ Week	Credits:	2

Objectives: This laboratory provides to understand the development of numerical methods, differential equations using C-language. And also provides the knowledge to develop the models of mechanical parts using modelling software.

Learning Outcomes: Student is able to generate the software programs using C-language. And also generate the mechanical models using modelling software, which will useful for project wok.

COMPUTER APPLICATIONS:(using C-language) [ANY Five]

1. Numerical Methods
2. Differential Equation solution
3. Two dimensional stress analysis
4. Cylinder subjected to internal pressure.
5. 1 D Heat Transfer (conduction)
6. 2 D Heat Transfer (conduction)
7. O.R. applications like L.P., Queing Theory, CPM, PERT etc..

Develop the 3D models using modeling software Pro-E / CATIA

Modeling of Mechanical elements:

- 1) Part modeling of “Stuffing Box”
- 2) Part modeling of “Screw Jack”
- 3) Part modeling of “Eccentric”

Assembling of Mechanical elements:

- 1) Assembly of “Stuffing box”
- 2) Assembly of “Screw jack”
- 3) Assembly of “Eccentric”

ME 5052
ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

Lecture : -	Internal Assessment:	25
Tutorial : -	Final Examination:	50
Practical : 3 hrs/ Week	Credits:	2

Objectives: This laboratory course will give a thorough knowledge about the basics of circuit analysis, DC machines and transformers and characteristics of basic electronic devices.

Learning Outcomes: At the end of course work the student gains knowledge of characteristics of DC machines and electronic devices to work with basic electrical and Electronic circuits

List of Experiments

ELECTRICAL LAB:

1. Verification of superposition theorem
2. Parameters of choke coil
3. Measurement of low and medium resistance
4. Speed control of DC shunt motor
5. Brake test on shunt motor
6. OCC of separately excited shunt generator
7. O.C and S.C test on a 1-phase transformer
8. Load test on 1-phase transformer.

Note: Any 5 experiments must be completed from above experiments.

ELECTRONICS LAB:

- 1 V/I Characteristics of Junction diode.
- 2 V/I Characteristics of Zener diode.
- 3 Half wave Rectifier and Fullwave rectifier.
- 4 OR AMP Applications
- 5 Common Emitter configuration
- 6 Characteristics of FET.
- 7 Characteristics of U J T
- 8 Transistor Biasing
- 9 RC coupled amplifier
- 10 Simple programs in Microprocessor
- 11 Verification of Flip – Flops. (JK, TD etc.)
- 12 Verification of combinational circuits (Half Adder, Full Adder, Half subtractor, Full subtractor)

NOTE: (Any Five Experiments)

REFERENCE: Laboratory Manual

ME 6001 ENGINEERING ECONOMICS & MANAGEMENT

Lecture : 3 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	3

Objectives: This course introduces different types of business organizations and the various scientific principles used in different departments like Personnel department, Financial Department and Marketing Department. The student should also be able to understand basic economic principles and strategies.

Learning Outcomes: The student will be ready to apply the different scientific methods used in various departments of any organization like Finance, marketing and Personnel departments. He will also be aware of the basic economic concepts.

UNIT – I

General management: Principles of scientific management, Henri Fayol's principles of management. Brief treatment of managerial functions: planning, organizing, staffing, directing, coordinating and controlling etc.

Forms of Business Organization: Salient features of sole proprietorship, partnership, Joint Stock Company: private limited and public limited companies.

Personnel management: The personnel function, functions of a personnel management, Job Evaluation – Methods

UNIT – II

Managerial Economics: Introduction, Basic Economic concepts, Supply and Demand Law of Diminishing Utility, Marginal Utility and Total Utility, Law of Equimarginal utility, Demand Analysis , Demand Schedule and Demand Curve , Factors influencing Demand, Shift in Demand, Demand Function, Supply Schedule and Supply Curve, Factors influencing Supply, Equilibrium of Supply and Demand, Elasticity of Demand, Elastic and Inelastic Demand
Production Aspect: Production function , Factors of production, Isoquants (Equal Product Curves), Least cost combination of inputs for a given output, Cost output relationship (Theory of Cost). Relationship between ATC and MC, Relationship between AC and MC. Theory of Firm, Profit maximization under perfect competition and under monopoly, Returns to scale

UNIT – III

Work study: Introduction, Management techniques to reduce work content and ineffective time.

Method Study: Procedure, Tools for recording information: charts and diagrams, use of fundamental hand motions (Therbligs), principles of motion economy, SIMO chart, cycle graph and chrono cycle graph.

Work Measurement: Objectives and techniques, time study methods and rating systems. Allowances: Standard time.

UNIT – IV

Marketing Management: Concept of selling and marketing – differences, functions of marketing, market research, advertising and sales promotion, break-even analysis, distribution channels – types, product life cycle.

Financial Management: Functions of financial management, simple and compound interest,

Methods of evaluating alternatives- Present Worth method. Future worth Method, Annual equivalent method. Depreciation, common methods of depreciation: straight line method, declining balance method, sum of year's digits method

Learning Resources:

Textbooks:

- Introduction to work study- ILO
- Industrial& business management-Marthand & Telsang

Reference books:

- Personnel Management- Tripathi and Reddy
- Engineering economy- Theusen & Theusen

Web references:

- www.tectime.com
- www.exinfm.com
- www.slideshare.net
- www.economywatch.com

ME 6002
DESIGN OF TRANSMISSION ELEMENTS

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	4

Objectives: The course introduces the fundamental Knowledge about the design of some transmission elements. A mastery of these concepts is essential for a student to analyse the behaviour of the transmission elements like shafts, belt drives, chain drives, different types of gears, etc.

Learning Outcomes: This course provides the knowledge about the basics and procedure for the design of transmission elements and enables them to do simple design calculations and design some elements.

UNIT - I

SHAFTS: Design of solid and hollow shafts for strength – For Bending, Torsion, Combined bending and torsion and combined bending, torsion and axial loads

KEYS: Introduction, Design of square and flat keys

SHAFT COUPLINGS: Rigid couplings – Muff, split muff and flange couplings, Flexible coupling-Modified Flange coupling

UNIT - II

BEARINGS AND LUBRICATION: Lubrication, Types of lubrications, types of lubricants, properties of lubricants, types of Bearings, Bearing materials, Journal bearing design (using Mckee's equation and Raymond and Boyd charts & tables)

Ball and Roller Bearings: Static load, Dynamic load, Equivalent radial load, selection of ball and roller bearings

UNIT – III

BELT DRIVES: Flat and V-belts, Belt constructions, Geometrical relationships, Analysis of belt tensions, condition for maximum power, Selection of V-belts – Selection of Pulleys.

CHAIN DRIVES: Introduction, Chain drives, Advantages of chain drives over belt drives, Polygonal effect, Selection of roller chains

UNIT - IV

SPUR GEARS : Classification of gears, Terminology of spur gear, standard systems of Gear Tooth, Force analysis, Gear tooth failures, Selection of material, Beam Strength of gear teeth, lubrication, Lewis Equation.

HELICAL GEARS: Terminology of helical gears, virtual number of teeth, Tooth proportions, force analysis, Beam Strength of helical gears, effective load on gear tooth, wear strength of helical gears. Lewis Equation.

BEVEL GEARS: Terminology, force analysis, Beam Strength of bevel gears, wear strength. Lewis Equation.

WORM GEARS: Terminology, Force analysis, Strength rating of worm gears, Wear rating of worm gears.

Learning Resources:**Text Books:**

- Design of machine elements by Bhandari, Tata McGraw Hill book Co.(2007]
- Machine Design by P.C. Sharma & D.K. Agarwal.

Reference books:

- Design of Machine Elements by Sharma & Purohit ,PHI
- Machine Design by Robert L.Norton.
- Design of Machine Elements by Kannaiah.

HAND BOOKS TO BE ALLOWED IN EXTERNAL EXAMINATION:

- Design data book, P.S.G. College of Tech, Coimbatore
- Design data book, Mahadevan & Balaveera Reddy - CBS Pub.

Web references:

- www.sgbau.ac.in
- www.niceindia.com
- www.onesmartclick.com
- www.indiastudychannel.com
- www.blockwise.com

ME 6003
ADVANCED MANUFACTURING. PROCESSES

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : -	Final Examination:	70
Practical : -	Credits:	4

Objectives: This course provides knowledge of different non- traditional machining techniques and their latest developments.

Learning Outcomes: After the completion of this course, the students will be familiar with the basics of gear manufacturing and finishing processes, non- traditional machining techniques, factors influencing their processes, applications, examples of components, machined with these techniques, merits and demerits of them, Design of Jigs and Fixtures and Processing methods of plastics.

UNIT – I

Gear Manufacturing

Gear materials, Types of gear manufacturing, gear generation and forming processes, Principles, Advantages and limitations of gear milling, Gear broaching, Gear shaping, Gear hobbing, Types of Gear hobbing.

Gear Finishing Methods: Gear burnishing, shaving, honing, lapping and grinding

Thread Manufacturing:

Thread chasing, Thread milling, rolling, grinding, tapping and thread cutting on lathe.

UNIT - II

Broaching:

Definition, advantages and disadvantages of broaching processes, nomenclature of broach, design of broach, types of broaches and broaching machines.

Modern Machining Processes:

Introduction, need, selection, Principles of operation, equipment, merits, demerits and applications of A J M, U S M, C H M.

UNIT – III

Introduction, need, selection, Principles of operation, equipment, merits, demerits and applications of ECM, ECG, EDM, LBM, PAM and EBM

UNIT - IV

Jigs and Fixtures:

Introduction, design considerations of jigs and fixtures, principles of location, locating devices, principles of clamping, clamping devices, types of drilling jigs, jig bushes, milling fixtures.

Processing of Plastics:

Blow moulding, Compression moulding and Injection moulding.

Learning Resources:

Text Books:

- P. C. Sharma, “Production Technology”
- P. N. Joshi, “Jigs and Fixtures”

- P. C. Pandey & H. S. Shan, “Modern Machining Processes”, Mc Graw Hill Publishing Co. Ltd., New Delhi.

Reference Books:

- Donaldson, “Tool Engineering”
- Kempster, “An Introduction to Jig and Tool Design”
- H M T “Production Technology”
- Amitabha Ghosh & A. K. Mallik, “Manufacturing Science”, Affiliated East West Press Pvt. Ltd., New Delhi.

Web references:

- www.srmuniv.ac.in
- www.jntu.ac.in
- www.iitm.ac.in

Other learning material such as computer based programs / CD, Professional standards / regulations

MIT Video lessons

IIT, NPTEL video lessons.

ME 6004 HEAT TRANSFER

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	4

Objectives: To make the student understand the basic concepts of Conduction (plane & composites, electrical analogy, fins), Convection (natural and forced convection, dimensionless quantities, and heat transfer coefficients), Radiation heat transfer laws, radiation heat exchange analysis. And also to highlight the applications of heat transfer in Heat exchangers, insulations etc

Learning Outcomes: At the end of the course, the students are made capable of calculating heat transfer and temp. distribution of composite structures, automobile radiator, optimum dimensions etc., Also calculating duration of heat treatment process, thermocouple design etc., They can optimize heat exchanger designs and capable of analyzing radiation heat exchange between bodies.

UNIT – I

INTRODUCTION: Basic Modes and laws of Heat transfer, thermal conductivity, Steady state Heat Conduction, General conduction equation in Cartesian, Cylindrical and Spherical coordinates, initial and boundary conditions.

ONE- DIMENSIONAL HEAT CONDUCTION: Heat flow through plane wall , cylinder and sphere with constant thermal conductivity , Heat flow through composite slab and Cylinders, Thermal resistance, Electrical analogy, Thermal contact resistance, critical insulation thickness, Heat source systems- Simple systems with uniform heat generation in slabs and cylinders.

EXTENDED SURFACES: Types, Applications, Fin materials, Heat transfer from fins with uniform cross section, Fin efficiency and Effectiveness.

UNIT – II

TRANSIENT HEAT CONDUCTION: One dimensional lumped heat capacity systems.

FORCED CONVECTION: Introduction, Principles of convection, Conservation of Mass and Momentum, Differential equation of continuity, Energy equation, Hydrodynamic and thermal boundary layers, concept of turbulence, Flow over bodies, Drag coefficient, Heat transfer coefficient, Empirical and semi empirical relations for heat transfer in Laminar and Turbulent flows over a flat plate, Relation between fluid friction and heat transfer in laminar & turbulent flow – Reynolds-Colburn Analogy, Laminar flow heat transfer in a pipe, Turbulent flow heat transfer in a pipe- Empirical relations.

Phase Change: Introduction – Film wise & Drop wise Condensation, Boiling Curve.

UNIT – III

NATURAL CONVECTION: Approximate analysis for laminar film on a vertical plate, Correlations for vertical plates, horizontal plates, vertical and horizontal cylinders, inclined surfaces.

HEAT EXCHANGERS: Classification and type of heat exchangers, Flow arrangement, Temperature distribution, Overall heat transfer coefficient, Fouling factor, LMTD method of Heat exchanger analysis, correction for LMTD for use with multi pass and cross flow Heat Exchanger, Effectiveness - NTU method for Heat Exchanger analysis.

UNIT – IV

RADIATION: Fundamentals of Radiation: Basic Concepts and definitions, Absorptivity, Reflectivity, Transmissivity, concept of Black body, Laws of Radiation, Kirchhoff's law, Planck's & Wein's law, Stefan Boltzman's law.

RADIANT HEAT TRANSFER: Heat Exchange by radiation between two finite parallel surfaces, Electrical analogy, solid angle and Radiation intensity, Heat exchange by radiation between two finite black and gray surfaces, shape factor, Radiation shields.

Learning Resources:**Text books:**

- Heat and Mass Transfer - Sachdeva
- Heat transfer - J.P.Holman
- Heat Transfer—D.S. Kumar

Reference books:

- Heat Transfer- A Basic Approach-- N.Ozisik
- Heat transfer - S.P.Sukhatme
- Introduction to Heat Transfer - Incropera and Dewitt

Web references:

- IIT video lecturers (NPTEL)
- <http://www.wisc-online.com/Objects/ViewObject.aspx?ID=SCE304>
- <http://web.cecs.pdx.edu/~gerry/heatAnimations/sphereTransient/#TOC>
- <http://rpaulsingh.com/animated%20figures/animationlisttopic.htm>
- <http://www.slideshare.net/meenng/transfer-of-heat>
- http://www.phy.cuhk.edu.hk/contextual/heat/hea/heatp01_e.html

NOTE: Heat and Mass Transfer Data Book by Kothandaraman and Subramanian to be allowed in the Examinations

ME 6005
ENGINEERING METROLOGY & MEASUREMENTS

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : -	Final Examination:	70
Practical :	Credits:	4

Objectives: The main objective of this course is to get acquainted with different concepts like Tolerances, gauges, comparators and surface roughness. This course also brings the procedures for measurement of strain and temperature.

Learning Outcomes: After completion of this course student can understand the gauges, tolerances, comparators and methods of measuring surface roughness. Student can also more conversant with the measurement of strain and temperature.

UNIT – I

METROLOGY: Introduction, Elements of engineering measurements, standards of length; end and line standards. Slip gauges, angle gauges, sine bars, spirit levels. bore gauges, straight edges

UNIT – II

LIMITS, FITS AND GAUGES: Theory of limits, Fits, Tolerances and their selection, Hole Basis and shaft basis system, IS system of limits & fits, Simple problems. Interchangeability, Selective Assembly, Limit gauges, Taylor's Principle of limit gauging, plug gauges, Ring gauges and their applications.

UNIT – III

COMPARATORS: Mechanical comparators- Read comparator, Sigma comparator, Solex pneumatic gauge, electrical & electronic comparator, projectors, Tool Maker's Microscope, Auto collimator, angle dekkor

MEASUREMENT OF SURFACE FINISH: Surface texture, roughness, waviness, Indian standard terminology, Various methods of measuring surface finish, Tomilson surface meter and Taylor Hobson Talysurf.

UNIT – IV

STRAIN MEASUREMENT: Introduction, electrical resistance strain gauges principle, method of fixing and bridge circuit for measuring strain gauges, gauge factor, Temperature compensation of strain gauge, application

TEMPERATURE MEASUREMENT: Liquid in glass thermometer, Bimetallic strip thermometer, Thermo couple, Thermistry

Learning Resources:

Text books:

- Metrology - R.K.Jain
- Mechanical Measurements & Control by D. S. Kumar

Reference Books:

- Engg.Metrology – D.M.Antony
- A text book of Engg.Metrology – I.C.Gupta.
- Hand Book of Industrial Metrology – ASTM.
- Mechanical Measurements by T.G.Beckwith & N.L.Buck

Web references:

- <http://www.metrologymetro.com>
- <http://www.emtoolbox.nist.gov/>.
- <http://en.wikipedia.org/wiki/Metrology#Basics>

ME 6051
FUELS & I.C ENGINES LAB

Lecture : -	Internal Assessment:	25
Tutorial : -	Final Examination:	50
Practical : 3 hrs/ Week	Credits:	2

Objectives: To provide practical approach of determining thermo-physical properties of some substances, which are essential in smooth working of mechanisms and machines. And also. Presenting Engine constructional and working details to evaluate the performance of automobile engines.

Learning Outcomes: At the end of the course the student can experimentally determine viscosity, calorific value, carbon residue of substances. Student will be able to conduct performance tests on both petrol and diesel engines.

Any Eight of the following

Fuels and models lab:

1. Redwood Viscometer I & II
2. Dead weight pressure gauge tester
3. Junker's gas calorimeter
4. Abel's Flash and Fire point tester
5. Canradson Carbon Residue Tester
6. Bomb Calorimeter
7. Two Stroke Petrol Engine (PTD)
8. Multi Cylinder Petrol Engine (VTD)

I.C. Engines lab:

1. Single Cylinder 4-Stroke Diesel Engine
2. Twin Cylinder 4-Stroke Diesel Engine
3. Two Stroke Petrol Engine
4. Reciprocating Air Compressor
5. Blower Test Rig

**ME 6052
MACHINE TOOL LAB**

Lecture : -	Internal Assessment:	25
Tutorial : -	Final Examination:	50
Practical : 3 hrs/ Week	Credits:	2

Objectives: Understanding the various operations which are being performed on a Lathe. The use of multi point cutting tools on Milling. Understanding the planar and curved surface generation on different Machine Tools in the Machine Shop. Understanding the surface finish obtained on various machines while working with different types of cutting tools.

Learning Outcomes: After successful completion of this course, the student will be able to know the use and setting of various machine tools like Lathe, Shaper, Slotting Machine, Milling, Grinding Machines.

TURNING

Multi-start threading, Drilling, Boring and Internal threading

Measurement of cutting forces using Dynamometer

DRILLING & TAPPING:

Drilling and Tapping of Different threads on drilling machine

MILLING

Key-way, Spur and Helical Gear Milling

SHAPING:

At least three models involving production of flat surface, Stepped surface, Cutting dovetail and rectangular grooves.

PLANING AND SLOTTING

Working on Planing and Slotting Machines

GRINDING

At least one model on surface grinder, cylindrical grinder or tool and cutter grinder.

ME 6053
COMPUTATIONAL METHODS LAB

Lecture : -	Internal Assessment:	25
Tutorial : -	Final Examination:	50
Practical : 3 hrs/ Week	Credits:	2

Objectives: To provide the knowledge about MATLAB. software & solving the numerical equations, Matrix calculations using MATLAB software

Learning Outcomes: After successful completion of this course, the student will be able to know the usage of MATLAB software, which will be useful for different core subjects like Design, FEA, operation research etc.

1. Introduction to MATLAB. Software.
2. Basics of MATLAB.

Programming using Matlab software:

1. Find roots of the following equations
 - a) Polynomial equation
 - b) Real roots of any equation
2. Find solution for linear equations
 - a) Gaussian elimination method
 - b) Matrix inverse method
 - c) Direct command method
3. Differentiate the following equations^s
 - a) Polynomial $a_n x^n + a_{n-1} x^{n-1} \dots \dots \dots a_0 x^0$
 - b) Transcendental $f(x) = \sin x + \cos x$
4. Symbolic Integration
5. Laplace & Inverse Laplace transforms
6. Ordinary differential equation using Runge-Kutta method
7. Ordinary differential equation with Laplace transformation
8. Simplify the complex number Z, and express in both rectangular & Polar form

**ME 6054
TERM PAPER**

Lecture : -	Internal Assessment:	25
Tutorial : 1 hr/ Week	Final Examination:	50
Practical : -	Credits:	1

Objectives: To inculcate the habit of independent learning among students. The course includes identification of a technical topic beyond curriculum, collection of existing literature and report preparation.

Learning Outcomes: Students will be able to familiarize with new technical topics and participate in technical seminars and paper contests.

Distribution of Marks:

Internal Evaluation : 25

Attendance	:	5
Report	:	10
Seminar & Viva	:	10

Semester end Evaluation: 50

Report	:	40
Seminar & Viva	:	10

**ME 7001
OPERATIONS RESEARCH**

Lecture : 3 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	3

Objectives: The basic objective is to impart knowledge of tools and techniques which helps to elicit a best possible solution to a problem mathematically, which improves or optimizes the performance of the system.

Learning Outcomes: The student will be able to use methods like mathematical modeling, statistics, and algorithms to arrive at optimal or good decisions in complex problems which are concerned with optimizing the maxima (profit, faster assembly line, greater crop yield, higher bandwidth, etc) or minima (cost loss, lowering of risk, etc) of some objective function.

UNIT – I

INTRODUCTION: Definition and Scope of Operations Research, Limitations of Operations Research, Model building in Operations Research.

LINEAR PROGRAMMING: Mathematical formulation of the problem, Graphical method, Simplex method, artificial basis technique, dual Simplex method. Degeneracy, alternative optima, unbounded solution, infeasible solution.

UNIT – II

TRANSPORTATION PROBLEM: Basic feasible solution by north-west corner method, Vogel's approximation method, assignment by inspection method. Finding optimal solution, degeneracy, unbalanced transportation matrix.

ASSIGNMENT PROBLEM: One-to-one assignment problem, optimal solution, unbalanced assignment matrix.

QUEUING THEORY: Queuing systems and their characteristics. M/M/1 : FCFS/ ∞ / ∞ and M/M/1 : FCFS/ ∞ / N models.

UNIT – III

PROJECT PLANNING THROUGH NETWORKS: Arrow (Network) Diagram representation. Rules for constructing an arrow diagram, PERT and CPM, Critical path calculations, earliest start and latest completion times, Determination of critical path, determination of floats, Probability considerations in project, cost considerations in project scheduling, crashing (least cost project scheduling).

UNIT – IV

GAME THEORY: Optimal solution of two-person zero-sum games, the max-min and min-max principle. Games without saddle points, mixed strategies. Arithmetic and algebraic methods, reduction by dominance and average, method of sub games, graphical method.

SEQUENCING: Introduction, Job shop Scheduling, Flow shop Scheduling, Solution of Sequencing Problem, Processing of n Jobs through two machines, Processing of n Jobs through m machines, Scheduling Criteria's.

Learning Resources:**Text books:**

- ‘Operations Research (units: I, IV)’S D Sharma, ‘Kedarnath, Ramnath & Co.,Meerut.
- Operations Research V K Kapoor.

Reference books:

- Operations Research’ R Pannerselvam Pentice Hall of India Pvt Ltd-New Delhi.

Web references:

- <http://www.universalteacherpublications.com/univ/ebooks/or/Ch1/origin.htm>
- <http://www.wolfram.com/solutions/OperationsResearch/>
- <http://www.informs.org/Journal/IJOC/Areas-and-Area-Editors>
- <http://orion.uwaterloo.ca/~hwoikowi/intrstsites.html>

ME 7002
DESIGN OF AUTOMOBILE COMPONENTS

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	4

Objectives: To introduce and design different types of suspension systems, clutches, brakes, I.C engine components for an automobile for higher loading capacity and better efficiency and the importance of optimisation and Reliability in designing machine components.

Learning Outcomes: The student will be able to understand the design procedure of suspension system, clutches, brakes and other I.C Engine components. Through the study of optimum design and reliability he will be able to assess the life of mechanical elements.

UNIT - I

Springs: Introduction; Materials; Types of springs, Helical springs under axial load, Fatigue loading, Torsion springs, Spiral springs, leaf springs.

UNIT - II

Brakes and Clutches:- Introduction to Brakes, Types, Analysis and design of block brakes, band brakes, block and band brakes; Internal shoe brakes, external shoe brakes, pivoted shoe brakes, Temperature rise, Friction materials, Clutches, Analysis and design of simple and multiple disc clutches, cone clutches and centrifugal clutches, friction materials; comparison of brakes and clutches.

UNIT - III

I. C. Engine Components: Introduction, Design of trunk type piston, connecting rod and crankshaft.

Optimum design: Optimization function of single variable and multi variables, optimization techniques, Interval halving and Golden section methods, optimum design of tension bar for minimum deflection, cost and weight, Torsion member for minimum deflection, cost and weight.

UNIT - IV

Flywheel: Introduction, construction, Torque analysis, solid flywheel, Rimmed flywheel, stresses in rimmed flywheel, Design of flywheel.

Reliability and life expectancies: Introduction, Method of achieving reliability, Series, Parallel and series and parallel reliability, Analysis.

Learning Resources:

Text Books:

- Design of machine elements by Bhandari, Tata McGraw Hill book Co.
- Machine Design by P.C. Sharma & D.K. Agarwal, S.K.Kataria & Sons
- Singeresu S. Rao, "Engineering Optimization - Theory and Practice" New Age Intl.

Ltd.Publishers, 2000.

Reference Books:

- Mechanical Engg Design by Joseph Edward Shigley, Tata McGraw Hill book Co.
- Machine Design by R.K. Jain, Khanna Publishers

HAND BOOKS TO BE ALLOWED IN UNIVERSITY EXAMINATION:

- Design data book, P.S.G. College of Tech, Coimbatore
- Design data book, Mahadevan & Balaveera Reddy - CBS Pub.

Web references:

- <http://nptel.iitm.ac.in>
- <http://school.mech.uwa.edu.au>
- <http://www.pdf-top.com>

ME 7003
FINITE ELEMENT METHOD

Lecture : 4 hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	4

Objectives: The main objective of the course to familiarize the Basics of Finite Element method, Rayleigh and Ritz methods for static analysis, Different elements like truss, beam, triangular, elements and analysis of one and two dimensional structural and thermal problems.

Learning Outcomes: At the end of the course the student will have a better perceptive on the numerical technique FEM and its wide range of applications in various engineering problems.

UNIT – I

FUNDAMENTAL CONCEPTS: Analysis of 3-D stresses & strains, stress-strain relations, stress cubic, principal stress calculations, potential energy and equilibrium, the Rayleigh-Ritz method, Galerkin's method.

UNIT - II

BASIC CONCEPTS OF F.E.M. AND ONE DIMENSIONAL PROBLEMS : Fundamental concepts, Finite Element Modeling, Coordinates and Shape functions, The Potential Energy Approach, Global Stiffness Matrix and Load Vector, The Finite Element equations; Treatment of boundary conditions, Examples of Axially Loaded Members.

ANALYSIS OF PLANE TRUSSES: Introduction, Plane Trusses, Local and Global Coordinate systems, Element Stiffness Matrix, Stress Calculations, Example of plane Truss with three members.

UNIT – III

ANALYSIS OF BEAMS: Introduction, Potential Energy Approach, Element stiffness matrix for two nodes, two degree of freedom for node beam element, load vector, simple beam problems.

STEADY STATE HEAT TRANSFER ANALYSIS: One Dimensional Heat transfer analysis of a Fin.

UNIT - IV

TWO DIMENSIONAL PROBLEMS : Introduction, Plane Stress and Plane Strain, Finite Element Modeling, Constant Strain Triangle (CST); Iso-parametric representation, Potential Energy Approach, Element Stiffness, Force terms, Galerkin Approach, Stress calculation, Problem modeling and boundary conditions, Examples of plane Stress and plane Strain problems with three degrees of freedom using CST Element.

STEADY STATE HEAT TRANSFER ANALYSIS: Two dimensional steady state heat transfer analysis of a thin plate.

Learning Resources:**Text books:**

- Introduction to Finite Elements in Engineering by Chandrupatla & Belegundu, PHI.

Reference books:

- Cook, Robert Davis et al, "Concepts and Applications of Finite Element Analysis" , Wiley, John & Sons,1999
- George R Buchanan, "Schaum's Outline of Finite Element Analysis", McGraw Hill Company, 1994.
- Finite Element Analysis by P. Seshu, PHI publications

Web References:

- http://en.wikipedia.org/wiki/Finite_element_method
- <http://reference.wolfram.com/applications/structural/FiniteElementMethod.html>
- <http://www.finite-element-method.info/>
- <http://nptel.iitm.ac.in/video.php?courseId=1012>

ME 7004 MANUFACTURING MANAGEMENT

Lecture : 3hrs/ Week	Internal Assessment: 30
Tutorial : 1 hr/ week	Final Examination: 70
Practical : -	Credits: 3

Objectives: The basic objective of the course is to impart knowledge of various production systems that exist. Forecast and schedule the production based on application of scientific principles, MRP (Material requirement planning) and should be able to apply various concepts related to inventory like EOQ (economic order quantity), ABC analysis etc.

Learning Outcomes: The student will be ready to apply the various methods learnt in forecasting, scheduling, Planning of raw materials an ordering of inventory and controlling the quality of the produced goods.

UNIT – I

Production systems: Continuous and intermittent production. Mass and flow production, batch production, job order production, production functions. Production Planning & Control Functions

Forecasting: Forecasting variables, forecasting procedure, methods of forecasting: moving average, least squares, simple exponential smoothing, linear regression, correlation coefficient, problems.

UNIT – II

Aggregate planning and scheduling: Long range, intermediate range and short range plans, the aggregate planning problem, aggregate planning strategies

Master scheduling: Master scheduling formation: inputs and outputs. Master scheduling methods.

UNIT – III

Materials Management and Inventory Control : Functions of materials management, purpose of inventories, types of inventories, relevant costs in inventory control, ABC, VED and XYZ analysis.

Economic order quantity (EOQ) models: Basic EOQ, economic production run length (ERL), quantity discounts, safety stock, problems, P & Q Systems of Control.

Materials requirement planning (MRP): Importance of MRP and CRP, MRP system inputs and outputs, bill of materials, MRP logic, MRPII, ERP.

UNIT – IV

Quality control: Tolerance limits of a process, control charts for variables: X and R charts. Control charts of attributes, p-chart, c-chart, zero defect programs, problems.

Acceptance sampling – single sampling, double sampling and multi sampling plans for attributes, OC curves, problems.

TQM, Demings Quality Philosophy, Taguchi Quality Philosophy.

Learning Resources:**Text books:**

- Operations Management – Joseph G. Monks

Reference books:

- Materials Management – Gopalakrishnan and Sudhakaresan
- Quality Control – Dale H. Besterfield.

Web references:

- www.transtutors.com
- www.referenceforbusiness.com
- www.prenhall.com
- www.brighthub.com

ME 7005/1 MECHATRONICS

Lecture : 3hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical :	Credits:	3

Objectives: The main objective of the course to familiarize the different sensors & transducers, signal conditioning, data presentation, basic system models, dynamic response of the system and usage of different controllers like PI,PD,PID & PLC etc.

Learning Outcomes: This course provides the basic knowledge about the Mechatronics, different Sensors, Signal conditioning, data acquisition system, system models, controllers like on-off mode, Proportional, PI,PD,PID, PLC, PLC programming, Design of Mechatronics.

UNIT – I

Introduction to Mechatronics

Sensors & Transducers: Introduction, performance terminology, classification of sensors, selection of sensors.

Signal Conditioning: Introduction data acquisition – Quantizing theory, Analog to digital conversion, digital to analog conversion.

Data Presentation Systems: Displays, Data presentation elements - i) Analog Chart recorders ii) magnetic recording codes iii) Visual display unit, Systems measurement, Testing and Calibration.

UNIT – II

Basic System Models: Modeling of one and two degrees of freedom Mechanical, Electrical, Fluid and thermal systems. Block diagram representations for these systems.

Dynamic Responses of System: Transfer function, Modeling Dynamic systems, first order systems, second order systems

UNIT – III

Closed loop controllers: Continuous and discrete processes, control modes, Two step, Proportional, Derivative, Integral, PID controllers.

Digital logic: Logic gates, Boolean algebra, Karnaugh maps

UNIT – IV

PLC : Introduction, basic structure, I/P, O/P, processing, programming, ladder diagrams, timers, internal relays and counters, data handling, analogue input and output selection of PLC.

Design : Designing Mechatronics systems, possible design solutions, case studies of Mechatronics systems – i) Pick and place robot ii) Timed switch iii) Bar code reader

Learning Resources:**Text books:**

- Mechatronics by W.Bolton (Pearson)

Reference Books:

- Mechatronics by HMT
- Mechatronics by Mahalik
- Introduction to Mechatronics – David and Alcaitore Michael B.Histand (TMH)

Web References:

- <http://www.engr.sjsu.edu/sjlee/vendors.htm>
- www.engr.colostate.edu/~dga/mechatronics/resources.html
- www.NI.com
- www.cambridgemechatronics.com/contact/terms
- www.pdf-free-download.com/mechatronics-labs.pdf
- mechatronics.me.wisc.edu
- www.engr.sjsu.edu/bjfurman/.../mechatronicstutorials.htm

Video references:

- http://video_demos.colostate.edu/mechatronics/index.html#actuators
- <http://video.designworldonline.com/channel/MECHANICAL>

ME 7005/2
AUTOMATIC CONTROL ENGINEERING

Lecture : 3hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	3

Objectives: To understand the methods to analyze the fundamentals Control Systems acquire basic understanding of principle & working stability of systems, Understand the Response of control systems, Understand root locus analysis and PID Controls

Learning Outcomes: The Student will be able to apply knowledge of mathematics, control engineering to use the analysis and design tools of classical linear control.

UNIT – I

Introduction to Control Systems:

Introduction-Examples of control Systems- Closed loop Control versus Open loop Control system- Design of Control Systems.

Mathematic Modeling of Dynamic Systems:

Introduction- Transfer Function and Impulse Response Function- Block Diagram-Modeling in State space.

UNIT – II

State-space Representation of Dynamic Systems:

Mechanical Systems- Electrical Systems- Liquid Level Systems- Thermal Systems- Linear Systems –Linear time Invariable systems, Linear time Varying System.

UNIT – III

Transient-Response Analysis and Response of Control Systems:

Introduction- First Order System- Second Order System- Higher Order Systems- Routh's Criterion, Nyquist stability criterion, Application of the Nyquist criterion.

Root Locus Analysis:

Introduction- Root Locus Plot- General Rules for constructing Root Loci- Root Locus Analysis of Control Systems- Root Contour Plots.

UNIT – IV

Frequency-Response Analysis:

Introduction-Bode Diagrams-Polar Plots-Closed loop Frequency Response- Experimental Determination of Transfer Functions.

P I D Controls:

Introduction – Tuning Rules for PID Controllers- Modifications of PID Controllers – Two Degree Freedom Controls.

Learning Resources:**Text books:**

- K. Ogata, Modern Control Engineering, Pearson Ed, 2002.

Reference books:

- Gene F. Franklin et. al. Feedback control of dynamic systems, Pearson Ed. Asia 1998
- Harison and Boilinger, Introduction to Automatic Control System Jolzn Wiley Publication 1976
- G. V. Reklatis, A. Ravinran and K. M. Ragsdell, Engineering Optimization: Methods and applications, Interscience 1983.
- Automatic Control Systems, by Benjamin C. Kuo.
Mechanical Measurements, by R.S.Sirohi, H.G. Radha Krishna, Wiley Eastern, New Delhi. Control Systems Engineering by Nagrath/Gopal, New age internati

ME 7005/3
HYDRAULIC AND PNEUMATIC SYSTEMS

Lecture : 3hrs/ Week	Internal Assessment: 30
Tutorial : 1 hr/ Week	Final Examination: 70
Practical : -	Credits: 3

Objectives: To be familiar with Circuit symbols and Control valves and principles of Pneumatic compressors, Hydraulic pumps, Pneumatic circuit design and maintenance of circuits.

Learning Outcomes: Students are familiarized with the practical applications of hydraulics & pneumatic systems and able to identify circuit symbols and to draw simple circuits.

UNIT – I

Oil hydraulic systems: Hydraulic power generators-selection and specification of pumps
Hydraulic actuators: Linear and Rotary Actuators-Selection and Specification

UNIT – II

Control and regulation elements: Pressure-direction and flow control valves
Introduction to Pneumatic Systems: Pneumatic fundamentals, brief description of control elements

UNIT – III

Hydraulic circuits: Reciprocation, quick return, Sequencing synchronizing circuits-accumulator circuits-industrial circuits-punching press circuit-hydraulic milling machine, shaper
Pneumatic circuits: Pneumatic circuits- Basic pneumatic circuit, Quick exhaust circuit, feed control circuit and Time delay circuit

UNIT – IV

Maintenance of fluidic circuits: Fault finding-hydro pneumatic circuits, Introduction to PLC, Basic structure of PLC, Timers, counters, PLC controlled hydraulic and pneumatic systems.

Learning Resources:

Text books:

- Antony Esposito, "Fluid power with Applications", Prentice Hall, 1980
- R Srinivasulu, "Hydraulic Pneumatic Controls", 2nd edition, TMH, 2009.

Reference books:

- Andrew Parr, "Hydraulics and Pneumatics", (HB), Jaico Publishing House, 1999
- Bolton. W. "Pneumatic and Hydraulic systems", Butterworth - Heinemann, 1997

Web references:

- <http://www.efluids.com/>
- <http://fluid.power.net/>
- www.hydraulicspneumatics.com/
- www.waterengr.com/
- www.pumps.org/

ME 7005/4
OPTIMIZATION TECHNIQUES

Lecture : 3hrs/ Week	Internal Assessment:	30
Tutorial : 1 hr/ week	Final Examination:	70
Practical : -	Credits:	3

Objectives: The basic objective is to impart knowledge of tools and techniques which helps to elicit a best possible solution to a problem mathematically, which improves or optimizes the performance of the system.

Learning Outcomes: The student will be able to use methods like mathematical modeling, statistics, and algorithms to arrive at optimal or good decisions in complex problems which are concerned with optimizing the maxima (profit, faster assembly line, greater crop yield, higher bandwidth, etc) or minima (cost loss, lowering of risk, etc) of some objective function.

UNIT – I

Introduction: Engineering Applications of Optimization, Problem formulation – Objective function, constraints and types – Equality and inequality, Classification of Optimization problems, Single variable optimization, Multi variable optimization, Constrained and Unconstrained optimization.

Linear Programming : Introduction, Formulation of the linear programming problem (LPP), Definitions, motivation to simplex method, Simplex Algorithm, Two phase simplex method, Revised simplex method, Quality in LP and Sensitivity.

UNIT – II

Optimal solution by north west corner method- least cost method – vogels approximation method – optimality test – MODI method.

Assignment problem – formulation – Hungarian method -unbalanced assignment problem.

UNIT – III

Non Linear Programming: Unconstrained nonlinear optimization – Direct elimination procedures, Direct climbing procedures, constrained nonlinear optimization.

Integer Programming: Cutting – Plane Algorithms, Branch and Bound method. Introduction to geometric programming

Dynamic Programming: Elements of Dynamic Programming model, Problem of dimensionality in Dynamic Programming, Solution of linear programs by Dynamic Programming.

UNIT – IV

Replacement Analysis: Replacement of items that deteriorate with time – value of money changing with time –not changing with time – optimum replacement policy – individual and group replacement. Sequencing problem: models with n jobs with 2 machines – problem with n jobs with 3 machines.

Queuing Theory: Basic elements of Queuing model, Poisson and exponential distributions, single server and multi server models, Queues with combined arrivals and departures. Queues with priorities for services.

Learning Resources:**Text books:**

- ‘Operations Research (units: I, IV)’SD Sharma,‘Kedarnath,Ramnath & Co.,Meerut.
- Operations Research V K Kapoor.

Reference books:

- Operations Research’ R Pannerselvam Pentice Hall of India Pvt Ltd-New Delhi.

Web resources:

- <http://www.universalteacherpublications.com/univ/ebooks/or/Ch1/origin.htm>
- <http://www.wolfram.com/solutions/OperationsResearch/>
- <http://www.informs.org/Journal/IJOC/Areas-and-Area-Editors>
- <http://orion.uwaterloo.ca/~hwoikowi/intrtsites.html>

ME 7006/1
ENERGY RESOURCES & UTILIZATION

Lecture : 4hrs/ Week	Internal Assessment:	30
Tutorial : -	Final Examination:	70
Practical : -	Credits:	4

Objectives: This course provides the student an understanding about various energy resources, technology for conversion of energy, various power plants, processes, equipment, safety parameters to be observed, plant economics, pollution and control measures, non- conventional energy resources.

Learning Outcomes: By the completion of the course the student will be able to be familiar with various energy sources and conversion processes like hydro electric, thermal, nuclear, diesel & gas power plants, plant efficiency factors like load economics, costs involved..Etc, Non conventional energy sources, their prospects and, pollution control measures being taken at various stages.

UNIT – I

INTRODUCTION: Various Energy Sources, Types of power plants

HYDRO ELECTRIC POWER PLANT: Hydrology, rainfall, runoff and their measurement, hydrograph, flow duration curve, mass curve and calculation of storage capacity, site selection of hydro plant, different types of hydro plants.

DIESEL AND GAS TURBINE POWER PLANTS: classification, main components of plant, plant layout, application and comparison with other plants.

UNIT – II

THERMAL POWER PLANT: general lay out, fuels coal analysis, coal handling, burning of coal-stoker and pulverized systems, ash handling systems, ESP, need for draught in thermal plants, high-pressure boilers, condensers, cooling ponds and towers(wet and dry types), deaeration.

UNIT – III

NUCLEAR POWER PLANTS: Principles of release of nuclear energy; Fusion and fission reactions. Nuclear fuels used in the reactors. Multiplication and thermal utilization factors. Elements of the nuclear reactor; moderator, control rod, fuel rods, coolants. Brief description of reactors of the following types-Pressurized water reactor, boiling water reactor, Sodium graphite reactor, Fast Breeder reactor, Homogeneous graphite reactor and gas cooled reactor, Radiation hazards, Shielding, Radio active waste disposal.

FLUCTUATING LOADS ON POWER PLANTS: Various performance factors (load factor, diversity factor, use factor etc...) .

POWER PLANT ECONOMICS: fixed costs, operating costs, cost per KWh, comparison of fixed and operating costs of hydro, thermal, nuclear plants, power tariffs.

POLLUTION AND CONTROL: Introduction, effluents from power plants and impact on environment- pollutants and pollution standards-methods of pollution control.

UNIT – IV

SOLAR ENERGY: solar collectors, solar energy storage, solar ponds , solar energy utilization and applications.

WIND ENERGY: Basic principle, different types of wind mills, wind energy conversion systems, other applications.

GEO-THERMAL POWER: Sources, energy conversion systems, potential in India.

BIO-MASS ENERGY: Sources, conversion systems

OTEC: ocean thermal energy conversion systems, introduction to tidal power.

DIRECT ENERGY CONVERSION SYSTEMS: fuel cells, MHD, Solar cell.

Learning Resources:

Text books:

- Power Plant Engineering - G.R.NAGPAL - khanna publications
- Power Plant Engineering - P.K.Nag – Tata McGraw hill
- Non Conventional Energy Resources - G.D.Rai -khanna publications

Reference books:

- Power Plant Technology - M.M. EL Wakil
- Principles of Energy Conversion - A.W.Culp

Web resources:

- en.wikipedia.org/wiki/Thermal_power_station
- www.world-nuclear.org/info/inf32.html
- en.wikipedia.org/wiki/Hydroelectricity
- en.wikipedia.org/wiki/Gas_turbine
- www.renewable-energy-sources.com/
- www.grist.org/article/the-economics-of-power-plant-construction/

ME 7006/2
REFRIGERATION & AIR CONDITIONING

Lecture : 4hrs/ Week	Internal Assessment:	30
Tutorial : -	Final Examination:	70
Practical : -	Credits:	4

Objectives: To introduce to vapor compression and vapor absorption system operation, cycle analysis and method for improving performance, various components of refrigeration systems, design of air conditioning systems by cooling load calculations, application of refrigeration and air conditioning systems

Learning Outcomes: This course provides the knowledge about refrigeration and air conditioning system, and enables them to do simple design calculations and analysis of these systems.

UNIT – I

INTRODUCTION TO REFRIGERATION: Necessity and applications, unit of refrigeration and C.O.P, mechanical refrigeration, types of ideal cycle of refrigeration, Refrigerants- desirable properties, commonly used refrigerants, nomenclature.

AIR REFRIGERATION: Bell Coleman cycle and Brayton cycle, Open and Dense air systems, Actual refrigeration system, refrigeration needs of aircrafts, adoption of air refrigeration, Justification, types of systems, problems.

UNIT – II

VAPOUR COMPRESSION REFRIGERATION: Working principle, essential components of plant, simple vapor compression refrigeration cycle, Multi pressure systems – multistage compression, multi evaporator system, Cascade system, use of p – h charts, problems.

SYSTEM COMPONENTS: Compressors- general classification, comparison, advantages and disadvantages, Condensers - classification, working, Evaporators - classification, working, Expansion devices - types, working.

UNIT – III

VAPOUR ABSORPTION SYSTEM: Calculation of max COP, description and working of NH₃ - water system, Li - Br, H₂O system, principle of operation of three fluid absorption system and salient features.

STEAM JET REFRIGERATION SYSTEM: Principle of working, application, merits and demerits.

NON-CONVENTIONAL REFRIGERATION METHODS: Principle and operation of thermoelectric refrigerator and Vortex tube or Hirsch tube.

UNIT – IV

INTRODUCTION TO AIR CONDITIONING: Psychrometric properties and processes, sensible and latent heat loads, need for ventilation, infiltration, concepts of RSHP, GSHP, ESHF & ADP, concept of human comfort and effective temperature, comfort air conditioning, industrial air conditioning requirements, air conditioning load calculations.

AIR CONDITIONING SYSTEMS: classification of equipment, cooling, heating, humidification and dehumidification, filters, grills and registers, deodorants, fans and blowers, heat pump, heat sources, different heat pump circuits, application.

Learning Resources:

Text books:

- Refrigeration and air conditioning - C. P. Arora.
- Refrigeration and Air conditioning - Manohar Prasad.
- A course in refrigeration and air conditioning - S. C. Arora, Domkundwar.

Reference books:

- Principles of Refrigeration - Dossat.
- Refrigeration and air conditioning - Stoecker.
- Refrigeration and Air conditioning Data book by Domkundwar&Domkundwar

Web Resources:

- <http://www.refrigerationbasics.com/index.htm>
- <http://www.howstuffworks.com/ac.htm>
- <http://www.ashrae.org>
- <http://www.taftan.com/thermodynamics/AIRCOND.HTM>
- <http://www.wisegeek.com/how-does-air-conditioning-work.htm>

ME 7006/3
COMPUTATIONAL FLUID DYNAMICS

Lecture : 4hrs/ Week	Internal Assessment:	30
Tutorial : -	Final Examination:	70
Practical : -	Credits:	4

Objectives: To expose the student to the governing equations required for CFD and their mathematical behavior, grid generation principles and types of grids required for different problems, and made aware of solution techniques and computer codes

Learning Outcomes: Knowledge about various computational methods for fluid flow and make student solve simple fluid dynamics problems.

UNIT – I

INTRODUCTION:-CFD as a design tool, as a research tool, impact of CFD, Applications.

GOVERNING EQUATIONS:- Continuity, Momentum and Energy equations in 3 Dimensions, Navier-Stokes equations, Single Generic Integral form equations for Continuity, Momentum and Energy.

UNIT – II

DISCRETIZATION:-Basic aspects of discretization, Techniques used--Finite Difference, Finite Volume and Finite Element, comparison of above, difference equations, Explicit and Implicit approaches.

UNIT – III

GRID GENERATION AND TRANSFORMATION:-Generation of grid, Transformation of non- uniform grids, General transformation of equations, form of governing equations suitable for CFD, Compressed grids, Boundary filled coordinate systems—Elliptic grid generation, Adaptive grids, Modern developments in grid generation.

UNIT – IV

CFD TECHNIQUES:-Introduction, LAX-WENDORFF technique, MACCORMICK technique, CRANK-NICHOLSON technique, Relaxation technique, ADI technique, suitability for different conditions. Aspects of numerical dissipation and dispersion.

Learning Resources:

Text books:

- Computational Fluid Dynamics, Basics with Applications—ANDERSON Jr.-MGH, 1995
- Numerical Heat Transfer and Fluid Flow—PATANKAR-Hemisphere, NY, 1980

Reference books:

- Computational Fluid Dynamics for Engineering—HOFFMAN K.A. - Engineering Education System, Austin, TX, 1989

Web resources:

- www.cfd-online.com
- Fluent Inc. Product Documentation
- <http://courses.cit.cornell.edu/fluent/index.htm>
- <http://www.flow3d.com/index.html>

**ME 7006/4
GAS DYNAMICS**

Lecture : 4hrs/ Week	Internal Assessment:	30
Tutorial : -	Final Examination:	70
Practical : -	Credits:	4

Objectives: To analyze flow through nozzle and diffuser with and without shock- flow through contact area duct using friction and heat transfer.

Learning On completion of this course- the students will be in a position to apply their

Outcomes: knowledge to solve problems in basic compressible flow.

UNIT – I

Definitions and basic Relations: Energy equation for a flow processes, stagnation- pressure, density, temperature, velocity, Mach number, effect of mach number on compressibility.

Rate equations for a control volume: Continuity equation, Navier stokes equations, aerofoil theory, boundary layer, boundary layer separation criterion.

UNIT – II

Isentropic flow with variable area: Comparison of isentropic and adiabatic processes, Mach number variation stagnation and critical states, area ratio as function of Mach number, mass flow rate, flow trough nozzles.

Flow with friction: flow in constant area duct with friction- Fanno Line, Fanno flow equations, Variation of flow properties, variation of Mach number with duct length.

UNIT – III

Flow with heating or cooling in ducts: Governing equations, Rayleigh curve, Rayleigh flow relations, heating in subsonic and supersonic flows.

Flow with Normal shock waves: Development of a shock wave, governing equations, Pandtl-Meyer relation, Static pressure, temperature and density (the Rankine-Hugoniot equations) ratios across the shock waves, determination of Mach number of supersonic flows.

UNIT – IV

Flow with Oblique shock waves: Nature of flow through oblique shock waves, fundamental relations, Prandtl's equation, Rankine-Hugoniot equation, variation of flow parameters, oblique shock relation from the normal shock equations.

Methods of measurement: Pressure measurement, Temperature, Density, Velocity, Hot-wire anemometer, Wind tunnels.

Learning Resources:

Text books:

- S.M.Yahya, “Compressible Fluid Flow”, Wiley Eastern Limited
- E.Radhakrishnan, Gas Dynamics, PHI Publishers

Reference books:

- John D.Anderson, Jr. “Modern Compressible Flow”, McGraw-Hill
- Camhel and Jennings, “Gas Dynamics”, McGraw-Hill

Web resources:

- <http://www.adl.gatech.edu/classes/gasdyn/gasdyn01.html>
- <http://web.ics.purdue.edu/~alexeenk/GDT/index.html>
- <http://www.nd.edu/~powers/ae.360/notes.pdf>
- Books available at college web 152.152.1.100

ME 7051
HEAT TRANSFER LABORATORY

Lecture : -	Internal Assessment:	25
Tutorial : -	Final Examination:	50
Practical : 3 hrs/ Week	Credits:	2

Objectives: This laboratory course will help the students to understand the practical experiments on heat transfer and applications of heat transfer in daily life.

Learning After successful completion of this course, the student will be able to know

Outcomes: Applications of heat transfer in daily life.

Any Eight Experiments of the following

1. Refrigeration Test Rig
2. Air Conditioning Test Rig
3. Heat Exchanger – Parallel Flow
4. Heat Exchanger – Counter Flow
5. Composite Slab / Metal Rod
6. Critical Heat flux Apparatus
7. Emissivity Apparatus
8. Pin fin – Natural Convection
9. Pin fin – Forced Convection
10. Insulating powder Apparatus
11. Dropwise and filmwise condensation Apparatus
12. Forced Convection Apparatus
13. Stefan – Boltzmann's Apparatus
14. Lagged pipe Apparatus
15. User defined design based experiment.

ME 7052
DESIGN & METROLOGY LABORATORY

Lecture :	-	Internal Assessment:	25
Tutorial :	-	Final Examination:	50
Practical :	3 hrs/ Week	Credits:	2

Objectives: This laboratory course will help the students to understand the need of precise measurements of various complicated contours and to study the dynamic behavior of machines.

Learning Outcomes: After successful completion of this course, the student will be able to know different measuring techniques and about the calibration. The student will also understand and verify various laws governing the dynamics of machines and he also understand the case studies in the field of vibration.

Any Twelve Experiments of the following

1. Measuring internal diameter using bore dial gauge
2. Measuring gear tooth thickness using gear tooth vernier
3. Measuring angles using universal bevel protractor
4. Measuring external diameters using micrometer and plotting x, r charts.
5. Measuring different elements of a thread using profile projector.
6. Measuring linear and angular dimensions of a tool using tool - makers microscope.
7. Measurement of surface finish using surf tester
8. Measuring effective diameter of the thread using three wire method
9. Measurement of cutting forces using dynamometer on a lathe machine
10. Measurement of cutting forces using dynamometer on a drilling machine
11. Alignment test on a lathe machine
12. Alignment test on a milling machine
13. Alignment test on a drilling machine
14. Alignment test on a cutter and tool grinder
15. Vibration measurements.
16. Gyroscopes
17. Balancing
18. Temperature, strain and displacement measurements
19. Speed measurement
20. Force & torque measurement
21. Use of comparators
22. Measurements using photo elastic bench.
23. User defined design based experiment.

**ME 7053
MINI PROJECT**

Lecture : -	Internal Assessment:	25
Tutorial : 1hr/week	Final Examination:	50
Practical : -	Credits:	1

Objectives: The student is introduced to the concept of validating a simple idea through model preparation / Software package or solving a simple Industrial/Theoretical problem.

Learning Outcomes: Student will be able to identify and solve theoretical or practical engineering problems of simple nature.

Distribution of Marks:

Internal Evaluation : 25

Attendance	:	5
Report	:	10
Seminar & Viva	:	10

Semester end Evaluation: 50

Report	:	40
Seminar & Viva	:	10

ME 8001
COMPUTER AIDED MANUFACTURING

Lecture :	4 hrs/ Week	Internal Assessment:	30
Tutorial :	-	Final Examination:	70
Practical :	-	Credits:	4

Objectives: The main objective of the course is to introduce the concepts of automation in manufacturing and direct & indirect applications of computers in manufacturing. This course provides the basic knowledge about the components of Numerical control systems, programming codes & concepts, features of CNC & DNC, Adaptive control, Computer Aided Process Planning (CAPP), Group Technology (GT) and applications & benefits of Flexible Manufacturing System(FMS).

Learning Outcomes: At the end of the course, students will be familiarized in basic concepts of CNC machines, manual & computer aided part programming, Computer Aided Process Planning (CAPP), Group Technology (GT) and Flexible Manufacturing Systems (FMS).

UNIT – I

NUMERICAL CONTROL IN PRODUCTION SYSTEMS: Need for numerical control, components of NC systems, Classification of NC systems, Punched tape, Tape format, NC co-ord system, NC Applications, Advantages and disadvantages of NC machines.

UNIT – II

COMPUTER CONTROL OF NC MACHINES: CNC concepts, Advantages of CNC, Direct numerical control, types, advantages, adaptive control machining

MANUAL PART PROGRAMMING: Introduction, Manual part programming, codes & concepts, length compensation, radius compensation, canned cycles, Simple programming examples.

UNIT – III

COMPUTER ASSISTED PART PROGRAMMING: Advantages of Computer assisted part programming, APT language, geometry, motion statements, Macros, Simple programming examples.

COMPUTER AIDED PROCESS PLANNING: Types of Computer Aided Process Planning. Retrieval – Type Process Planning Systems, Generative Process Planning Systems, Benefits of CAPP.

UNIT – IV

GROUP TECHNOLOGY: Introduction, Part Families, Parts Classification and Coding, Different Parts Classification and Coding Systems, Cellular Manufacturing, Composite Part Concept, Benefits of Group Technology.

FLEXIBLE MANUFACTURING SYSTEMS: Introduction, Types of FMS, FMS Layout Configurations, FMS Applications and Benefits. Introduction to Computer Integrated Manufacturing.

Learning Resources:**Text books:**

Automation, Production Systems and CIM by Mikel P. Groover. Prentice Hall of India, Delhi, 1995.

Reference books:

- CAD/CAM Mikel P. Groover. Prentice Hall of India, Delhi, 1995.
- Numerical Control & Computer Aided Manufacturing – T.K.Kundra, P.N.Rao & N.K.Tiwari.
- Computer Aided Manufacturing - T.K.Kundra, P.N.Rao & N.K.Tiwari. (TMH).
Computer Integrated Design and Manufacturing, by David D.Bedworth, Mark R.Henderson & Philip M.Wolfe, McGraw-Hill Book Company, Singapore.

Web References:

- <http://www.enotes.com/computer-aided-design-cad-computer-aided>
- <http://www.britannica.com/EBchecked/topic/130575/computer-aided-manufacturing>
- http://en.wikipedia.org/wiki/Computer-aided_design#Overview

Video lessons:

- <http://www.youtube.com/watch?v=83rhQ6oehIc>
- http://www.metacafe.com/watch/1014072/cnc_basics_e_course_3_cad_learn_cad_vid_eo_cad_cam_tips_1/
- <http://www.youtube.com/watch?v=nvZBtJ-ncEM>

ME 8002/1
COMPUTER AIDED DESIGN

Lecture :	4 hrs/ Week	Internal Assessment:	30
Tutorial :	-	Final Examination:	70
Practical :	-	Credits:	4

Objectives: The main objective of the course is to introduce the concepts of Introduction to CAD fundamentals, design work station, Computer systems, programming languages, CAD hard ware and Software, primitives & Geometric transformations.

Learning Outcomes: At the end of this course the student will be familiar with CAD fundamentals, Modeling & design of Mechanical Elements. And alsoable to develop usage of Modeling & analysis software like Pro-E, CATIA, and ANSYS etc.

UNIT - I

INTRODUCTION: Fundamentals of CAD, Design process, Applications of computer for design, Benefits of CAD, Design Workstation, Graphic terminal.

COMPUTER SYSTEMS: CPU, Categories of Computer, Mass Storage Devices, Input and Output Devices. Data representation, Programming Languages, Operating system, System Configuration.

UNIT - II

COMPUTER AIDED DESIGN SYSTEM HARDWARE: Graphics Input Devices – Light pens, Analogue devices, Keyboard devices, Graphics Display Devices – CRT devices, Plasma Panel Display devices, Pen Plotter and other graphics output devices, CAD System Configuration.

UNIT – III

COMPUTER AIDED DESIGN SYSTEM SOFTWARE: Operating System, Graphics System, Graphics Database structure and handling, Operating features, Symbols, Macros, Editing facility. Graphics Standards, GKS and CORE, GKS-3D and PHIGS, IGES.

PRIMITIVES: Point Plotting, Drawing of Lines, Line drawing algorithms, DDA algorithm, Bresenham's Circle algorithm.

UNIT - IV

GEOMETRIC TRANSFORMATIONS: Co-ordinate system used in Graphics and Windowing, Viewport, 2-D Transformations, Scaling, Translation, Rotation, Shearing. Homogeneous Transformations, Combination Transformations, Clipping, 3-D Transformations.

Learning Resources:

Text Books:

- CAD/CAM by Mikel P.Groover and Emory W.Zimmers,Prentice Hall of India , Delhi
- Computer Aided Design and Manufacture by C.B.Besant, and C.W.K.Lui, Affiliated East – West Press Pvt Ltd, New Delhi.

References:

- CAD/CAM by Ibrahim Zied

Web References:

- <http://www.caddprimer.com/>
- <http://www.compinfo-center.com/cad/cad.htm>
- <http://www.srikumar.com/cad/cad.html>
- <http://www.tenlinks.com/CAD/reference/directories.htm>

Video Reference:

- <http://blog.capinc.com/2010/06/convert-to-a-section-view/>
- <http://www.solidsmack.com/design-resources/solidworks-lamborghini-gallardo-car-tutorial/>

ME 8002/2
AUTOMOBILE ENGINEERING

Lecture :	4 hrs/ Week	Internal Assessment:	30
Tutorial :	-	Final Examination:	70
Practical :	-	Credits:	4

Objectives: To impart the knowledge of Engine construction and working details, Carburetion and injection in engines, Clutch, gearbox, hydrodynamic drives, automatic transmission, Starting system, ignition system, charging system, lighting system and accessories. Also the knowledge of construction and Working principle of Front Axle, Rear Axle, Wheels, Tyres, Final Drive, Steering system, suspension system and Brakes.

Learning Outcomes: At the end of the course the students are familiarized with vehicle models, newer engine models, fuel systems, clutches, gear boxes, differential etc. Also they are able to diagnose problems of cooling, lubricating, electrical systems etc., aware of stability, safety and control of vehicle

UNIT – I

INTRODUCTION: Classification of vehicles – applications, options of prime movers, transmission and arrangements.

ENGINE: Engine Classifications - Number of strokes, cylinders, types of combustion chambers for petrol and diesel engines, DTSI, valves, valve arrangements and operating Mechanisms (SOHC & DOHC), Piston - design basis, types, piston rings, firing order, Crankshaft, Flywheel

FUEL SUPPLY SYSTEMS FOR PETROL AND DIESEL ENGINES: Fuel pumps- Mechanical and Electrical Diaphragm pumps, Air and Fuel Filters, Fuel injection systems for Diesel and Petrol Engines, (CRDI), Electronic Fuel injection-MPFI System, super chargers, Mufflers, Catalytic Converter.

UNIT - II

COOLING SYSTEMS FOR I.C. ENGINES: Need for cooling system, Air, evaporative cooling and water cooling-Thermo-syphon and forced circulation, radiator, Thermostat, Antifreeze solutions.

LUBRICATING SYSTEMS FOR I.C. ENGINES: Splash, Petroil, Pressure & Dry sump lubrication systems, oil filters, Crankcase ventilation.

ELECTRICAL SYSTEM: Ignition system, Spark plugs, Electronic Ignition, Alternator, cutout, Current and voltage regulators, starting motors-Bendix Drive Mechanism, lighting, instruments and accessories.

UNIT – III

CHASSIS & TRANSMISSION SYSTEMS: Introduction to Chassis & Transmission, Clutches – Single-plate and Multi-plate clutches, Centrifugal clutches, Fluid Fly Wheel, Cone Clutch actuating mechanisms.

TRANSMISSION: Gear Box - Theory, Four speed and Five Speed Sliding Mesh, Constant mesh & synchromesh type, selector mechanism, automatic transmission, overdrive, propeller shaft, differential - principle of working.

UNIT - IV

SUSPENSION SYSTEMS: Need for suspension systems, springs, shock absorbers, axles – front and rear, different methods of floating rear axle, front axle and wheel alignment.

VEHICLE CONTROL: steering mechanisms and power steering, types of brakes and brake actuation mechanisms (air and hydraulic), Disc Brakes, Anti-lock braking system, Air bags. Introduction - Tyres & retread.

Learning Resources:**Text books:**

- Automobile Engineering - G.B.S. Narang.
- Automobile Engineering - Vol I & II - Kirpal Singh

Reference books:

- Automotive Mechanics - Joseph Heitner
- Automobile Engineering – R.B. Gupta

Web references:

- www.gec.ac.in/~bsm/automobile/automobile.html
- <http://auto.howstuffworks.com/engine2.htm>
- www.carbibles.com/steering_bible.html
- www.educyclopedia.be/education/carjava.htm

ME 8002/3
EXPERIMENTAL STRESS ANALYSIS

Lecture : 4hrs/ Week	Internal Assessment:	30
Tutorial : -	Final Examination:	70
Practical : -	Credits:	4

Objectives: The main objective of the course is to understand the basic knowledge of theory of elasticity, different types of strain gauges, applications of transducers, Principle of Photo Elasticity and stress analysis by different methods.

Learning Outcomes: At the end of the course the students should be able to understand and apply these principles to the solution of various engineering problems in terms of measuring stress and strain experimentally for variety of practical problems.

UNIT – I

Introduction to theory of Elasticity:- Stress at a point, stress equations of equilibrium, principal stresses, maximum shear stress, plane stress and plane strain conditions, compatibility conditions, three-dimensional stress-strain relations, problems on plane stress & plane strain.

UNIT – II

Strain Measurements Methods: - Types of strain gauges, semiconductor strain gauges, electrical resistance strain gauges, (Gage construction, strain gage mounting methods, gage sensitivity & gauge factor), strain gage circuits-potentiometer, Wheatstone bridge & transducer applications.

UNIT – III

Photo Elasticity: The stress optic law, plane and circular polariscopes, photo elastic materials, Fringe multiplication.

UNIT – IV

Stress analysis using brittle coating methods, moiré method & grid method of strain analysis.

Learning Resources:

Text books:

- Experimental Stress Analysis, James W. Dally & William F. Riley, McGraw-Hill, INC. Newyork.
- Experimental Stress Analysis, L.S.Srinath, Tata McGraw-Hill.

Reference Books:

- Theory of Elasticity by Timoshenco and Goodier

Web References:

- <http://www.experimentalstress.com/>
- <http://rapiddigger.com/experimental-stress-analysis-william-f-riley/>
- Www.Rapid4search.Com/Files/Experimental_Stress_Analysis

ME 8002/4
MECHANICS OF COMPOSITE MATERIALS

Lecture : 4hrs/ Week	Internal Assessment:	30
Tutorial : -	Final Examination:	70
Practical :	Credits:	4

Objectives: The main objective of the course is to study the composition, properties and analysis of composite materials and to understand the various manufacturing methods of composite materials, stress analysis of composite beams, plates and shells

Learning Outcomes: At the end of completion of this course the students will be able to understand micro mechanical behavior of lamina and laminates and analyze the characteristics of composite beams, plates and shells.

UNIT – I

Basic Concepts : - Classification and characteristics of Composite materials, Mechanical behaviour, Advantages and limitations, manufacturing procedures.

UNIT – II

Macromechanical behaviour of a lamina:- Stress- Strain relations for anisotropic materials, Engineering constants for orthotropic materials, stress-strain relations for plane stress in an orthotropic materials, Stress-strain relations for a Lamina of arbitrary orientation.

UNIT – III

Strength of an orthotropic lamina, Biaxial strength theories-maximum stress, maximum strain and T-Sai Hill theories, Failure envelope.

Micromechanical behaviour of a lamina:- Mechanics of materials approach to stiffness & strength (tensile loading).

UNIT – IV

Macromechanical behaviour of a laminatae: Classical lamination theory, Lamina stress-strain behaviour, strain-stress variation in a laminate, resultant laminate forces & moments, symmetric & Anti symmetric laminates (15)

Learning Resources:

Text Books:

- Robert M. Jones, Mechanics of Composite materials, McGraw-HILL KOGAKUSHA, LTD, Tokyo.

Reference books:

- B.D.Agarwal, Lawrence J.Broutman & K.Chandrashekhara, Analysis and performance of fiber composites, John wiley & Sons, Inc, USA.
- ISSAC M.DANIEL & ORI ISHAI, Engineering Mechanics of Composite Materials, OXFORD University Press.

Web References:

- <http://www.springer.com/materials/>
- <http://composite.about.com/>
- <http://www.matter.org.uk/matscicdrom/manual/co.html>

ME 8003/1 ROBOTICS

Lecture : 4hrs/ Week	Internal Assessment:	30
Tutorial : -	Final Examination:	70
Practical : -	Credits:	4

Objectives: The main objective of the course is to introduce the concepts of automation in manufacturing and direct & indirect applications of robotics in manufacturing.

Learning Outcomes: At the end of the course, students will be familiarized in basic components of robotics, classification of robots, robot grippers, Machine vision functions, Robot sensory devices, and transformations and kinematics of robot joints.

UNIT – I

Introduction to Robotics, major component of a robot, robotic like devices, classification of robots – Classification by coordinate system and by control method, Specifications of robots, fixed versus flexible automation, economic analysis, Overview of robot application.

UNIT – II

Robot end Effectors: Introduction, end effectors, interfacing, types of end effectors, grippers and tools, considerations in the selection and design of remote centered devices.

Machine Vision: Introduction, Functions of machine vision, applications of machine vision.

UNIT – III

Robotic sensory devices : Objective, Non-optical position sensors – potentiometers, synchros, optical position sensors – opto interrupters, optical encoders (absolute & incremental).

Proximity sensors : Contact type , non contact type – reflected light scanning laser sensors.

Touch & slip sensors : Tactile sensors – proximity rod & photo detector sensors, slip sensors – Forced oscillation slip sensor, interrupted type slip sensors

UNIT – IV

Transformations and Kinematics : Objectives, homogenous coordinates, basic transformation operations, forward solution – Denavit Hartenberg procedure. Simple problems involving planar manipulators.

Introduction to Trajectory Planning, the manipulator jacobian.

Learning Resources:

Text books:

- Robotic Engineering by Richard D.Klafter, Prentice Hall
- Industrial Robotics by Mikell P.Groover, McGraw-Hill Int. Edition

Reference Books:

- Introduction to Robotics – John J. Ceaig, Addison Wesley
- Robotics – K. S. Fu, Gonzalez & Hee
- Robotics for Engineers by Yoram Koren.

Web References:

- <http://nptel.iitm.ac.in/courses.php?branch=Mechanical>
- <http://academicarth.org/courses/introduction-to-robotics>

Video references:-

- <http://nptel.iitm.ac.in/video.php?courseId=1052>

ME 8003/2**FLEXIBLE MANUFACTURING SYSTEMS & GROUP TECHNOLOGY**

Lecture : 4hrs/ Week	Internal Assessment:	30
Tutorial : -	Final Examination:	70
Practical : -	Credits:	4

Objectives: To introduce different types of Modern Methods of Manufacturing. Studying the concepts of Manufacturing Cell, Flexible Manufacturing System (FMS) & Group Technology (GT). Grouping of Parts and way of classification and Studying Automated Material Handling.

Learning Outcomes The student will Understand the Modern Method of Manufacturing. Understanding the concepts of Flexible Manufacturing Cell (FMC), Flexible Manufacturing System (FMS) & Group Technology (GT). the Automated Guided Vehicles (AGV's) and their implementation in the Industry.

UNIT – I

INTRODUCTION: Manufacturing Automation, Definition and types of FMS, Architecture of FMS, Workpiece flow in FMS, Performance measures of FMS.

WORK STATION: CNC Machines, Machine Centers, Inspection Stations.

UNIT – II

AUTOMATED MATERIAL HANDLING: Function of MHS, Types of Material handling equipment, Conveyor systems, AGVs, Industrial Robots.

AUTOMATED STORAGE SYSTEMS: Characteristics of Storage Systems.

UNIT – III

COMPUTER CONTROL SYSTEM OF FMS: Functions of Computer, Control system architecture, Factory level, Cell level control systems, Equipment control systems, Factory communications, Local area networks, Data files and system reports.

GROUP TECHNOLOGY: Introduction, need of G.T. Part families, Methods for developing part families.

UNIT – IV

BASIC TYPE OF CODES : Hierarchical codes, Attribute code, Hybrid code, selecting a coding system, Developing a coding system in an industry, examples of coding systems, MICLASS, OPITZ, CODE systems. Facility Design using, GT, Economic modeling in GT environment – production planning cost model, Economics of GT, Application of GT for design retrieval, CAPP, NIC, MR and FMS.

Learning Resources:**Text books:**

- Automation, Production Systems and Computer Integrated Manufacturing by M.P.Groover.

References:

- Performance Modeling of Automated Manufacturing Systems, N.Viswanadham, Y.Narahari.
- CAD/CAM Handbook by Eric Teichloz.
- Computer Integrated Design and Manufacturing by Bedworth Henderson,

Web references:

- <http://www.mechanicalindetail.info/advanced-manufacturing-systems/concept-of-flexible-manufacturing-systems-FMS.htm>
- <http://www.scribd.com/doc/19321303/Flexible-Manufacturing-Systems-FMS-A-Whitepaper>

ME 8003/3
MACHINE TOOL DESIGN

Lecture : 4hrs/ Week	Internal Assessment:	30
Tutorial : -	Final Examination:	70
Practical : -	Credits:	4

Objectives: This course provides knowledge of design of various parts of machine tools, like gear box, feed box, bed, columns, spindles, etc

Learning At the end of the course, the student will be in a position to list out the factors

Outcomes: that influence the application of machine tools in the industrial environment.

UNIT – I

Introduction: Working and Auxiliary motions in Machine Tools, Parameters defining the working motions of a machine tool, determination of the forces acting on the tool, determination of the forces acting on the tool in certain machining operations and horse power requirement in lathe. Techno economical pre requisites for undertaking the design of new machine tool, General requirements of machine tool design. Engineering design process applied to machine tools.

Machine Tool Drives: Classification and choice of driving system, basic considerations in the design of drives, Mechanical and Hydraulic Transmission and its elements, Aim of speed and feed regulation.

UNIT – II

Design of Gear Box: Stepped regulation of speed, Design of speed gear box, feed gear box, Machine tool drives using multiple speed motors, Special cases of gear box design, General recommendations for developing the gearing diagram, Standardization of common ratio, Ray diagrams, Classifications of speed and feed boxes. Step less regulation of speed and feed rates (elementary treatment only)

Machine Tool Guide ways: Functions and types of guide ways, types of slide ways, Types of anti friction ways, Design of slide ways, Shapes of slide ways, Materials of slide ways, Methods of adjusting clearances in slide ways, Design criteria and calculations for slide ways, Design of slide ways for wear resistance, Design of slide ways for stiffness, Effect of lubrication and design of guide ways, Protecting devices for slide ways.

UNIT – III

Machine Tool Structures: Function of Machine Tool Structures and their requirements, Design criteria for machine tool structures, profile of machine tool structures, Basic design procedure of machine tool structures, Introduction to design of Beds, Columns and Housings.

Design of Spindle and Power Screws: Functions of spindle unit and requirements of spindles, Introduction to design of power screws, Design of sliding friction power screw, Design of rolling friction power screws.

UNIT – IV

Machine Tool Vibrations: Introduction, forced vibration, self excited vibration, forced and damped vibrations, stick- slip vibration in machine tools, vibration isolated tool holders.

Lubrication and Rigidity in Machine Tools:

Introduction, Steps in selecting proper lubricating oil, specification of lubricating oil, friction conditions of working, Rigidity of machine tool unit, Overall static rigidity of machine tool, Dynamic rigidity of machine tool.

Learning Resources:**Text books:**

- N. K. Mehata, “Machine Tool Design”, Tata Mc Graw Hill Publ. Co. Ltd., New Delhi.
- S. K. Basu & D. K. Pal, “Design of Machine Tools”, Allied Publishers, India.

Reference Books:

- G. C. Sen and A. Bhattacharyya, “Design and construction of Machine Tools”, New Central Book agency, Calcutta.
- F. Koenisberger, “Design principles of Metal Cutting Machine Tools”, Pergamon Press.
- N. Acherkhan, “Machine Tool Design”, Vol. 1 & 2 , and 3& 4, M I R Publishers, Moscow.

Web references:

- www.srmuniv.ac.in
- www.jntu.ac.in
- www.iitk.ac.in
- www.vit.edu

Other learning material such as computer based programs / CD, Professional standards / regulations

MIT Video lessons

IIT, NPTEL video lessons.

ME 8003/4
DESIGN FOR MANUFACTURING AND ASSEMBLY

Lecture : 4hrs/ Week	Internal Assessment:	30
Tutorial : -	Final Examination:	70
Practical : -	Credits:	4

Objectives: This course will introduce the principles of design for manufacturing and assembly. The course will begin by examining modern manufacturing operations including machining, casting, forging, welding, and assembly and specialized manufacturing processes. This will also introduce the Design for manufacturing principles, including how a design can be made suitable for various assembly process requirements.

Learning Outcomes: At the end of the course the students will be able to understand the various assembly methods and processes and design for assembly guidelines and the factors influencing the manufacturability of components and the use of tolerances in manufacturing. Students will experience the interactions between product design, material selection, manufacturing process selection, and cost. Also understand the relationships between customer desires, project materials, product design, and manufacturing process selection.

UNIT – I

INTRODUCTION TO DFM:Qualities of a designer - Systematic working plan - Factors influencing choice of materials - Manufacturing methods. Process capability. Tolerances - Relevant to manufacturing, assembly. Tolerance stack - effects on assembly - Methods of eliminating tolerance stack.

UNIT – II

FORM DESIGN - CASTING AND WELDING:Influence of loading, materials, production methods on form design. Casting considerations - Requirements and rules. Welding considerations - Requirements and rules. Redesign of components for castings. Redesign of components for welding. Case studies.

FORM DESIGN-FORGING

Forging considerations - Requirements and rules. Choice between casting, forging and welding. Redesign of components for forging. Case studies

UNIT – III

INTRODUCTION TO DFA:Distinction between assembly methods and processes. Factors determining assembly methods and processes. Design factors independent of methods and processes. Design factors dependent on methods. Design factors dependent on processes.

UNIT – IV

DESIGN FOR ASSEMBLY METHODS:Approaches to design for assembly - Approaches based on design principles and rules - Qualitative evaluation procedures, knowledge based approach, and Computer aided DFA methods. Assimilability measures. Boothroyd - Dewhurst DFA method - Redesign of a simple product. Case studies

Learning Resources:**Text books:**

- Harry Peck., Design for Manufacture, Pittman Publication, 1983
- Alan Redford and Chal, Design for Assembly - Principles and Procedures, McGraw Hill International Europe, London, 1994

Reference books:

- Robert Matousek., Engineering Design - A Systematic Approach, Blackie & Sons Ltd, 1963
- James G. Bralla, Hand Book of Product Design for Manufacturing, McGraw Hill Co., 1986
- Swift, K. G., Knowledge Based Design for Manufacture, Kogan Page Ltd., 1987

Web references:

- <http://www.npd-solutions.com>
- <http://poeth.com>
- <http://hubpages.com>
- www.sciencedirect.com
- <http://soa.asee.org>

ME 8051
CAD & CAM LABORATORY

Lecture : -	Internal Assessment:	25
Tutorial : -	Final Examination:	50
Practical : 3 hrs/ Week	Credits:	2

Objectives: Analysis of problems related to Mechanical and Production Engineering using a Finite Element Software ie ANSYS
Development of CNC programs& simulation of turning, milling, thread cutting etc.

Learning Outcomes: After successful completion of this course, the student will be able to know the use of ANSYS software for finite element analysis & the programming skills in CNC machine.

ANSYS software:

1. Static analysis of stepped bar
2. Static analysis of thick cylinder
3. Temperature distribution in the wall of a thick cylinder
4. Thermal stresses in thick cylinder
5. Combined static & thermal stresses in thick cylinder

CNC TRAINER LATHE:

1. Step turning
2. Taper turning
1. Profiles
2. Parting
3. Thread Cutting

CNC MILLING MACHINE: Production of various contours

Programming of Robot
Programming for A.G.V.

SIMULATION: Simulation using Flexsim

Simulation of Machine Shop with 2 or more machines using Flexsim
Simulation of Telephone Lines using Flexsim

User defined design based experiment

**ME 8052
PROJECT WORK**

Lecture : 2 hrs/ Week	Internal Assessment:	50
Tutorial : 6 hrs/ Week	Final Examination:	100
Practical : 10 hrs/ Week	Credits:	12

Objectives: Identification of an industrial / a theoretical problem of smaller scale in his/her field of interest, survey of existing literature and exposure to problem solving methodology are the main objectives.

Learning Outcomes: Exposure to research and development procedures, latest developments in the selected areas, software development, development of a prototype, solution to industrial / theoretical problems and publication of research paper in National or International conference.

Distribution of Marks:

Internal Evaluation : 50

Attendance	:	05
Seminar 1	:	10
Seminar 2	:	10
Viva & draft report	:	25

External Evaluation : 100

Report	:	60
Seminar	:	20
Viva	:	20