I SEMESTER	L	T	P	C
	3	-	-	3
16BS1T01: PROFICIENCY COURSE IN ENGLISH -I				

COURSE OBJECTIVES

1. To improve the language proficiency of technical under graduates in English with emphasis on LSRW Skills.
2. To provide learning environment to practice Listening, Speaking, Reading and Writing Skills within and beyond the classroom environment.
3. To assist students to carry on the tasks and activities through guided instructions and materials.
4. To effectively integrate English language learning with employability skills and training.
5. To design the main course material and exercises with authentic materials drawn from everyday use to cater to everyday needs.
6. To provide hands-on experience through case –studies, mini –projects, group and individual presentations.

COURSEOUTCOMES

A) Reading Skills:

- Addressing explicit and implicit meaning of a text.
- Understanding the context.
- Learning new words and phrases.
- Using words and phrases in different contexts.

B) Writing Skills:

- Using the basic structure of a sentence.
- Applying relevant writing formats to create paragraphs, essays, letters, e-mails, reports and presentations.
- Retaining a logical flow while writing.
- Planning and executing an assignment creatively.

C) Interactive skills:

- Analyzing a topic of discussion and relating to it.
- Participating in discussions and influencing them.
- Communicating ideas effectively.
- Presenting ideas coherently within a stipulated time.

D) Grammar in context:

- Enable the skills of grammar using in a situation
- Identifying the needs of apt grammar in life related situation
- Promoting discourse with grammar effectively

Syllabus:

S No	Content	Hours
UNIT –I	The Power of Prayer One word substitutes Nouns – Pronouns	8
UNIT –II	Is progress real? Commonly Confused words Verbs	8
UNIT-III	Secret of Work Collocations Adjectives ,Adverbs and Articles	8
UNIT-IV	An Astrologer's Day GRE words Prepositions and Sentences	8
UNIT-IV	Marriage Proposal Idioms Conjunctions and Interjections	8
UNIT-VI	The Road not Taken Phrasal Verbs Tenses	8
		48

TEXT BOOK: Proficiency Course in English, Semester –I by Maruti Publications.

I SEMESTER	L	T	P	C
	3	-	-	3
16MA1T01: DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS				

Prerequisites

Knowledge of differentiation, integration, logarithms, hyperbolic functions, and trigonometry is necessary**.** Concept of functions and their types, partial differentiation is also needed.

COURSE OBJECTIVES

1. The study of differential equations is introduced to make the students how to solve the problems in first order and first degree differential equations.
2. The study of second and higher order differential equations with constant coefficients.
3. To transform a given problem from one domain into another so that solving the corresponding problem becomes easier, Laplace transforms are introduced.
4. To know various physical and geometrical problems involving two or more independent variables, partial differential equations will be studied.

COURSE OUTCOMES

The students are able to

1. solve linear differential equations of all orders.
2. solve the first order partial differential equations.
3. apply the knowledge to find the expansions of functions using Taylors and Maclaurin's series.
4. solve many problems in engineering with the knowledge of Laplace transforms.

UNIT -I

Differential equations of first order and first degree

Linear – Bernoulli – Exact - Reducible to exact - Newton's Law of cooling-Law of natural growth and Decay - Orthogonal Trajectories.

UNIT –II

Linear differential equations of higher order

Non-homogeneous equations of higher order with constant coefficients with RHS term of the type e^{ax}, Sin ax, cos ax, polynomials in x, $e^{ax}V(x)$, $xV(x)$.Method of Variation of parameters for solving second order linear differential equations.

UNIT -III

Partial Derivatives

Taylor series and Maclaurin's series expansions of functions of single and two variables (without Proofs) - Jacobian, Functional dependence.

UNIT –IV

Partial Differential Equations

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions –solutions of first order linear (Lagrange) equation and nonlinear (standard type) equations- Solutions of Linear Partial differential equations with constant coefficients by the method of separation of Variables.

UNIT -V

Laplace transforms

Laplace transforms of standard functions-Shifting Theorems, Transforms of derivatives and integrals – Unit step function –Dirac's delta function.

UNIT –VI

Inverse Laplace transforms

Inverse Laplace transforms -Convolution theorem (without proof).

Application: Solutions of ordinary differential equations using Laplace transforms.

TEXT BOOKS:

1. **B.S. GREWAL**, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers.
2. **B.V. RAMANA**, Higher Engineering Mathematics, Tata McGraw Hill.

REFERENCE BOOKS:

1. **ERWIN KREYSZIG**, Advanced Engineering Mathematics, 9th Edition, Wiley-India

I SEMESTER	L	T	P	C
	3	-	-	3
16MA1T02: NUMERICAL METHODS & INTEGRAL TRANSFORMS				

PREREQUISITES

The two year intermediate course of Mathematics.

COURSE OBJECTIVES

1. To give a good training to the student in each topic and method.
2. To get the good results of the student in competitive examinations like GRE, GATE etc., by training in this context.
3. To develop the skills of the student to solve the different mathematical methods efficiently to meet the needs of solving the different mathematical models involving in real world process and engineering.
4. To motivate the student for innovating ideas by learning mathematical methods in the context of the real world applications and the need of the world.
5. To produce the competent engineers and professional, to meet the needs of industries in the context scenario.

COURSE OUTCOMES

Students are able to

1. solve the algebraic and transcendental equations by different methods and also know the different interpolation formulae to find a polynomial or the value of the polynomial at a given point.
2. find the quadrature, the solutions of ODEs by different formulae.
3. solve the problems on Z-transforms and Fourier transforms.
4. interpret a function as a Fourier series.

UNIT-I

Solution of Algebraic and Transcendental Equations: Introduction - Bisection Method - Method of False Position - Iteration Method - Newton Raphson Method.

UNIT-II

Interpolation: Introduction - Finite differences - Forward Differences Backward differences - Central differences - Symbolic relations, Differences of a polynomial - Newton's formulae for interpolation - Lagrange's Interpolation formula for unevenly spaced points.

UNIT-III

Numerical integration and solution of ordinary differential equations: Numerical Integration: Trapezoidal rule - Simpson's 1/3 rule - Simpson's 3/8 rule.

Numerical Solution of Ordinary Differential Equations: Solution by Taylor's series method - Euler's Method - Euler's Modified Method - IV order Runge Kutta Method

UNIT-IV

Z-Transform: Introduction - properties - Damping rule - Shifting rule - Initial and final value theorems - Inverse z transform- -Convolution theorem.

Applications: Solution of difference equations by Z-transforms.

UNIT–V

Fourier Series: Introduction- Determination of Fourier coefficients - even and odd functions - change of interval - Half-range sine and cosine series

UNIT – VI

Fourier Transforms: Fourier integral theorem (statement only) - Fourier Transforms, Fourier sine and cosine transforms - properties - inverse transforms - Finite Fourier transforms.

TEXT BOOKS:

1. **B.S. GREWAL**, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers.
2. **B.V. RAMANA**, Higher Engineering Mathematics, Tata McGraw Hill.

REFERENCE BOOKS:

1. S. S. Sastri (PHI), Introductory Methods of Numerical Analysis 5th Edition.
2. ERWIN KREYSZIG, Advanced Engineering Mathematics, 9th Edition, Wiley-India

I SEMESTER	L	T	P	C
	3	-	-	3
16BS1T02: ENGINEERING CHEMISTRY				

COURSE OBJECTIVES

1. For prospective engineers knowledge about water used in industries (boilers etc) and for drinking purposes is useful hence chemistry of hard water, boiler troubles and modern methods of softening hard water is introduced.
2. Knowledge of galvanic cells, electrode potentials is necessary for engineers to understand corrosion problem and its control, also this knowledge helps in understanding modern bio-sensors, fuel cells improve them.
3. The problem associated with corrosion are well known and the engineers must be aware of these problems and also how to counter them.
4. A board understanding of the more important fuels employed on a large scale is necessary for engineer to understand energy – related problems and solve them.
5. Plastics are materials used very widely an engineering materials. An understanding of properties particularly physical and mechanical properties of polymers / plastics/elastomers helps in selecting suitable materials for different purpose.
6. With the knowledge available now, future engineers should know at least some of the Engineering materials that are becoming available. Hence some of them are introduced here.

COURSE OUTCOMES

1. Student able to understand how to produce soft water & potable water by various methods.
2. Student can learn about nature and working various electrodes and cells.
3. Student can able to understand how to protect metals from the environment
4. Student can understand the importance of fuels and characteristics and HCV & LCV.
5. Student can understand the properties of polymers & their applications in our day today life.
6. Student can understand the building materials, solar materials and Nanomaterials and principles of green chemistry.

UNIT-I

WATER TECHNOLOGY

Hard Water – Estimation of Hardness By EDTA Method – **Potable Water**- Sterilization and Disinfection – Boiler Feed Water – **Boiler Troubles** – Priming And Foaming , Scale Formation, Boiler Corrosion, Caustic Embrittlement – **Softening of Water** - By Lime Soda, Zeolite Processes – Ion Exchange Process – Desalination Process by - Reverse Osmosis – Electro Dialysis.

UNIT-II

ELECTRO CHEMISTRY

Electro Potential –Determination of single electrode potential –Standard electrode potential - Nernst Equation(problems)–Electro Chemical cell (Galvanic Cell) -**Reference Electrodes**-Standard Hydrogen Electrode, Calomel Electrode Determination of pH and conductivity – Applications (Strong Acid Vs Strong Base) - **Batteries** – Primary Cell: Dry Cell – Secondary Cell: Lead Acid Accumulator, Lithium Ion Battery – **Fuel Cells** – Hydrogen – Oxygen Fuel Cell, Methanol – Oxygen Fuel Cell.

UNIT-III

CORROSION

Introduction - **Theories of Corrosion**(i) Dry Corrosion (Pilling Bed worth rule) (ii) Wet Corrosion – Galvanic Series – **Types of Corrosion**: Galvanic Corrosion, Differential Aeration Corrosion, Pitting Corrosion, Stress Corrosion – Factors Influencing Corrosion – Nature of The Metal , Nature of The Environment – **Corrosion Control**: Material Selection & Design –Cathodic Protection- Surface Coatings – Methods of Applications on Metals -Hot Dipping , Electroplating, Electroless Plating – Paints – Their Constituents & Their Function.

UNIT-IV

FUELS

Introduction to Fuels – Classification – **Solid Fuels** Merits & Demerits - Calorific Value – HCV and LCV – Bomb Calorimeter - Problems Based on Calorific Values – Analysis of Coal (Proximate and Ultimate Analysis) – Numerical Problems Based on Analysis – **Liquid Fuels** Merits & Demerits – Petroleum – Refining – Cracking(types) –Petrol – Diesel Knocking – Octane Number, Cetane Number - **Gaseous Fuels** Merits & Demerits – Natural Gas – LPG, CNG.

UNIT-V

POLYMERS SCIENCES & TECHNOLOGY

POLYMERS- introduction – Types of Polymers–Mechanism of Polymerization (Addition and Condensation) – Determination of Molecular weight by weight and number average methods - Individual Polymers (Preparation Properties and uses of PS, PVC and Bakelite) – Biodegradable polymers – Ziegler Natta Catalysis.

PLASTICS – Types – Compounding of Plastics –Moulding (Four Types) - Bullet Proof Plastics – Engineering Applications.

RUBBER &ELASTOMERS: Introduction –Preparation – Vulcanization – Compounding of Rubber – Preparation, Properties Uses of Buna-S, Buna-N and Thiokol-Engineering Applications.

UNIT VI

ENGINEERING MATERIALS, GREEN AND NANO CHEMISTRY

Refractories (Types, Properties Applications) – **Cement**-Hardening and Setting-Deteriorations of cement concrete – **Solar Energy Materials –** Introduction - Advantages and Disadvantages – Construction and Working of Photovoltaic cell – Solar Reflectors - **Carbon Nano tubes** - Preparation (Arc discharge, Laser Ablation, Chemical Vapor Deposition (CVD) methods), Properties & Applications – **Green Chemistry** – Principles -Engineering Applications.

TEXT BOOKS:

1. N. Y. S. Murthy, V. Anuradha, K Ramana Rao" A Text Book of Engineering Chemistry", Matuthi.
2. K.Sesha Maheswaramma and Mridula chugh (2013) A Text Book of Engineering Chemistry, Pearson Publications.

REFERENCE BOOKS:

1. Shashi Chawal "A Text Book of Engineering Chemistry, Dhanpat Rai Publishing company Ltd.
2. S. S. Dara (2013) Text Book of Engineering Chemistry, S. Chand Technical Series.

I SEMESTER	L	T	P	C
	3	-	-	3
16CS1T01: FUNDAMENTALS OF COMPUTERS AND C PROGRAMMING				

Prerequisites

Basic Mathematical Problems and their Solutions

COURSE OBJECTIVES

1) To enable the student to learn about the major components of a computer system.
2) To introduce the basic structure of the Algorithm and Flowchart.
3) To know the concepts of conditional & loop statements.
4) To implement the different user defined and pre-defined functions.
5) To know the pointers, structures and unions concept used in various areas.
6) To provide practical, hands-on training in C programming.

COURSE OUTCOMES

The student will be proficient in the following:

1) Identification and Usage of each part of a computer system.
2) The Evolution and Purpose of Programming.
3) Mastering in basic programming concepts and logic implementations.
4) Knowledge in file I/O operations (i.e. open, close, read, write, seek)
5) Ability to identify and implement appropriate Solution for a given Problem.
6) Know the terms "Structured Programming", “Algorithm” ,”Flowchart” ,"Data Types", “Control Statements”, “Arrays”, “Functions” , “Pointers”, “Structures”, “Unions”, ” File I/O” and where they are applicable.

UNIT-I

COMPUTER FUNDAMENTALS

Computer System:definition, block diagram,**Hardware:**components, mother board layout,block diagram of mother board,**Software:**definition,types of software, **Algorithm:** definition, properties of algorithm, algorithms on basic problems,**Flowchart:** definition, symbols used in flow charts, flow charts for basic problems,types of computer Languages, bits, bytes,binary system.

UNIT-II

FUNDAMENTALS OF C LANGUAGE

Character Set, Tokens, Identifiers,Constants,Basic Data Types and Sizes,Arithmetic Operators, Relational Operators, Logical Operators, Conditional Operator, Increment and Decrement Operators, Assignment Operators, Bit-wise Operators, Special Operators, Expressions, Operator Precedence and Order of Evaluation, Evaluation of Expressions, Type Conversions: Implicit and Explicit, Structure of C Program.

UNIT-III

CONTROL STRUCTURES

Selection Statements: Simple if, if-else Statement, Nested ifStatement, else-ifLadder, switch Statement.

Iterative Statements: while, do-while and for loops, break and continue statements, goto statement.

ARRAYS

Array definition, declaration, initialization and accessing array elements of 1-D and2-D arrays.

STRINGS

String definition, declaration, initialization and accessing, string handling functions in **string.h**

UNIT-IV

FUNCTIONS

Introduction to Function, Types of Functions, Return Statement,Declaration, Definition and Calling a Function, Parameter Passing Techniques,Storage Classes, Passing 1-D Array to Functions.

Recursion: Types of recursion, rules of recursion, recursive solutions for factorial of a number, Fibonacci Series and GCD of two numbers.

C Preprocessors: File Inclusion and Macro Substitution.

UNIT-V

POINTERS

Pointer Definition, Declaration, Initialization and Accessing a Pointer, void pointer, null pointer, Pointer Arithmetic, Pointer to Pointer, Dynamic Memory Management Functions.

STRUCTURES AND UNIONS

Definition, Declaration and Initialization of Structures, Accessing Structures, Nested structures, Array of Structures, Pointer to structures

Definition, Declaration and Initialization of Unions, difference between structures and unions

UNIT-VIFILES

Introduction to Files, File I/O functions, File opening modes, sequential and random accessing files, file operations.

TEXT BOOKS

1. Programming in ANSI C	E. Balagurusamy	TMH

REFERENCE BOOKS

1. Programming with ANSI and Turbo C	Ashok N. Kamthane	Pearson
2. Let us C	YashwantKanetkar	BPB
3. The C Programming Language	Kernighan & Ritchie	PHI
4. Programming in C	PradipDey&ManasGhosh	Oxford

I SEMESTER	L	T	P	C
	3	-	-	3
16BS1T04: ENVIRONMENTAL SCIENCE				

COURSE OBJECTIVES

The objectives of the course is to impart

1. Overall understanding of the natural resources.
2. Basic understanding of the ecosystem and its diversity.
3. Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities.
4. An understanding of the environmental impact of developmental activities.
5. Awareness on the social issues, environmental legislation and global treaties.

COURSE OUTCOMES

After completion of the course student able to understand:

1. The natural resources and their importance for the sustenance of the life and recognize the need to conserve the natural resources.
2. The concepts of the ecosystem and its function in the environment. The need for protecting the producers and consumers in various ecosystems and their role in the food web.
3. The biodiversity of India and the threats to biodiversity, and conservation practices to protect the biodiversity.
4. Various attributes of the pollution and their impacts and measures to reduce or control the pollution along with waste management practices.
5. Social issues both rural and urban environment and the possible means to combat the challenges.
6. The environmental legislations of India and the first global initiatives towards sustainable development.
7. About environmental assessment and the stages involved in EIA and the environmental audit.

UNIT – I

Multidisciplinary nature of Environmental Science: Definition, Scope and Importance –Sustainability: Stockholm and Rio Summit–Global Environmental Challenges: Global warming and climate change, acid rains, ozone layer depletion.

UNIT - II

Natural Resources: Natural resources and associated problems

Forest resources – Use and over – exploitation, deforestation – Timber extraction – Mining, dams and other effects on forest and tribal people.

Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources

Food resources: World food problems, changes caused by non-agriculture activities-effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity

Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources.

Land resources: Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT – III

Ecosystem and its conservation: Concept of an ecosystem. - Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem - Ecological succession. - Food chains, food webs and ecological pyramids. - Introduction, types, characteristic features, structure and function of Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems.

UNIT-IV

Biodiversity and its management: Definition: genetic, species and ecosystem diversity- classification - Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: conservation of biodiversity

UNIT –V

Environmental Pollution: Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies.

Solid Waste Management: Sources, classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products.

UNIT - VI

Social Issues: Population growth and explosion, effects. Water conservation, rain water harvesting. Role of information Technology in Environment and human health. Environmental Protection Act -Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act -Wildlife Protection Act - Forest Conservation Act – Motor Vehicle Act - Issues involved in enforcement of environmental legislation.

Environmental Management: Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS, Environmental audit. Field work: visit to an industrial area/ecosystem area (Forest, Grassland, Desert, and Aquatic)

Text Books:

1. Environmental Studies by K. V. S. G. Murali Krishna, VGS Publishers, Vijayawada
2. A text book of Environmental Studies by C. P. Kaushik & Anubha Kaushik, New Age International Publishers.

Reference Books:

1. Text Book of Environmental Studies by Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
2. A text book of Environmental Studies by Shaashi Chawla, TMH, New Delhi.

I SEMESTER	L	T	P	C
	-	-	4	2
16BS1L01: ENGLISH PROFICIENCY LAB				

COURSE DESCRIPTION

Communicating in a language is also a skill. So a student has to look for an opportunity to practice English language in order to acquire proficiency in English. 'Strengthen your Communication Skills: Part - A' is designed to provide opportunities for engineering students to revise and consolidate the basic skills in listening, speaking, reading and writing in addition to giving ample practice in various communicative functions and Life skills.

PREREQUISITES

The student is expected to have basic knowledge in English language and must be able to write in English. He is also expected to possess fundamental knowledge of general English grammar and vocabulary.

COURSE OBJECTIVES

- To improve the language proficiency of technical under graduates in English with emphasis on LSRW Skills.
- To provide learning environment to practice Listening, Speaking, Reading and Writing Skills within and beyond the classroom environment.
- To assist students to carry on the tasks and activities through guided instructions and materials.
- To effectively integrate English language learning with employability skills and training.
- To design the main course material and exercises with authentic materials drawn from everyday use to cater to everyday needs.
- To provide hands-on experience through case-studies, mini-projects, group and individual presentations.

COURSE OUTCOMES

a) Reading Skills.

- Addressing explicit and implicit meaning of a text.
- Understanding the context.
- Learning new words and phrases.
- Using words and phrases in different contexts.

b) Writing Skills:

- Using the basic structure of a sentence.
- Applying relevant writing formats to create paragraphs, essays, letters, E-Mails, reports and presentations.
- Retaining a logical flow while writing.
- Planning and executing an assignment creatively.

c) Interactive skills:

- Analyzing a topic of discussion and relating to it.
- Participating in discussions and influencing them.
- Communicating ideas effectively.
- Presenting ideas coherently within a stipulated time.

d) Life Skills and Core Skills:

- Examining self-attributes and identifying areas that require improvement self-diagnosis, self-motivation.
- Adopting to a given situation and developing a functional approach to find solutions-adaptability, problem-solving.
- Understanding the importance of helping others-community service, enthusiasm.

WEEK	TOPIC
1	Introduction to syllabus UNIT- 1 Section-A Greeting, Introducing and taking leave
2	UNIT- 1 Section-B Pure Vowels
3	UNIT- II Section-A Giving Information and Asking for information
4	UNIT- II Section-B Diphthongs
5	UNIT- III Section-A Inviting, Accepting and Declining Invitations
6	UNIT- III Section-B Consonants
7	UNIT- IV Section-A Commands, Instructions and Requests
8	UNIT- IV Section-B Accent and Rhythm
9	UNIT- V Section-A Suggestions and Opinions
10	UNIT- V Section-B Intonation
10WEEKS	TOTAL

TEXT BOOKS:

Strengthen Your Communication Skills: Part – A by Maruthi Publications.

REFERENCE BOOKS:

1) INFOTECH English (Maruthi Publications)
2) Personality Development and Soft Skills (Oxford University Press, New Delhi)

I SEMESTER	L	T	P	C
	-	-	4	2
16BS1L02: ENGINEERING CHEMISTRY LAB				

COURSE OBJECTIVES

1. To Investigate and understand physical behavior in the lab using scientific reasoning and logic and interpret the result of simple experiments and demonstration of chemical principles and also evaluate the impact of chemical discoveries on how we view the world.
2. Effectively communicate experimental results and solutions to application problems through oral and written reports.
3. Understand the basic concepts, definitions, characteristics and phenomena's.
4. Recognize the classical ideas and chemical phenomena and also define and analyze the concepts.

COURSE OUTCOMES

1. An understanding of professional and develop confidence on recent trends
2. Able to gain technical Knowledge of measuring, operating and testing of chemical instruments and equipment's.
3. Acquire ability to apply knowledge of Chemistry.
4. Exposed to the real time working environment.
5. Demonstrate the ability to learn principles, design and conduct experiments
6. Ability to work on laboratory and multidisciplinary tasks

List of Experiments

S. No	TITLE
	Introduction to chemistry lab
1	Estimation of HCl using standard Na_2CO_3
2	Determination of Total hardness of water
3	Estimation of Ferric iron
4	Estimation of $KMnO_4$ using standard $H_2C_2O_4$
5	Estimation of Dissolved Oxygen by Wrinkles Method
6	Determination of pH by pH – Meter and universal indicator Method
7	Conductometric titration of Strong acid Vs Weak base
8	Conductometric titration of strong acid **Vs** Strong base
9	Potentiometric titration of Strong acid Vs Strong base
10	Potentiometric titration of Strong acid Vs Weak base
11	Preparation of Phenol-Formaldehyde Resin
12	Determination of saponification value of oils
13	Determination of Pour and Cloud point of oils

TEXT BOOKS:

1. Engineering Chemistry Lab Manual Prepared by Chemistry Faculty.

REFERENCE BOOK:

1. Dr. Jyotsna Cherukuis(2012)Laboratory Manual of Engineering Chemistry-II, VGS Techno Series
2. K. Mukkanti (2009) Practical Engineering Chemistry, B. S. Publication.

I SEMESTER	L	T	P	C
	-	-	4	2
16CS1L01: C PROGRAMMING LAB				

COURSE OBJECTIVES

1. The Objective of this course is to introduce the field of programming using C language.
2. To have fundamental knowledge on basics of computers hardware and number systems.
3. To enhance their analyzing and problem solving skills and use the same for writing programs.
4. To learn and acquire art of computer programming.
5. The nature of C language is emphasized with a wide variety of examples.
6. To write efficient, maintainable, and portable code.

COURSE OUTCOMES

After Completion of the course student are

1. Able to identify different components of computer and their usage.
2. Able to write algorithms and flowcharts for basic problems.
3. Able to know concepts in problem solving.
4. Able to write, compile and debug programs in C language.
5. Design programs involving decision structures, loops and functions, pointers.
6. Able to understand the basic terminology used in computer programming.
7. Use of different data types in program.
8. To write diversified solutions using C language.

EXERCISE-I

1) Identify different components of a computer system. Write about them.

2) Prepare block diagram of mother board of a PC and describe each component.

3) Prepare algorithm for sequence and selection control structures.

4) Prepare algorithm for iterative control structure

5) Draw flowcharts for control structures (sequence, selection & iterative).

EXERCISE-II

1) Demonstrate the structure of C program
2) Write a C program to find the size of basic data types in C language.
3) Write a C program to find the biggest of three numbers using ternary operator.
4) Write a C program to convert decimal number to binary number using bitwise operators.

EXERCISE-III

1) Write a C program to find the biggest of three numbers using nested if-else statement.
2) Write a C Program to find the roots of a quadratic equation.
3) Write a C program to perform arithmetic operations using switch statement.
4) Write a C program to calculate the electricity bill using else-if ladder statement.
5) Write a C program to find the sum of elements of an integer array.

EXERCISE-IV

1) Write a C program to find the smallest and largest elements of an integer array.
2) Write a C program to perform matrix addition by checking compatibility.
3) Write a C program to perform matrix multiplication by checking compatibility.
4) Write a C program to generate the prime numbers up to n.

EXERCISE-IV

1) Write a C program to find given number is Armstrong number or not
2) Write a C program to find the length of the string without using string functions.
3) Write a C program to check the given string is palindrome or not without using string functions.
4) Write a C program to perform string operations using string handling functions.

EXERCISE-VI

1) Write a C program to find the square of a number using function and macro.
2) Write a C program to demonstrate the use of static storage class.
3) Write a C program to pass array to function and count the sum of elements in the array.

EXERCISE-VII

1) Write C functions to generate Fibonacci series with and without using recursion.

2) Write C functions to factorial with and without using recursion.

3) Write C functions to GCD of two numbers with and without using recursion.

EXERCISE-VIII

1) Write a C program to find address of a variable and a pointer variable.

2) Write a C functions to swap two numbers using call by value and call by reference

3) Write a C program to print employee details using structures and array of structures.

EXERCISE-IX

1) Write a C program to read and write individual characters to a file.

2) Write a C program to copy contents of one file to another.

3) Write a C program to reverse the contents in a file.

4) Write a C program to merge two files into third file.

II SEMESTER	L	T	P	C
	3	-	-	3
16BS2T01: PROFICIENCY COURSE IN ENGLISH -II				

COURSE OBJECTIVES

1. To improve the language proficiency of technical under graduates in English with emphasis on LSRW Skills.
2. To provide learning environment to practice Listening, Speaking, Reading and Writing Skills within and beyond the classroom environment.
3. To assist students to carry on the tasks and activities through guided instructions and materials.
4. To effectively integrate English language learning with employability skills and training.
5. To design the main course material and exercises with authentic materials drawn from everyday use to cater to everyday needs.
6. To provide hands-on experience through case –studies, mini –projects, group and individual presentations.

CORUSEOUTCOMES

a) Reading Skills.

- Addressing explicit and implicit meaning of a text.
- Understanding the context.
- Learning new words and phrases.
- Using words and phrases in different contexts.

b) Writing Skills:

- Using the basic structure of a sentence.
- Applying relevant writing formats to create paragraphs, essays, letters, e-mails, reports and presentations.
- Retaining a logical flow while writing.
- Planning and executing an assignment creatively.

c) Interactive skills:

- Analyzing a topic of discussion and relating to it.
- Participating in discussions and influencing them.
- Communicating ideas effectively.
- Presenting ideas coherently within a stipulated time.

d) Grammar in context

- Enable the skills of grammar using in a situation
- Identifying the needs of apt grammar in life related situation
- Promoting discourse with grammar effectively

Syllabus:

S No	Content	Hours
UNIT –I	Inspiring speech One word substitutes Subject- verb agreement Describing objects	8
UNIT –II	Dial 000 Commonly confused words Voice Paragraph writing	8
UNIT-III	My Struggle for Education Collocations Reported speech Letter writing	8
UNIT-IV	A Snake in the grass GRE words Conditional clauses Note making and note taking	8
UNIT-V	Lithuania Idioms Degrees of comparison Resume	8
UNIT-VI	Virtue Phrasal verbs Simple compound and complex sentences Report writing	8
	Total	48

TEXT BOOK: Proficiency Course in English -II by Maruti Publications.

II SEMESTER	L	T	P	C
	3	-	-	3
16MA2T01: LINEAR ALGEBRA & VECTOR CALCULUS				

PREREQUISITES

The two year intermediate course of Mathematics.

COURSE OBJECTIVES

1. To train the students for finding Rank –Echelon form, Normal form, and solution of liner systems – Direct Methods- Gauss Elimination, Gauss Jordon.
2. To train the student effectively how to find Eigen values, Eigen vectors and their properties.
3. To make the student to know the Cayley Hamilton Theorem-Applications: Finding Inverse and powers of a matrix by using Cayley-Hamilton theorem.
4. To evaluate many improper integrals easily by using Beta and Gamma functions.

COURSE OUTCOMES

The students are able to

1. apply the knowledge of matrices for solving linear system of equations
2. find the powers of the matrices by using Cayley Hamilton theorem.
3. apply the knowledge of evaluate improper integrals by using Beta and Gamma functions.
4. apply the knowledge of Vector Differentiation and Vector Integration in finding work done by a force.

UNIT-I

Linear systems of equations

Rank-Echelon form, Normal form – Solution of Linear Systems – Direct Methods- Gauss Elimination, Jacobi and Gauss Seidel Method.

UNIT-II

Eigen values - Eigen vectors

Eigen values - Eigen vectors - Properties (without proof)-Cayley-Hamilton Theorem (without proof) Applications: Finding Inverse and powers of a matrix by using Cayley-Hamilton theorem.

UNIT-III

Special functions

Beta and Gamma functions - Properties - Relation between Beta and Gamma functions Application: Evaluation of improper integrals.

UNIT-IV

Multiple integrals

Multiple integrals - Double and triple integrals - Change of variables - Change of order of Integration. Application: Applications of Integration to Lengths, Volumes and Surface areas of solids of revolution in Cartesian Coordinates.

UNIT-V

Vector Differentiation

Gradient- Divergence- Curl - Laplacian and second order operators -Vector identities.

UNIT VI

Vector Integration

Line integral - work done - Potential function - area - surface and volume integrals.

Vector integral theorems: Greens, Stokes and Gauss Divergence Theorems (without proof) and related problems.

Application: Work done by a force

TEXT BOOKS:

1. **B.S. GREWAL,** Higher Engineering Mathematics, 42nd Edition, Khanna Publishers
2. **B.V. RAMANA,** Higher Engineering Mathematics, Tata McGraw Hill

REFERENCE BOOKS:

1. ERWIN KREYSZIG, Advanced engineering Mathematics, 9th Edition, Wiley-India

II SEMESTER	L	T	P	C
	3	-	-	3
16EE2T02: BASIC ELECTRICAL AND ELECTRONICS				

COURSE OBJECTIVES

Students able to Understand

a) To study the concepts of various electrical elements, various network reduction techniques and AC circuits.
b) To understand the principle of operation and performance of DC and AC machines.
c) To study the principle of operation and working of various types of measuring instruments.
d) To study the construction details, operation and characteristics of various semiconductor devices, digital and logic operations.

COURSE OUTCOMES

Students are able to

a) Solve electrical networks with network topology concepts.
b) Analyze the characteristics and performance of DC and AC machines.
c) Choose right type of instrument for measurement of various electrical parameters.
d) Explain the operation and characteristics of various semiconductor devices and concepts of digital and logic operations.

UNIT – I

Introduction To Electrical Engineering: Basic Electrical circuit elements (Resistor, Inductor and capacitor)-voltage and current sources-Ohm's Law-Kirchhoff's Laws-series circuits-equivalent resistance-star/delta conversion- Node and mesh analysis of DC circuits - Simple problems.

Network Theorems (DC Excitation)-Superposition-Thevenin's-Norton's-Maximum Power Transfer Theorem-Simple problems

UNIT – II

Ac Fundamentals: Introduction to AC circuits-RMS value-average value-form and peak factors – Real and reactive power – Apparent power- power factor- Behavior of R, L, and C in AC Circuits-Introduction to three phase circuits- phase and line parameters-three phase balanced and unbalanced systems-Simple problems.

UNIT – III

Electrical Machines: DC Machines: Classification of DC Machines-DC Generator and Motor-Construction-Principle of operation –EMF Equation-Performance Characteristics-Simple problems

AC Machines: Classification of AC Machines-Transformers-Synchronous Machines, Induction motor-Performance Characteristics-Starting Methods-Simple problems**.**

UNIT – IV

Measurement and Measuring Instruments: Introduction – Analog and Digital Instruments – Passive and Active Instruments – Static

Characteristics – Linear and Non-linear Systems – Dynamic Characteristics – Classification of the Instrument System – Measurement of Error – Indicating type Instruments – Measurement of Power-Voltmeter and Ammeter method- two and three wattmeter method-Measurement of Energy.

UNIT-V

Semi-Conductor Devices And Its Characteristics : Characteristics of PN Junction Diode — Zener Diode- Intrinsic and Extrinsic Semiconductors – Semiconductor Diodes– Bipolar Junction Transistors-CB, CE, CC Configurations and Characteristics – FET – MOSFET – Silicon-controlled Rectifier – DIAC – TRIAC-Half waveand Full wave Rectifiers- Voltage Regulation.

UNIT – VI

Introduction To Digital Electronics : Binary Number System – Logic Gates – Boolean Algebra -De Morgan’s Theorem- Simplification of Boolean Expressions using De Morgan’s Theorem – Half and Full Adders – A/D and D/A Conversion.

TEXT BOOKS:

1. Electrical and Electronic Principles and Technology-John Bird, Published by Elsevier Ltd
2. Engineering Circuit Analysis – William H. Hayt& Jack E. Kemmerly, Tata McGraw-Hill Company,7thEdition.

REFERENCE BOOKS:

1. Basic Electrical and Electronics Engineering – S. K. Bhattacharya, Pearson Publications.
2. Basic Electrical & Electronics Engineering – J. B. Gupta, S. K. Kataria& Sons Publications.
3. A Course in Electrical and Electronic Measurements and Instrumentation – A. K. Sawhney,DhanpatRai& Co.
4. Electronic Devices and Circuit Theory – Robert L. Boylestad& Louis Nashelsky, Prentice- Hall of India, 6th Edition.
5. Electrical & Electronics Engineering – J. B. Gupta, S. K. Kataria& Sons Publications.

II SEMESTER	L	T	L	C
	3	-	-	3
16BS2T03: ENGINEERING PHYSICS				

COURSE OBJECTIVES

1) **Understand** the basic concepts, definitions, characteristics and phenomena.
2) **Recognize** the classical ideas and physical phenomena and also define and analyze the concepts.
3) **Assess the role of Science** and in particular, physics, in helping us better understanding the complex, technological society of which we are apart.
4) **Investigate** and understand physical behavior in the lab using scientific reasoning and logic and interpret the result of simpleexperiments and demonstration of physical principles and also evaluate the impact of physical discoveries on how we view the world.
5) **Solve** a variety of basic problems and given word problems, student will identify the physical principle required to solve the problem, formulate the equationnecessary to solve the problem.
6) **Effectively communicate** experimental results and solutions to application problems through oral and written reports.

   Explain physical phenomena using realistic mathematical modeling at the level of general physics

COURSE OUTCOMES

Student able to understand:

1. Basic crystal systems and determination of crystal structures.
2. Proper choice of Magnetic/Dielectric Materials as per the functionality of appliance could be realized.
3. Concept of Magnetic Induction and Maxwell's equations.
4. Application of Schrodinger equation and Concept of band theory of solids.
5. Pure & doped Semiconductor devices for better utility.
6. Optical properties of solids and super conducting properties of solids and their applications.

UNIT-I

CRYSTALLOGRAPHY AND X-RAY DIFFRACTION

Introduction – Space lattice – Basis – Unit Cell – Lattice parameters – Bravais lattices – Crystal systems – Structures and packing fractions of SC,BCC and FCC-Directions and planes in crystals – Miller indices – Separation between successive (h k l) planes – Bragg's law- Bragg's Spectrometer.

UNIT-II

MAGNETIC AND DIELECTRIC PROPERTIES

MAGNETIC PROPERTIES: Origin of magnetic moment-Magnetic Materials: Classification of Magnetic Materials and properties - Hysteresis Loop of ferromagnetic material.

DIELECTRIC PROPERTIES: Introduction - Electronic, ionic and orientational (Qualitative) polarizations - Internal fields in solids – Clausius - Mossotti equation.

UNIT-III

ELECTROMAGNETISM

Introduction-Concept of Electric Flux - Gauss's Law – Integral and Differential forms - Magnetic Field – The Biot-Savart's Law - Ampere's Law - B for a Solenoid - Faraday's Law of induction - Lenz's law - Displacement Current - Maxwell's Equations.

UNIT –IV

QUANTUM MECHANICS AND BAND THEORY OF SOLIDS:

De Broglie concept of matter waves, Schrodinger Time Independent wave equation – Application to a Particle in a box- Defects of Classical free electron theory of metals – Quantum free electron theory – concept of Fermi energy - Bloch theorem (qualitative) – Kronig – Penney model – Origin of energy band formation in solids – Classification of materials into conductors, semiconductors & insulators.

UNIT – V

SEMICONDUCTOR PHYSICS

Introduction – Intrinsic semiconductor and carrier concentration – Equation for conductivity – Extrinsic semiconductor and carrier concentration – Drift and diffusion currents – Einstein's equations - Hall Effect and its applications.

UNIT-VI

LASERS AND SUPER CONDUCTIVITY

LASERS: Introduction– Characteristics of lasers – Spontaneous and Stimulated emission of radiation – Einstein's coefficients – Population inversion - Three level and four level laser pumping schemes - Ruby laser – Helium-Neon laser- Applications of Laser.

SUPERCONDUCTIVITY: General properties – BCS Theory of Superconductivity - Meissner effect – Type-I and Type-II superconductors – Flux quantization –Josephson effects – Applications of Superconductors.

TEXT BOOKS

1. A text book of Engineering Physics by M-N- Avadhanulu & P.G. Kshirasagar (S-Chand publications)
2. Engineering Physics by R.K. Gaur and S.L. Gupta.

REFERENCE BOOKS

1 Engineering Physics‟ by Palanisamy (Scitech Publishers)
2 Engineering Physics by Mani Naidu S (Pearson Publications)
3 Introduction to solid state physics‟ by Charles Kittle (Willey India Pvt-Ltd)
4 Applied Physics‟ by T. Bhimasenkaram (BSP BH Publications)
5 Applied Physics‟ by M. Arumugam (Anuradha Agencies)
6 Physics by David Halliday and Robert Resnick – Part I and Part II

II SEMESTER	L	T	L	C
	3	-	-	3
16ME2T02: ENGINEERING MECHANICS				

COURSE OBJECTIVES

1. To understand the vectorial and scalar representation of forces and moments, static equilibrium of particles and rigid bodies in two and three dimensions.
2. To understand the principle of work and energy, the effect of friction in equilibrium, the kinematics and laws of motions and the dynamic equilibrium.

COURSE OUTCOMES

At the end of the course student able to

1. Analyze the principles of statics of particles to solve engineering problems.
2. Establish various forces and moments acting on rigid bodies.
3. Define properties and theories related to surfaces and solids.
4. Describe the principles of various types of friction.
5. Analyze the principles of dynamics of particles to solve engineering problems.

UNIT– I

CONCURRENT FORCES IN A PLANE: Principles of statics, composition and resolution of forces, Equilibrium of concurrent forces in a plane, Method of projections, Equilibrium of three forces in a plane, Method of moments.

PARALLEL FORCES IN A PLANE: Two parallel forces, General case of parallel forces in a plane, Center of parallel forces

UNIT – II

GENERAL CASE OF FORCES IN A PLANE: Composition of forces in a plane, Equilibrium of forces in a plane

FORCE SYSTEMS IN SPACE: Concurrent forces in space: method of projections, Method of moments, couples in space, Parallel forces in space, General case of forces in space

UNIT – III

FRICTION: Introduction, Angle of Repose, Laws of Friction, and Friction of Bodies moving Up and Down on an Inclined Plane, Wedge Friction, Screw Jack.

UNIT - IV

CENTROID AND CENTER OF GRAVITY: Centroid of simple figures and Centroid of Compositefigures. Center of Gravity of simple Bodies and Center of Gravity of Composite Bodies, Pappus Theorem.

MOMENT OF INERTIA: Introduction, Polar Moment of Inertia, Radius of Gyration, Parallel AxisTheorem, Moment of Inertia of Composite Areas, Product of Inertia.

MASS MOMENT OF INERTIA: Introduction, Radius of Gyration, Transfer Formula for CompositeBodies.

UNIT – V

KINETICS: Analysis as a Particle and analysis as a Rigid Body in Translation–Central Force Motion–Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies.

KINEMATICS: Rectilinear and Curvilinear Motion–Velocity and Acceleration–Motion of Rigid Body–Types and their Analysis in Planar Motion.

UNIT – VI

WORK-ENERGY METHOD:

Equations for Translation, Work-Energy Applications to Particle Motion, Connected System-Fixed Axis Rotation and Plane Motion. Impulse momentum method.

TEXT BOOKS:

1. ENGINEERING MECHANICS - S. Timoshenko & D.H. Young, McGraw Hill.2017
2. ENGINEERING MECHANICS - A.K.TAYAL – UMESH Publications.2009
3. ENGINEERING MECHANICS - BASUDEB BHATTACHARYA – Oxford University Press. 2014

REFERENCE BOOKS:

1. ENGINEERING MECHANICS - A. NELSON, McGraw Hill Publications.2009
2. ENGINEERING MECHANICS - Ferdinand L. Singer, Harper Collins Publishers.1994
3. ENGINEERING MECHANICS - S. S. Bhavikatti, New Age Publishers.2010

II SEMESTER	L	T	P	C
	1	-	4	3
16ME2T01: ENGINEERING DRAWING				

COURSE OBJECTIVE

Engineering drawing is the principle method of communication for engineers.The objective to introduce the students, the techniques of constructing the various types of polygons and curves. The objective is also to visualize and represent the 3D objects in 2D planes with proper dimensioning, scaling etc.

COURSE OUTCOMES

1. Usage of drawing instruments and construct polygons.
2. Understand the orthographic projections of points, lines and planes in different positions.
3. Understand the orthographic projections of Solids.
4. Convert the Orthographic projections into Isometric and vice versa.

UNIT - I

INTRODUCTION: Engineering Drawing and Plane Curves, Use of Drawing Instruments andConventions.

GEOMETRICAL CONSTRUCTIONS: Constructions of Polygons using General Method.

CONICS: Construction of Ellipse, Parabola and Hyperbola by Eccentricity Method.

CYCLOIDAL CURVES: Construction of Cycloid, Epi-Cycloid and Hypo-Cycloid.

UNIT - II

PROJECTIONS OF POINTS AND LINES: Introduction to Orthographic Projections - Projection ofPoints.

PROJECTION OF STRAIGHT LINES: Parallel to both the Planes, Parallel to One Plane and Inclined to Other Plane, Inclined to Both the Planes.

UNIT – III

PROJECTIONS OF PLANES: Introduction to Perpendicular Planes, Perpendicular to both theReference Planes, Perpendicular to One Plane and Parallel to Other Plane, Perpendicular to One Plane and Inclined to Other Plane, Inclined to Both the Reference Planes.

UNIT – IV

PROJECTIONS OF SOLIDS: Projections of Simple Solids like Prism, Cylinder, Pyramids and Cones.Projections of Solids with Axis Perpendicular to one Plane, Projections of Solids with Axis Parallel to Both the Planes.

UNIT – V

PROJECTIONS OF SOLIDS – AXIS INCLINED TO ONE PLANE: Projections of Solids with Axis inclinedto one plane and parallel to other Plane (Axis inclined to the VP and Parallel to the HP, Axis Inclined to the HP and Parallel to the VP).

UNIT – VI

ISOMETRIC PROJECTIONS: Principles of Isometric Projections - Isometric Scale, IsometricProjections of Planes, Simple Solids, Conversion of Isometric to Orthographic Views and Vice Versa.

TEXT BOOKS:

1. Engineering Drawing by N.D. Bhatt, Charotar Publishers.2016
2. Engineering Drawing by K.L. Narayana & P. Khannaiah., SCIETECH Publishers. 2010

REFERENCE BOOKS:

1. Engineering Drawing by M.B. Shah & B.C. Rana., Pearson's Publishers. 2009
2. Engineering Drawing by K. Venugopal., NEW AGE Publications. 2006

II SEMESTER	L	T	P	C
	-	-	4	2
16BS2L01: ENGLISH COMMUNICATION SKILLS LAB				

COURSE DESCRIPTION

Communicating in a language is also a skill. So a student has to look for an opportunity to practice the language he is learning in order to acquire communication skills. 'Strengthen your Steps' is designed to provide opportunities for engineering students to revise and consolidate communication skills in different contexts formal and informal. It prepares the student for facing Interviews, participating in group discussions and making presentations.

PREREQUISITES

The student is expected to have basic knowledge in English language and must be able to write in English.He is also expected to possess fundamental knowledge of general English grammar and vocabulary.

Syllabus and Lesson Plan

No. of Sessions	Name of the Topic
2	Unit - 6 Body Language
2	Unit - 7 Dialogues
2	Unit - 8 Presentation Skills
2	Unit - 9 Group Discussion
2	Unit - 10 Interviews and Telephonic interviews.
2	Unit - 11 Debates
12	**Total**

TEXT BOOK:

1. Strengthen Your Communication Skills – Maruthi Publications.

REFERENCE BOOKS:

1. Effective technical communication – Ashraf Rizvi.
2. A course in English communication – Madhavi Apte.

II SEMESTER	L	T	P	C
	-	-	4	2
16BS2L03: ENGINEERING PHYSICS LAB				

COURSE OBJECTIVES

1. To Investigate and understand physical behavior in the lab using scientific reasoning and logic and interpret the result of simple experiments and demonstration of physical principles and also evaluate the impact of physical discoveries on how we view the world.
2. Effectively communicate experimental results and solutions to application problems through oral and written reports.
3. Understand the basic concepts, definitions, characteristics and phenomena's.
4. Recognize the classical ideas and physical phenomena and also define and analyze the concepts.

COURSE OUTCOMES

1. An understanding of professional and develop confidence on recent trends
2. Able to gain technical Knowledge of measuring, operating and testing of physics instruments and equipment's.
3. Acquire ability to apply knowledge of Physics.
4. Exposed to the real time working environment.
5. Demonstrate the ability to design and analyze Laws and Principles and conduct experiments
6. Ability to work on laboratory and multidisciplinary tasks

List of Experiments

Any Ten Experiments of the Following

A. Mechanics:

1. Determination of the Rigidity Modulus of given material wire using Torsional Pendulum.
2. Determination of the Acceleration due to Gravity and Radius of Gyration using Compound Pendulum.
3. Determination the Frequency of vibration in Transverse and Longitudinal Modes using Melde's Apparatus.
4. Determination Frequency of A.C supply by using Sonometer

B. Optics:

1. Determination of wavelength of Laser using diffraction grating.
2. Determination of Numerical Aperture of an Optical Fiber.
3. Determination of the Planck's constant using Photo-Cell.

C. Electro-Magnetism and Electronics:

1. Study the variation of Magnetic Field along the axis of a solenoid coil using Stewart-Gee'sApparatus.
2. Determination of the Time Constant for a C-R Circuit.
3. Determination of the Band Gap of a Semiconductor using a p-n junction diode.
4. Study of Characteristic curves (l/V) of a Zener diode to determine its Breakdown voltage.
5. Determination of Thermoelectric coefficient of a Thermistor by using its Characteristic curve.

REFERENCE BOOK:

1. Engineering Physics Lab Manual Prepared by Physics Faculty.

II SEMESTER	L	T	P	C
	-	-	4	2
16ME2L01: ENGINEERING WORKSHOP PRACTICE				

COURSE OBJECTIVE: To impart hands–on practice on basic Engineering trades and skills.

COURSE OUTCOMES:

1. Model and Develop various basic prototypes in the carpentry trade such as Lap joint, Dovetail joint, Mortise & Tenon joint and Cross-Lap joint.
2. Develop various basic prototypes in the trade of Sheet metal.
3. Understand various basic House Wiring Techniques and Forging Operations.
4. Identify different parts of Computer and its Operating Systems.

NOTE: At least **Two** Exercises to be done from each trade.

TRADE:

I. CARPENTRY:

1. CROSS LAP JOINT 2. DOVETAIL JOINT 3. MORTISE and TENNON JOINT

II. FITTING:

1. SQUARE FIT 2. V-FIT 3. HALF ROUND FIT

III. FORGING:

1. ROUND ROD TO SQUARE
2. S-HOOK
3. ROUND ROD TO SQUARE HEADED BOLT

IV. HOUSE WIRING:

1. PARALLEL/SERIES CONNECTION OF THREE BULBS
2. STAIR CASE WIRING
3. FLOURESCENT LAMP FITTING

V. SHEET METAL:

1. SQUARE TRAY 2. HOLLOW CYLINDER 3. OPEN SCOOP

MANUAL:

1. Engineering Work Shop Practice Lab Manual Prepared by Mechanical Faculty.

III SEMESTER	L	T	P	C
	3	1	-	4
16ME3T01: THERMODYNAMICS				

COURSE OBJECTIVES

1. To understand the basic concepts and basic laws of thermodynamics and their applications.
2. To understand the process of steam formation and its representation on property diagrams and to calculate the quality of the steam with the help of steam tables and charts.
3. To understand the operating principles of air standard cycles, thermal power cycles, Refrigeration cycles and their performance Evaluation.

COURSE OUTCOMES

At the end or the course student able to

1. apply basic principles and first law of thermodynamics to solve problems.
2. apply second law of thermodynamics and general thermodynamic property relations to solve problems.
3. describe the thermodynamic concepts of pure substances and identify their properties using standards.
4. analyze various power cycles, vapour power cycles and Refrigeration cycles.

UNIT – I

INTRODUCTION: BASIC CONCEPTS : System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Cycle – Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility – Energy in State and in Transition, Types, Work and Heat, Point and Path function. Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry – Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale.

UNIT II

FIRST LAW OF THERMODYNAMICS : Perfect Gas Laws – Equation of State, specific and Universal Gas constants – Joule's Experiments – First law of Thermodynamics – Corollaries – PMM I - First law applied to a Process –various Non-flow processes, properties, end states, Heat and Work Transfer, changes in Internal Energy – Throttling and Free Expansion Processes, First law applied to a flow system – Steady

Flow Energy Equation. – Flow processes – Deviations from perfect Gas Model – Vander Waals Equation of State – Compressibility charts.

UNIT – III

SECOND LAW OF THERMODYNAMICS: Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.

UNIT IV

PROPERTIES OF PURE SUBSTANCES : Pure Substances, p-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

UNIT - V

POWER CYCLES : Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.

UNIT – VI

REFRIGERATION CYCLES: Brayton and Rankine cycles – Performance Evaluation – combined cycles, Bell- Coleman cycle, Vapour compression cycle-performance Evaluation.

TEXT BOOKS:

1. **Engineering Thermodynamic** - P.K. Nag, 4th Edition, Tata McGraw Hill Education Private Limited, New Delhi. 2008
2. **A Text Book of Engineering Thermodynamics**- Fourth Edition, R.K. Rajput - Lakshmi Publications. 2015

REFERENCE BOOKS:

1. **K. Ramakrishna (2011)**, *Engineering Thermodynamics*, 2nd edition, Anuradha Publishers, India.
2. **Thermodynamics** – An Engineering Approach – Yunus Cengel & M.A.Boles, Tata McGraw Hill Publishing Company Limited, New Delhi. 2014
3. **An Introduction to Thermodynamics**- Y. V. C. Rao, Revised Edition, Universities Press, Hyderabad, India.2003

III SEMESTER	L	T	P	C
	3	1	-	4
16ME3T02: MECHANICS OF SOLIDS				

COURSE OBJECTIVES

1. To understand the basic concepts related tensile, compressive and shear stresses in engineering components.
2. To understand the basic principles of torsion in shafts, shear force and bending moment in beams, deflection in beams.
3. To understand the different stresses in Thin and Thick Cylinders

COURSE OUTCOMES

At end of the course student able to

1. Understand the concepts of Stress, Strain in different systems.
2. Understand and draw shear force and bending moment diagrams for different loads, different support arrangements and different configuration.
3. Determine Flexural stresses, Shear stresses and deflections of various cross sections of beams.
4. Understand concepts of Thin and Thick Cylinders.

UNIT - I

SIMPLE STRESSES & STRAINS : Elasticity and plasticity – Types of stresses & strains–Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Elastic module & the relationship between them – Bars of varying section – composite bars – thermal stresses. Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

UNIT-II

SHEAR FORCE AND BENDING MOMENT: Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, Uniformly Distributed Load, uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

UNIT-III

FLEXURAL STRESSES : Theory of simple bending – Assumptions – Bending equation – Determination of bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle sections – Design of simple beam sections

UNI- IV

SHEAR STRESSES: Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.

TORSION: Theory of simple torsion - Torsion of circular shafts, pure shear, transmission of power by circular shafts, Shafts in series, shafts in parallel.

UNIT-V

DEFLECTION OF BEAMS: Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, - Uniformly Distributed Load , Uniformly Varying Load. Mohr's theorems – Moment area method – application to Simple cases.

UNIT-VI

THIN CYLINDERS: Thin seamless cylindrical shells – Longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in cross section, and volume of thin cylinders – Riveted boiler shells – Thin spherical shells.

THICK CYLINDERS: lame's equation – cylinders subjected to internal and external pressures – compound cylinders.

TEXT BOOKS:

1. Strength Of Materials – S. Ramamrutham/Dhanpat Rai Publications. 2017
2. Strength Of Materials – R.K. Rajput/S.Chand. 2007
3. Engineering mechanics of solids – E.P.Popov/Prentice Hall Publications. 1998

REFERENCE BOOKS:

1. Strength Of Materials –R.S Khurmi ,N.Khurmi/ S.Chand Publications. 2015
2. Strength Of Materials – Jindal/ Umesh Publications
3. Analysis Of Structures – Vazirani And Ratwani-kanna publications. 2003

III SEMESTER	L	T	P	C
	3	-	-	3
16ME3T02: FLUID MECHANICS AND HYDRAULIC MACHINERY				

COURSE OBJECTIVES

The students completing this course are expected to understand the properties of fluids, its kinematic and dynamic behavior through various laws of fluids like continuity, Euler's, Bernoulli's equations, energy and momentum equations. Working and performance characteristics of various hydraulic machines like pumps and turbines.

COURSE OUTCOMES

At end of the course student able to

1. Understand and apply concepts of fluid statics, kinematics and dynamics for solving various fluid flow problems.
2. Analyze various losses in pipe flow problems and understand the measurement of flow.
3. Understand the concept of hydrodynamic force of jets on stationary and moving flat, inclined and curved vanes
4. Explain the working and performance of various types of turbines and pumps and their characteristics.

UNIT-I

FLUID STATICS: Dimensions and units- physical properties of fluids- specific gravity, viscosity and surface tension- vapour pressure and their influence on fluid motion- atmospheric gauge and vacuum pressure –measurement of pressure- Piezometer, U- Tube and Differential manometers.

UNIT-II

FLUID KINEMATICS: Stream line, path line, streak lines and stream tube-Classification of flows-steady & unsteady, uniform, non-uniform, laminar, turbulent, rotational, and irrational flows-Equation of continuity for one dimensional flow.

FLUID DYNAMICS: Surface and body forces -Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its application on force on pipe bend.

UNIT-III

CLOSED CONDUIT FLOW: Reynold's experiment- Darcy Weisbach equation - Minor losses in pipes- pipes in series and pipes in parallel - Total energy line-hydraulic gradient line.

MEASUREMENT OF FLOW: Pilot tube, venture meter, orifice meter and Flow nozzle

UNIT-IV

BASICS OF TURBO MACHINERY: Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes, Force exerted by jet of water on series of vanes.

UNIT-V

HYDRAULIC TURBINES: Classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies , hydraulic design –draft tube theory- functions and efficiency.

PERFORMANCE OF HYDRAULIC TURBINES: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

UNIT-VI

CENTRIFUGAL PUMPS: Classification, working, work done – Manometric head- losses and efficiencies specific speed- pumps in series and parallel-performance characteristic curves, NPSH.

RECIPROCATING PUMPS: Working, Discharge, slip, indicator diagrams.

TEXT BOOKS:

1. Hydraulics, fluid mechanics by P.N. MODI and S.M.SETH, Standard book house. 2015
2. A text book of Fluid Mechanics and Hydraulic Machines by R.K.Bansal, Laxmi Publications. 2004

REFERENCE BOOKS:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons. 2014
2. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.2007

III SEMESTER	L	T	P	C
	3	-	-	3
16ME3T02: METALLURGY & MATERIAL SCIENCE				

COURSE OBJECTIVE

To understand the basic fundamentals of Material science and Physical metallurgy. The basic concepts to be taught will help for the improvement, proper selection and effective utilization of materials which is essential to satisfy the ever increasing demands of the society.

COURSE OUTCOMES

At end of the course student able to

1. Understand the various structures of metals, their bonding and constitution of alloys.
2. Identify the amount of phase existed in different equilibrium diagram.
3. Understand the properties and applications of cast iron and steels
4. Identify the properties produced by annealing, Normalizing, Hardening, Tempering, age hardening process and properties and applications of ceramic materials and composite materials

UNIT – I

STRUCTURE OF METALS: Bonds in Solids–Metallic bond - crystallization of metals, grain and grain boundaries, effect of grain boundaries on the properties of metal / alloys – determination of grain size.

CONSTITUTION OF ALLOYS: Necessity of alloying, types of solid solutions, Hume Rotherys rules, intermediate alloy phases, and electron compounds.

UNIT -II

EQUILIBRIUM DIAGRAMS: Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of important binary phase diagrams of Cu-Ni-, Al-Cu, Bi-Cd, Cu-An, Cus-Sn and Fe-Fe_3C.

UNIT -III

CAST IRONS AND STEELS: Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheroidal graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.

UNIT – IV

HEAT TREATMENT: Effect of alloying elements on Fe-Fe_3C system, Annealing, normalizing, Hardening, TTT diagrams, tempering, Hardenability, surface - hardening methods, Age hardening treatment, Cryogenic treatment of alloys.

UNIT - V

NON-FERROUS METALS AND ALLOYS: Structure and properties of copper and its alloys, Aluminium and its alloys, Titanium and its alloy

UNIT – VI

CERAMIC MATERIALS: Crystalline ceramics, glasses, cermates, abrasive materials, Nano materials–definition, properties and applications of the above.

COMPOSITE MATERIALS: Classification of composites, various methods of component manufacture of composites, particle, reinforced materials, fiber reinforced materials, metal ceramic mixtures, metal – matrix composites and C – C composites.

TEXT BOOKS:

1. Introduction to Physical Metallurgy - Sidney H. Avener, Tata McGraw Hill Edition. 2006
2. Material Science and Engineering - V. Rahghavan , PHI Publications.2002

REFERENCE BOOKS:

1. Material science and metallurgy by V.D. Kodgire, S.V.Kodgire, Everest Publishing House. 2017
2. Engineering materials and metallurgy - R.K.Rajput, S.Chand & company, New Delhi. 2010
3. Material Science & Metallurgy by O.P.Khanna – Dhanpatrai publications. 2014
4. Material Science & Metallurgy by R.B.Choudary – Khanna Publicaations. 2007

III SEMESTER	L	T	P	C
	3	-	-	3
16BM3T01: MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS				

COURSE OUTCOMES

At the end of the course the student should be able to

1. Describe the importance of Managerial Economics and its utility in decision making
2. Understand the meaning and usefulness of production function and cost function in analyzing firm's production activity.
3. Comprehend the concept of Market structure, different types of Markets and pricing policies.
4. Identify different forms of business organizations and analyze their merits and demerits.
5. Evaluate the investment proposals through techniques of capital budgeting and Financial performance of the company through Financial Statements.

UNIT –I

Managerial Economics &Demand Analysis:

Definition – Nature and Scope - Relation with other disciplines - Concept of Demand-Types-Determinants - Law of Demand – Exceptions - Elasticity of Demand - Types and Measurement-Demand forecasting and its Methods.

UNIT –II

Production and Cost Analysis:

Production function - Law of Variable proportions - Isoquants and Isocosts -Law of returns - Economies of Scale - Cost Concepts - Fixed ,Variable Costs ,Explicit Costs , Implicit Costs & Opportunity cost - Cost Volume Profit Analysis - Break Even Point (Simple Problems)

UNIT -III

Market Structures & Pricing Policies:

Perfect Competition, Monopoly, Monopolistic Competition and Oligopoly – Features – Price & Output Determination - Pricing Methods

UNIT -IV

Forms of Organizations & Business Cycles:

Business Organization- Sole Trader – Partnership - Joint Stock Company - State/Public Enterprises and their forms - Business Cycles: Meaning and Features - Phases of Business Cycle.

UNIT - V

Introduction to Accounting:

Definition- Branches-Systems of Accounting-Single Entry- Double Entry System – Journal- Ledger-Trail Balance-Final Accounts (Simple problems)

UNIT – VI

Capital and Capital Budgeting:

Concept of Capital – Types -Sources of Capital-Long Term Sources-Equity, Preference and Debt Capital - Concept of Capital Budgeting-Cash Flow Estimation-Techniques of Capital Budgeting-Traditional and Modern Methods (Simple problems).

TEXT BOOKS:

1. Aryasri: Managerial Economics and Financial Analysis, 2/e, TMH, 2005.
2. T.V.Ramana & B. Kuberudu: Managerial Economics and Financial Analysis, Himalaya Publishing House,Mumbai
3. Varshney & Maheswari: Managerial Economics, Sultan Chand, 2003.

REFERENCE BOOKS:

1. Ambrish Gupta, Financial Accounting for Management, Pearson Education, New Delhi.
2. H. Craig Peterson & W. Cris Lewis, Managerial Economics, PHI, 4th Ed.
3. Suma Damodaran, Managerial Economics, Oxford University Press.
4. Lipsey & Chrystel, Economics, Oxford University Press.
5. S. A. Siddiqui & A. S. Siddiqui, Managerial Economics & Financial Analysis, New age International Space Publications.
6. Domnick Salvatore: Managerial Economics In a Global Economy, 4th Edition, Thomson.
7. Narayanaswamy: Financial Accounting A Managerial Perspective, PHI.
8. Raghunatha Reddy & Narasimhachary: Managerial Economics& Financial Analysis, Scitech.
9. S.N.Maheswari & S.K. Maheswari, Financial Accounting, Vikas.

III SEMESTER	L	T	P	C
	-	-	4	2
16ME3L01: MECHANICS OF SOLIDS AND METALLURGY LAB				

COURSE OBJECTIVE

To impart practical exposure on the microstructures of various materials and their hardness evaluation. Also to impart practical knowledge on the evaluation of material properties through various destructive testing procedures.

COURSE OUTCOMES

At the end of the lab student able to

1. Illustrate the impact resistance in machine components
2. Find out hardness of metals and rigidity modulus of spring.
3. Calculate Torsional rigidity and elasticity modulus
4. Compare microstructure of the material with standard structure
5. Observe the how the hardness is changes by Jomney end quench test

ANY 5 EXPERIMENTS FROM EACH SECTION A AND B.

SECTION - A

MECHNICS OF SOLIDS LAB:

1. Direct tension test
2. Bending test
3. Torsion test
4. Hardness test a) Brinell's hardness test b)Rockwell hardness test
5. Test on springs.
6. Impact test
7. Compression Test

SECTION - B

METALLURGY LAB:

1. Preparation and study of the Micro Structure of pure metals like Iron, Cu and Al.
2. Preparation and study of the Microstructure of Mild steels, low carbon steels, high – C steels.
3. Study of the Micro Structures of Cast Irons.
4. Study of the Micro Structures of Non-Ferrous alloys.
5. Study of the Micro structures of Heat treated steels.
6. Hardenability of steels by Jomney End Quench Test.
7. To find out the hardness of various treated and untreated steels.

III SEMESTER	L	T	P	C
	-	-	4	2
16ME3L02: FLUID MECHANICS AND HYDRAULIC MACHINERY LAB				

COURSE OBJECTIVE

To impart practical exposure on the performance evaluation methods of various flow measuring equipment and hydraulic turbines and pumps.

COURSE OUTCOMES

At the end of the lab student able to

1. Predict major and minor losses in various piping system.
2. Predict performance characteristics of various Turbines and Pumps.
3. Calibrate Venturi meter and Orifice meter.
4. Student can apply the impulse momentum concepts on jets.

List of Experiments:

1. Impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Performance Test on Single Stage Centrifugal Pump.
6. Performance Test on Multi Stage Centrifugal Pump.
7. Performance Test on Reciprocating Pump.
8. Calibration of Venturi meter.
9. Calibration of Orifice meter.
10. Determination of friction factor for a given pipe line.
11. Determination of loss of head due to sudden contraction in a pipeline.
12. Bernoulli's apparatus.

NOTE: Any 10 of the above 12 experiments are to be conducted.

III SEMESTER	L	T	P	C
	-	-	4	2
16EE3L02: ELECTRICAL AND ELECTRONICS LAB				

COURSE OBJECTIVES

This laboratory course will give a thorough knowledge about.

1. To Implement and verify circuit theorems
2. To give students a fair knowledge of testing different types of DC machines andTransformers.

COURSE OUTCOMES

At the end of the lab student able to

1. Acquire knowledge and skills about electric instruments, such as multimeter, oscilloscope
2. Verify in practice some important circuit Theorems and concepts, such as Thevenin,Superposition and Norton's.
3. Demonstrate knowledge of D.C. motor and generator operation and Transformer theory.

LIST OF EXPERIMENTS

1. Determine the voltage and current in given circuits using Kirchhoff's laws theoretically and verify the laws experimentally.
2. Verification of Thevenin's, Norton's and Superposition Theorems.
3. OC and SC test on transformers
4. Load test on DC Shunt generator and determine its characteristics.
5. Speed control of DC shunt motor by field and armature control.
6. Measurement of AC and DC voltages.
7. Measurement of power using two Wattmeter methods.
8. Implementation of digital functions using logic gates
9. Verification of Demorgan's theorems
10. Verification of truth tables of Logic Gates (OR, AND, NOT, NAND, NOR, EX-OR, EX-NOR)

REFERENCE BOOKS:

1. Department Lab Manual
2. Sudhakar.A and ShyamMohan.S.P, "C*ircuits and Networks Analysis and Synthesis"*, Fourth edition, Tata McGraw Hill Publishing Company Ltd., NewDelhi,
3. Schaum's Outline of Electric Circuits, Sixth Edition, Mahmood Nahvi, PhD, Joseph A. Edminister, McGraw-Hill Education.

IV SEMESTER	L	T	P	C
	3	1	-	4
16ME4T01: IC ENGINES AND GAS TURBINES				

COURSE OBJECTIVES

1. To make the student learn and understand the reasons and effects of losses in actual engine operation.
2. To familiarize the student with various engine systems along with their functions and necessity.
3. To make the student learn to perform testing on S.I and C.I engines for calculations of performance parameters.
4. To understand the gas turbine working and different operating cycles and learn the concepts of Jet propulsion and rocketry.

COURSE OUTCOMES

1. Students able to compare Air standard cycles and Actual cycles and compare various types of I.C Engines and cycles of operations
2. Students able to classify various types of compressors and understand the principle of operation.
3. Students can describe the working of gas turbines and its performance evaluation.
4. Students able to explain jet propulsion and Rocketry principles and its thermodynamics.

UNIT – I

ACTUAL CYCLES AND THEIR ANALYSIS: Introduction, Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blow down-Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines.

UNIT-II

I.C. ENGINES : Classification - Working principles, Valve and Port Timing Diagrams, Air – Standard, air-fuel and actual cycles - Engine systems – Fuel, Carburetor, Fuel Injection System, Ignition, Cooling and Lubrication, principle of wankle engine, principles of super charging and turbo charging.

UNIT – III

COMBUSTION IN S.I. ENGINES : Normal Combustion and abnormal combustion – Importance of flame speed and effect of engine variables – Type of Abnormal combustion, pre-ignition and knocking (explanation of) – Fuel requirements and fuel rating, anti knock additives – combustion chamber – requirements, types.

COMBUSTION IN C.I. ENGINES : Four stages of combustion – Delay period and its importance – Effect of engine variables – Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence – open and divided combustion chambers and nozzles used – fuel requirements and fuel rating.

UNIT –IV

TESTING AND PERFORMANCE : Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power – Determination of frictional losses and indicated power – Performance test – Heat balance sheet and chart.

UNIT-V

GAS TURBINES: Simple gas turbine plant – ideal cycle, essential components – parameters of performance – actual cycle – regeneration, inter cooling and reheating –closed and semi-closed cycles – merits and demerits, types of combustion chambers.

UNIT-VI

JET PROPULSION : Principle of operation –classification of jet propulsive engines – working principles with schematic diagrams and representation on t-s diagram - thrust, thrust power and propulsive efficiency – turbo jet engines – needs and demands met by turbo jet – schematic diagram, thermodynamic cycle, performance evaluation, thrust augmentation – methods.

ROCKETS : Application – working principle – classification – propellant type – thrust, propulsive efficiency – specific impulse – solid and liquid propellant rocket engines.

TEXT BOOKS:

1. I.C. Engines / V. GANESAN- TMH 2004
2. Gas Turbines – V.Ganesan –TMH 2017

REFERENCE BOOKS:

1. Thermal Engineering/ R.K. Rajput-Laxmi Publications 2018
2. Thermal Engineering /Mahesh Rathore-TMH.2010

IV SEMESTER	L	T	P	C
	3	1	-	4
16ME4T02: KINEMATICS OF MACHINERY				

COURSE OBJECTIVES

1. To understand the basic concepts of mechanisms, cam, gear train and their kinematics.
2. To understand the power transmission through belt,chain and gear trains

COURSE OUTCOMES

At end of the course student able to

1. Describe the fundamentals of various mechanisms.
2. Analyze the kinematics of mechanisms.
3. Design CAM and gear mechanisms for specific output motion.
4. Determine the transmission of power by belts,chains and geartrains.

UNIT-I

INTRODUCTION TO MECHANISMS: Kinematic Elements or Links – Classification – kinematic pair, Kinematic Chain- Degrees of freedom, Grashoff's law, Kutzbach criterion for planar mechanisms.

MECHANISM AND MACHINES

Mechanism and machines – classification of machines – inversion of mechanism – inversions of quadric cycle, chain – single and double slider crank chains.

UNIT-II

LOWER PAIR MECHANISMS : Exact and approximate copiers and generated types – Peaucellier, Hart and Scott Russell – Grasshopper – Watt TChebicheff and Robert Mechanisms and straight line motion, Pantograph- Conditions for correct steering – Davis Steering gear, Ackerman's steering gear – velocity ratio- HOOKE'S JOINT : Single and double Hooke's joint – Universal coupling – application.

UNIT-III

KINEMATICS: Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration diagrams – Graphical method – Application of relative velocity method four bar chain. Analysis of Mechanisms : Analysis of slider crank chain for displacement , velocity and acceleration of slider – Acceleration diagram for a given mechanism, Klein's construction, Coriolis acceleration, determination of Coriolis component of acceleration. Plane motion of body: Instantaneous center of rotation, centroids and axodes – relative motion between two bodies – Three centers in line theorem – Graphical determination of instantaneous center, diagrams for Simple mechanisms and determination of angular velocity of points and links.

UNIT-IV

CAMS : Definitions of cam and followers – their uses – Types of followers and cams – Terminology – Types of follower motion - Uniform velocity – Simple harmonic motion and uniform acceleration .Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases. Analysis of motion of followers: Roller follower – circular cam with straight, concave and convex flanks.

UNIT-V

GEARS: Higher pairs, friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion, Form of teeth: cycloidal and involute profiles. Velocity of sliding – phenomena of interferences – Methods of interference. Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact – Introduction to Helical, Bevel and worm gearing.

UNIT-VI

POWER TRANSMISSION : Introduction, Belt and rope drives, selection of belt drive- types of belt drives, V-belts, materials used for belt and rope drives, velocity ratio of belt drives, slip of belt, creep of belt, tensions for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt, Chains- length, angular speed ratio, classification of chains.

GEAR TRAINS: Introduction – Train value – Types – Simple and reverted wheel train – Epicyclical gear Train. Methods of finding train value or velocity ratio – Epicyclical gear trains. Selection of gear box- Differential gear for an Automobile

TEST BOOKS:

1. Theory of Machines - S.S Rattan-TMH.2014
2. Mechanism and Machines Theory - Jagadish Lal – Metropolitan Book Co. (p) Ltd.1987
3. The Theory of Machines - Thomas Bevan / Pearson Publications.2009

REFERENCE BOOKS:

1. Theory of Machines – R.K Bansal /Laxmi Publications (P)Ltd.2013
2. The Theory of Machines – Shigley/ Oxford.2014
3. Kinematics and Dynamics of Machinery – R.L.Norton – Tata McGraw-Hill.2009

IV SEMESTER	L	T	P	C
	3	-	-	3
16ME4T03: PRODUCTION TECHNOLOGY				

COURSE OBJECTIVE

To impart basic knowledge and understanding about the primary manufacturing processes such as casting, joining, forming and powder metallurgy and their relevance in current manufacturing industry; To introduce processing methods of plastics.

COURSE OUTCOMES

At the end of the course student able to

1. Understand various metal casting processes.
2. Explain various melting methods of metals and solidification of pure and alloy metals.
3. Understand various metal joining processes and special welding processes and metal cutting processes.
4. Understand Hot and Cold working, Forging, extrusion of metals and processing of Plastics.

UNIT – I

CASTING: Steps involved in making a casting – Advantage of casting and its applications. – Patterns and Pattern making – Types of patterns – Materials used for patterns, pattern allowances and their construction, Principles of Gating, Gating ratio and design of Gating systems

UNIT – II

MELTING AND SOLIDIFICATION:

Methods of melting**:** Crucible melting and cupola operation, steel making processes.

Solidification of casting – Concept – Solidification of pure metal and alloys, short & long freezing range alloys. Risers – Types, function and design, casting design considerations, special casting processes 1) Centrifugal 2) Die, 3) Investment.

UNIT – III

WELDING: Classification of welding process types of welds and welded joints and their characteristics, design of welded joints, Gas welding, ARC welding, Forge welding, resistance welding, Thermit welding and Plasma (Air and water) welding.

CUTTING OF METALS: Oxy – Acetylene Gas cutting, water plasma. Cutting of ferrous, non-ferrous metals.

UNIT – IV

SPECIAL WELDING PROCESSES

Inert Gas welding, TIG & MIG, welding, Friction welding, Induction welding, Explosive welding, Laser welding, Soldering & Brazing. Heat affected zones in welding; welding defects – causes and remedies – Destructive, Non Destructive Testing of welds.

UNIT – V

HOT & COLD WORKING: strain hardening, recovery, recrystallization and grain growth, Comparison of properties of Cold and Hot worked parts, Rolling fundamentals – theory of rolling, types of Rolling mills and products. Stamping, forming and other cold working processes : Blanking and piercing – Bending and forming – Drawing and its types – wire drawing and Tube drawing – coining – Hot and cold spinning – Types of presses and press tools.

UNIT- VI

EXTRUSION OF METALS: Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion Hydrostatic extrusion.

FORGING PROCESSES: Principles of forging – Tools and dies – Types Forging – Smith forging, Drop Forging – Roll forging – Forging hammers: Rotary forging – forging defects.

PROCESSING OF PLASTICS: Types of Plastics, Properties, applications and their Processing methods & Equipment (blow & injection moulding)

TEXT BOOKS:

1. **Manufacturing Engineering and Technology** / Kalpak jain S/ Pearson Edu. 2014
2. **Manufacturing Technology** / P.N. Rao/TMH 2017

REFERENCES BOOKS:

1. **Production Technology** / R.K. Jain /Khanna.2001
2. **Process and materials of manufacturing** –Lindberg/PHI 2008
3. **Principles of Metal Castings** / Roenthal. 2001
4. **Welding Process** / Paramar / Tata MC Graw Hill 2009
5. **Production Technology** /Sarma P C / S.Chand.2014
6. **Production Engineering** – Suresh Dalela & Ravi Shankar / Galgotia Publications Pvt. Ltd. 2000

IV SEMESTER	L	T	P	C
	3	-	-	3
16MA4T01: PROBABILITY & STATISTICS				

PREREQUISITES

Subject needs the knowledge in fundamentals of set theory, basic counting principles and elementary calculus.

COURSE OBJECTIVES

The student should be able to

1. Calculate probabilities of events using sample space and counting techniques, understand the idea of independent events and calculating conditional probabilities using Baye's theorem
2. Identify the appropriate distribution for use in solving a problem. Distinguish between discrete and continuous random variables.
3. Differentiate between the binomial and the Poisson discrete probability distributions and their applications.
4. Construct a probability distribution for discrete/continuous random variable , determine its mean and variance
5. Learn how to formulate and test hypothesis about a population mean and/or a population proportion.
6. Understand the types of errors possible when conducting a hypothesis test.

COURSE OUTCOMES

The student should be able to

1. Compute probabilities by modeling sample spaces and applying rules of permutation and combinations, additive and multiplicative laws and conditional probability. Construct the probability distribution of a random variable, based on a real-world situation, and use it to compute expectation and variance.
2. Construct the probability distribution of a random variable, based on a real-world situation, and use it to compute expectation and variance. Also compute probabilities based on practical situations using the binomial and normal distributions.
3. Use the normal distribution to test statistical hypothesis and to compute confidence intervals.
4. Use least squares approximation to find the best fit linear curve for a given set of data points.

Unit-I

PROBABILITY: Sample spaces and events-probability-the axioms of probability-some elementary theorems-conditional probability-Baye's theorem.

Unit-II

RANDOM VARIABLES & DISTRIBUTIONS: Introduction-random variables and its classifications. Discrete random variable – moments and moment generating functions.

Discrete Probability Distributions: Binomial & Poisson distributions with moment generating functions.

Unit-III

CONTINUOUS PROBABILITY DISTRIBUTIONS: Continuous random variable, Normal and exponential distributions with moment generating functions.

Unit-IV

SAMPLING DISTRIBUTIONS: Population and samples – Sampling distribution of mean for large and small samples (with known and un-known's variance) – Sampling Distribution of Proportions - sampling distribution of Sums and differences of means – sampling distributions of variances – point and interval estimators for means and proportions.

Unit-V

TESTS OF HYPOTHESIS: Introduction – Type I and Type II errors – Maximum error – one tail, two tail tests – Tests concerning one mean and proportion, two means – proportions and their differences using Z-test, Student's t-test – F-test and Chi-square test.

Unit-VI

CURVE FITTING: Method of least squares – Fitting a straight line, second degree parabola – exponential curve – power curves.

TEXT BOOKS:

1. Probability and Statistics by Mr. K. Murugesan and Mr.P.Gurusamy
2. Probability and Statistics for Engineers and scientists by R.E.Walpole and Raymond H. Myers.

REFERENCES:

1. Probability and Statistics for Engineers by Miller & Freund's
2. Higher Engineering Mathematics by Dr. B. S. Grewal.

IV SEMESTER	L	T	P	C
	3	-	-	3
16ME4T04: INDUSTRIAL ENGINEERING AND MANAGEMENT				

COURSE OBJECTIVES

1. To impart fundamental knowledge and skill sets required in the Industrial Management and Engineering profession, which include the ability to apply basic knowledge of mathematics, probability and statistics, and the domain knowledge of Industrial Management and Engineering.
2. To produce graduates with the ability to adopt a system approach to design, develop, implement and innovate integrated systems that include people, materials, information, equipment and energy.
3. To enable students to understand the interactions between engineering, business, technological and environmental spheres in the modern society.
4. To enable students to understand their role as engineers and their impact to society at the national and global context.

COURSE OUTCOMES

1. Students will be able to demonstrate and understanding of management principles and integrate these principles into job situations.
2. The students will be able to interpret and utilize management oriented information, develop supervisory skills for industry, function successfully as a team/group member.
3. The students will be able to produce sample layouts of manufacturing operations.
4. The students should be able to obtain the necessary data and use that data to design an efficient manufacturing facility.

UNIT - I

MANAGEMENT SCIENCE: Basic concepts of Management, Contribution of Taylor and Fayol to Scientific Management, Motivation and Control, Maslow's hierarch of needs, Leadership styles, Managerial Grid.

UNIT - II

WORK STUDY: Introduction, Techniques of work study, Method study- procedure, recording techniques, Principles of motion economy, Micro-motion analysis, Work measurement – Time study, work/activity sampling, Predetermined motion time standards, Job evaluation and Merit rating-Procedure and Methods.

UNIT - III

PLANT LOCATION: Importance and factors affecting plant location, Single and Multi facility plant location problems.

PLANT LAYOUT: Need, Importance, Objectives and Principles of good plant layout, Types of layout and applications.

UNIT-IV

MATERIAL HANDLING: Objectives, functions, principles of material handling, Types of material handling equipment and selection.

UNIT - V

MATERIALS MANAGEMENT: Objectives, Inventory control- Purpose, types, functions, basic EOQ, safety stock inventory control systems, selective control of inventory ABC and VED analysis, Inventory control system-periodic review system, Store Management and stores record, purchase management.

UNIT - VI

INSPECTION AND QUALITY CONTROL: Types of Inspections, Statistical Quality Control techniques, acceptance sampling plan, Introduction to Total Quality Management, Quality Circles, ISO 9000 series procedures.

TEXT BOOK:

1. Khanna O.P., **Industrial Engineering and Management**, Khanna Publishers, New Delhi,1999.

REFERENCE BOOKS:

1. Amrine, H.T., Ritchey, J.A., Moodie, C.L., & Kmec, J.F., **Manufacturing Organization and Management**, Pearson Education, 2nd Edition, 2004.
2. James M. Apple, **Principles of Layout and Material Handling**, Ronald press, 1997.
3. Maynard, H., **Industrial Engineering** Hand Book, McGraw Hill Book Co., New York,1999.
4. Kanawaty,G., **Introduction to work study**, International Labour Office, 4th Edition, Geneva, 1992.
5. Fiegenbarum, A.V., **Total Quality Control**, McGraw Hill Inc., 1991.

IV SEMESTER	L	T	P	C
	-	-	4	2
16ME4L01: MACHINE DRAWING PRACTICE				

COURSE OBJECTIVES

1. To provide basic understanding and drawing practice of various joint, simple mechanical parts Selection of Views, additional views for the following machine elements and parts with every drawing proportion.
2. To draw the assembly from the individual part drawing.

COURSE OUTCOMES

At end of the course student able to

1. Draw different machine parts such as sectional views, bolts, nuts and lock nuts.
2. Design riveted, welded, and cotter joints
3. Draw the various shaft couplings.
4. Assemble of various machine parts

MACHINE DRAWING CONVENTIONS:

Need for drawing conventions – introduction to IS conventions

a) Conventional representation of materials, common machine elements and parts such as Screws, nuts, bolts, keys, gears, webs, ribs.
b) Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features.
c) Common abbreviations & their liberal usage

I. DRAWING OF MACHINE ELEMENTS AND SIMPLE PARTS

Selection of Views, additional views for the following machine elements and parts with every Drawing proportions.

a) Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
b) Keys, Cotter joints and knuckle joint.
c) Riveted joints for plates
d) Shaft coupling, spigot and socket pipe joint.
e) Journal, pivot and collar and foot step bearings.

II. ASSEMBLY DRAWINGS:

Drawings of assembled views for the part drawings of the following using conventions and easy Drawing proportions.

a) ENGINE PARTS– stuffing boxes, cross heads, Eccentrics, Petrol Engine connecting rod, Piston assembly.

b) OTHER MACHINE PARTS- Screws jacks, Machine Vices Plummer block, Tailstock.

c) VALVES: Steam stop valve, spring loaded safety valve, feed check valve and air cock.

TEXT BOOKS:

1. **Machine Drawing** – K.L.Narayana, P.Kannaiah & K. Venkata Reddy / New Age/ Publishers.2016

2. **Machine Drawing** –N.D Bhatt, V. M. Panchal/ Charotar Publishing House Pvt. Ltd.2013

REFERENCE BOOKS:

1. **Machine Drawing** – P.S.Gill / S. K. Kataria & Sons.2018

IV SEMESTER	L	T	P	C
	-	-	4	2
16ME4L02: PRODUCTION TECHNOLOGY LAB				

COURSE OBJECTIVE

To impart hands-on practical exposure on manufacturingprocesses and equipment.

COURSE OUTCOMES

At the end or the course student able to

1. describe effects of the properties of green sand of grain size, moisture content, compressive strength, shear strength, permeability.
2. perform Arc Welding and Spot Welding.
3. perform the metal casting and Press working operations.
4. perform the Pattern making.

I. METAL CASTING LAB:

1. Pattern Design and making - for one casting drawing.
2. Sand properties testing - Exercise -for strengths, and Permeability – 1
3. Moulding Melting and Casting - 1 Exercise

II WELDING LAB:

1. ARC Welding Lap & Butt Joint - 2 Exercises
2. Spot Welding - 1 Exercise

III MECHANICAL PRESS WORKING:

1. Blanking & Piercing operation and study of simple, compound and progressive press tool.
2. Hydraulic Press: Deep drawing and extrusion operation.
3. Bending and other operations

IV PROCESSING OF PLASTICS:

1. Injection Moulding
2. Blow Moulding

IV SEMESTER	L	T	P	C
	-	-	4	2
16ME4L03: COMPUTER AIDED ENGINEERING DRAWING PRACTICE				

COURSE OBJECTIVE

To enhance the student's knowledge and skills in engineering drawing and to introduce drafting packages and commands for computer aided drawing and modelling.

Course Outcomes:

At end of the course student able to

1. Understand and draw the projections planes and solids and development and intersection of solids.
2. Understand and draw the isometric and perspective projections of planes and solids.
3. Create 2Dimensional drawings using CAD software.
4. Create 3Dimensional drawings using CAD software.

UNIT – I

PROJECTIONS OF SOLIDS:

Projection of regular solids inclined to both the planes, Auxiliary views and sectional views of Regular solids.

UNIT –II

DEVELOPMENT OF SURFACES OF RIGHT REGULAR SOLIDS-Prisms, cylinders, pyramids, cone and their parts Interpenetration and Intersection of right regular solids

UNIT –III

ISOMETRIC PROJECTIONS AND ORTHOGRAPHIC PROJECTIONS- Plane figures, simple and compound solids, isometric projections of objects having non-isometric lines and spherical parts. Perspective Projections-perspective view of points, lines, plane figures and simple solids, vanishing point method

UNIT-IV

INTRODUCTION TO COMPUTER AIDED DRAFTING- Generation of points, lines, curves, polygons, dimensioning. Types of modeling-Object selection commands, edit, zoom, cross, hatching, pattern filling, utility commands in object selection commands,2D and 3D wire frame modeling

UNIT-V

VIEW POINTS AND VIEW PORTS-view point coordinates and views displayed, examples to exercise different options like save , restore, delete, joint, single option

UNIT-VI

COMPUTER AIDED SOLID MODELING- Isometric projections, orthographic projections of isometric projections, modelling of simple solids, machines and machine parts

TEXT BOOKS:

1. Engineering Drawing by N.D.Bhatt , Charotar Publications 2016
2. Text book of Engineering Drawing with AutoCAD - K.Venkata reddy / B.S.Publications 2017

REFERENCE BOOKS:

1. Engineering Drawing - R.K. Dhawan,S.Chand 2012
2. Engineering Drawing - K.L.Narayana, P.Kannaiah, and K.Venkata Reddy/ New Age International Publishers. 2016

Mode of Examination for Computer Aided Engineering Drawing Practice

The syllabus in respect of the subject "Computer Aided Engineering Drawing Practice" consists of two major portions

1. **Unit I to III** - conventional drawing pattern.
2. **Unit IV to VI** - computer lab pattern using any drafting package.

Class work - 4 hrs per week Credits - 2

Max Marks – 100. Internal Marks: 40 & External Marks: 60

The examination in respect of the above may conducted on par with lab with the following pattern:

Mid Exam:

I Mid Exam from first Three Units - Conventional Drawing

II Mid Exam from Last three Units - Computer Lab

End Exam duration - 4 hrs

Part - A - Conventional Drawing test in Drawing Hall from first FOUR Units - 2 hrs duration.

Part - B - Exam in Computer Lab using any drafting package - 2 hrs duration.

V SEMESTER	L	T	P	C
	3	1	-	4
16ME5T01: DYNAMICS OF MACHINERY				

COURSE OUTCOME: Students are able to

CO1: Apply the concepts of friction in analyzing screws and clutches. **[K3]**

CO2: Apply the concept of friction in analyzing brakes and dynamometers. **[K3]**

CO3: Analyze the effect of gyroscopic couple on planes and ships as well as **Apply** principles of Engineering Mechanics for analyzing dynamic forces in a given mechanism.**[K3, K4]**

CO4: Construct turning moment diagrams and **Apply** them in designing flywheels. **[K3]**

CO5: Analyze the performance of various types of governors. **[K4]**

CO6: Apply the principles of static and dynamic balancing in computing the unbalance in rotating and reciprocating masses as well as **Analyze** the unbalance in reciprocating multi cylinder engines **[K3, K4]**

UNIT – I

FRICTION: Principles of friction, Inclined plane, friction of screw and nuts, pivot and collar, uniform pressure, uniform wear, friction circle and friction axis.

CLUTCHES: Friction clutches- single disc clutch, multiple disc clutch, cone clutch, centrifugal clutch.

UNIT – II

BRAKES AND DYNAMOMETERS: Simple block brakes, band brake of vehicle, Band and Block Brake, internal expanding brake, Principle and operation of dynamometers: Prony, Rope brake, Epicyclic, Bevis Gibson.

UNIT – III

GYROSCOPE: Gyroscopes, effect of precession motion on the stability of airplanes and ships.

DYNAMIC FORCE ANALYSIS: Introduction, D-Alembert's Principle, velocity and acceleration of the Piston and Connecting rod, Forces on the Reciprocating parts of an Engine, Inertia force and Inertia Torque in a reciprocating Engine.

UNIT – IV

TURNING MOMENT DIAGRAMS: Introduction, Turning moment diagram for Single and Multi cylinder Engines, Fluctuation of energy. Coefficient of fluctuation of Speed, Energy Stored in Flywheel, Flywheel in Punching Press.

UNIT – V

GOVERNORS: Introduction, Centrifugal governor, Watt, Porter and Proell governors, spring loaded governors, Hartnell and Hartung with auxiliary springs, Performance parameters - Sensitiveness, Isochronism and Hunting.

UNIT – VI

BALANCING: Introduction, Static balancing, dynamic balancing, balancing of single unbalanced rotating mass, Balancing of Several Masses in the same planes, Balancing of Several Masses in Different planes.

BALANCING OF RECIPROCATING MASSES: Primary and secondary balancing of reciprocating masses, locomotive balancing, hammer blow, swaying couple, variation of Tractive effort, primary and secondary balancing of multi cylinder in-line engines

TEXT BOOKS:

1. Theory of Machines - S.S Rattan / TMH Publications.2014
2. Theory of Machines - R S Khurmi, J K Gupta / Schand Publications.2005
3. Theory of Machines - Thomas Bevan / Pearson Publications.2009

REFERENCES:

1. Theory Of Machines - R.K Bansal /Laxmi Publications (P)Ltd 2013
2. The Theory Of Machines – Shiegley/ Oxford 2014
3. Mechanism and Machines Theory - Jagadish Lal / Metropolitan Book Co. (p) Ltd.1987
4. Theory of Mechanisms and Machines - A Ghosh, A K Mallik / Affiliated East-West Press.2015

V SEMESTER	L	T	P	C
	3	1	-	4
16ME5T02:DESIGN OF MACHINE ELEMENTS				

COURSE OUTCOMES: Students are able to

CO1: Describe the Design Procedure and evaluate the size of simple mechanical components Subjected to static loads considering theories of failure **[K4]**

CO2: Explain the concepts of stress concentration under fatigue loading. **[K3]**

CO3: Design the shafts based on static and fatigue loading situations. **[K4]**

CO4: Design the temporary joints such as cotter joints, knuckle joints etc. **[K4]**

CO5: Design the permanent joints such as riveted joints, welded joints **[K4]**

CO6: Design and Analyze mechanical springs for the given loading **[K4]**

UNIT – I

INTRODUCTION: General considerations in the design of Engineering Materials and their properties – Selection –Manufacturing consideration in design. Tolerances and fits–BIS codes of steels.

DESIGN OF MACHINE ELEMENTS FOR STATIC LOADING: Concept of Machine Design: Types of loads, stresses and strain, modes of failure, Principal stresses, theories of failures, Design of simple machine parts

UNIT – II

DESGN OF MACHINE ELEMENTS FOR DYNAMIC LOADING:

Stress concentration – Stress concentration Factors, fatigue failure. Endurance limit. Notch sensitivity. Soderberg, Goodman and modified Goodman diagrams, fatigue design under combined stresses.

UNIT – III

SHAFTS: Design of shafts. Shafts subjected to bending, torsion and axial loading, Shafts subjected to fluctuating loads.

UNIT – IV

KEYS, COTTERS AND KNUCKLE JOINTS:

Types of keys, Design of Keys. Design of Socket & Spigot cotter joint, Design of Sleeve & Cotter joint, Design of Gib and Cotter joint, Knuckle Joint.

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UNIT – V

RIVETED JOINTS:

Types of riveted joints, Types of failures, Efficiency of riveted joint, Design of joints for boiler Shell. Eccentrically loaded riveted joints.

WELDED JOINTS:

Types of welded joints, Strength of Parallel Fillet welds, Strength of Transverse Fillet welds, axially loaded Unsymmetrical welded joints, eccentrically loaded welded joints.

UNIT – VI

MECHANICAL SPRINGS:

Helical springs- classification, terminology, spring materials. Spring end formation. Design of helical springs, concentric springs, and surge in spring, helical torsion springs. Design of
Leaf springs.

TEXT BOOKS:

1. Machine Design - V.B.Bandari / TMH Publishers, New Delhi.2010

2. Machine Design - R.S. khurmi, J.K.Guptha / S Chand publications.1979

3. Machine Design - P.C. Sharma., D.K. Agarwal / S.K.Kataria& Sons

4. Machine Design- S MD Jalaludin / Anuradha Publishers.2013

REFERENCES:

1. Design of Machine Elements - V.M. Faires / Macmillan 1955

2. Machine design - Schaum Series / McGraw Hill Professional.1961

3. Machine design - Pandya & shah / Charotar Publishing House Pvt. Limited.2006

V SEMESTER	L	T	P	C
	3	-	-	3
16ME5T03:THERMAL ENGINEERING				

COURSE OUTCOMES: Students are able to

CO1:Analyze and compare the performance of different vapour power cycles [K4]

CO2: Calculate air – fuel ratios and enthalpy of reaction of various fuels and describe working of high pressure boilers [K2, K3]

CO3: Analyze the performance steam nozzles and of different condensers [K4]

CO4: Describe the working and analyze the performance of both impulse and reaction turbines [K2, K4]

CO5: Describe the working and analyze the performance of reciprocating air compressors.[K2, K4]

CO6: Describe the working and analyze the performance of rotary air compressors [K2, K4]

UNIT – I

VAPOUR POWER CYCLES:

Rankine cycle, comparison of Rankine and Carnot cycles, actual vapor cycle processes, Rankine cycle with superheat, Reheat cycle, Regenerative cycle, Reheat and Regenerative cycle, Energy analysis of vapor power cycles, efficiencies, work ratio, binary vapor cycle

UNIT – II

FUELS AND COMBUSTION

Fuels, combustion equations, stoichiometric air-fuel ratio, exhaust and flue gas analysis, practical analysis of combustion products, internal energy and enthalpy of reaction, enthalpy of formation, practical analysis of exhaust/flue gas products – Orsat apparatus, NDIR, FID, calorific value of fuels-HCV and LCV, Dew point temperature.

STEAM BOILERS:

Classification of steam boilers, selection of a steam boiler, Description of high and supercritical boilers -La-Mont boiler, Benson boiler, Loeffler boiler, Use of various mountings and accessoriesof steam boiler.

UNIT – III

STEAM NOZZLES:

Nozzle shapes, thermodynamic analysis – assumptions, critical pressure ratio, maximum mass flow, nozzle efficiency, criteria to decide nozzle shapes, Nozzles off design pressure ratio, Super saturated flow, its effects, degree of super saturation and degree of under cooling - Wilson line.

STEAM CONDENSERS:

Advantages of condenser in a steam power plant, requirements of a steam condensing plant, classification of condensers, jet condenser, surface condensers, comparison of jet and surface condensers, Daltons law of partial pressures, measurement of vacuum in a condenser, vacuum efficiency, condenser efficiency, mass of cooling water required, sources of air leakages into condenser, effects of air leakage.

UNIT – IV

STEAM TURBINES:

Classification,Impulse turbine- velocity diagram – effect of friction – power developed, axial thrust, blade or diagram efficiency – condition for maximum efficiency. methods to reduce rotor speed-velocity compounding, pressure compounding and velocity & pressure compounding, combined velocity diagram for a velocity compounded impulseturbine, condition for maximum efficiency.

Reaction turbine-Principle of operation, thermodynamic analysis of a stage of Parson's reaction turbine, degree of reaction, velocity diagram, condition for maximum efficiency – calculation of blade height.

UNIT – V

RECIPROCATING AIR COMPRESSORS:

Introduction, classification of air compressors, working of single stage reciprocating air compressor, work done by the reciprocating air compressor without and with clearance volume, multistage compression, advantages of multistage compression, two stage reciprocating air compressor with inter cooler, minimum work required for a two stage reciprocating air compressor, heat rejected in single and two stage reciprocating air compressors, calculation of ratio of cylinder diameters.

UNIT – VI

ROTARY AIR COMPRESSORS:

Comparison of reciprocating and rotary air compressors, types of rotary air compressors, centrifugal compressor, velocity triangle for moving blades of centrifugal compressor, work done by centrifugal air compressor, width of impeller blades, pre whirl.

Axial flow compressors, comparison of axial flow and centrifugal compressors, velocity diagrams for axial flow air compressors, degree of reaction.

TEXT BOOKS:

1. Applied Thermodynamics for Engineering Technologists, T. D. Eastop. A. McConkey, Fifth Edition, Pearson Education Asia.1993
2. Applied Thermodynamics, R. K. Rajput, Laxmi Publications (P) limited, 2011
3. Thermal Engineering, Mahesh M Rathore, Tata McGraw Hill, 2012

REFERENCES:

1. Thermal Engineering, R. S Khurmi and J. S. Gupta, S. Chand Company limited, 2009
2. Thermal Engineering, P. L. Ballaney, Twenty Fourth Edition, Khanna Publishers, New Delhi

Steam Tables:

Steam Tables with Mollier digram, R. S. Khurmi, S. Chand & Companey Ltd., 2007

V SEMESTER	L	T	P	C
	3	-	-	3
16ME5T04: MACHINE TOOLS				

COURSE OUTCOMES: Students are able to.

CO1: Describe the metal cutting theory and analyze importance of process parameters for machining.[K2& K4]

CO2: Differentiate engine and automatic lathes and explain various operations performed on lathe.[K2]

CO3: Explain working principle of shaping, slotting, planning machines and various operations performed.[K2]

CO4: Explain the working principle of milling, methods of indexing and accessories of milling machine.[K2]

CO5: Explain the working principle of drilling, boring and describe the function of jigs and fixtures. [K2]

CO6: Describe the various finishing processes such as grinding, lapping, honing and broaching.[K2]

UNIT – I

FUNDAMENTALS OF METAL CUTTING: Elementary treatment of metal cutting theory – element of cutting process – geometry of single point cutting tool, tool angles, chip formation and types of chips – built-up edge and its effects chip breakers, mechanics of orthogonal cutting –Merchant's force diagram, cutting forces, cutting speeds, feed, depth of cut, tool life, coolants, cutting tool materials.

UNIT – II

LATHE: Engine lathe – working principle, specification of lathe - types of lathe - work and tool holding devices, Taper turning, Thread turning - Lathe attachments. Turret and capstan lathe - Principle features of automatic lathes - classification: Single spindle and multi-spindle automatic lathes - tool layouts.

UNIT – III

SHAPING, SLOTTING AND PLANNING MACHINES: Principles of working - principal parts - specification, classification, operations performed. Kinematic scheme of shaping, slotting and planning machines, machining time calculations.

UNIT – IV

MILLING MACHINE: Principles of working–specifications–classification of Milling Machines–principal features of horizontal, vertical and universal Milling Machine, machining operations, types of cutters and geometry of milling cutters–methods of indexing, accessories to milling machines.

UNIT – V

DRILLING & BORING MACHINES: Principles of working, specifications, types, operations performed – tool holding devices – twist drill – Boring Machines – fine Boring Machines – jig boring machine, deep hole drilling machine.

JIGS & FIXTURES: Principles of design of jigs and fixtures and uses, classification of jigs & fixtures, principles of location and clamping, types of clamping & work holding devices.

UNIT – VI

FINISHING PROCESSES: Theory of grinding – classification of grinding machines, cylindrical and surface grinding machines, tool and cutter grinding machines, different types of abrasives, specification and selection of a grinding wheel. Lapping, Honing & Broaching operations, comparison to grinding.

TEXT BOOKS:

1. Production Technology - R.K. Jain and S.C. Gupta / Khanna Publishers, New Delhi 2017
2. Workshop Technology - Vol. - II - B. S. Raghuvamsi/ Dhanapat Rai publications 2015

REFERENCES:

1. Manufacturing Technology Vol-II/P.N Rao/Tata McGraw Hill 2013
2. Production Technology / H.M.T. Hand Book (Hindustan Machine Tools).2016
3. Metal cutting Principles - M.C. Shaw / CBS publications 2002.
4. Elements of Workshop Technology, Vol. II - Hajra Chowdary, S.K., and Hajra Chowdary, A.K., Asia Publishing House, Bombay, 2003.

V SEMESTER	L	T	P	C
	3	-	-	3
16ME5E01:ADVANCED MECHANICS OF SOLIDS				

Course Outcomes: Students are able to

CO1: Describeand evaluate the strain energy and energy theorems. [K2, K4]

CO2: Calculate the Fixed moments, slope and deflection of the fixed beams of uniform and Non-Uniform sections. [K3]

CO3: Analyze the reaction supports of the continuous Beams. [K3]

CO4: Evaluate the loads and deflections in columns and struts. [K4]

CO5: Calculate the stresses in the wheel Rims of uniform thickness and Uniform strength. [K4]

CO6: Analyze the Torsion of different types of Bars and thin walled tubes and closed sections. [K3]

UNIT – I

Energy Methods: Introduction, Principles of superposition, Strain energy, Reciprocal relations, Maxwell Betti theorem, Elastic strain energy in tension and compression, Strain energy in beams subjected to bending and shafts to torsion. Impact loading in tension and bending, first & second theorem of Castigliano and its applications.

UNIT – II

Fixed Beams:

Fixing moments for a fixed beam of uniform and variable sections, Effect of sinking support, Slope and Deflection.

UNIT – III

Continuous Beams:

Analysis of continuous Beam, Reactions at the supports, Effect of sinking of supports.

UNIT – IV

Columns and Struts:

Columns with one end free and the other fixed, Both ends fixed, One End Fixed and other End hinged, Limitation of Euler's formulae, Column carrying Eccentric load, Empirical formulae.

UNIT – V

Stresses due to Rotation:

Wheel Rim, Disc of Uniform Thickness, Disc of Uniform Strength.

UNIT – VI

Torsion of generalized Element Section: Introduction, Torsion of General Prismatic Bars–Solid Sections, Torsion of Circular and Elliptical Bars, Torsion of Equilateral Triangular Bar, Torsion of Rectangular Bars, Membrane Analogy, Torsion of Thin-walled Tubes, Torsion of Thin-walled Multiple-Cell Closed Sections.

TEXT BOOKS:

1. Strength of Materials – R.K. Rajput – S.Chand & Company 2018

2. Mechanics of Material – J.M. Gere and S.P. Timoshenko – CBS publisher 2004

3. Chapter VI from Advanced topics in Strength of Materials, by Prof. L.B. Shah and Dr. R.T. Shah.

REFERENCES:

1. Mechanics of Material – F.P. Bear and E.E. Johnston – McGraw Hill 2009.

2. Strength of Material, Vol. I and II – S.P. Timo Shenko – EWP Press 2004.

3. Strength of Material – Dr. Sadhu Singh – Khanna Publishers 1992.

V SEMESTER	L	T	P	C
	3	-	-	3
16ME5E02:REFRIGERATION AND AIR CONDITIONING				

COURSE OUTCOME: Students are able to

CO1: identify the necessity and applications of refrigeration and **analyz**e various air refrigeration cycles. [K4]

CO2: Classify refrigerants and describe their properties and effects, also **analyze** the vapour compression refrigeration cycles to improve their performance [K4].

CO3: Students are able to classify refrigeration system components and **explain** their working [K3]

CO4: Students are able to **explain** the working of Vapor absorption system, Steam jet refrigeration system and other nonconventional refrigeration systems [K3]

CO5: Students are able to **apply** psychometric properties & processes for estimating thermal load [k5]

CO6: Students are able to **analyze** the requirements of an air conditioning system for human comfort and industrial applications and also differentiate various air conditioning systems and their components. [k4]

UNIT – I

FUNDAMENTALS OF REFRIGERATION: Introduction to refrigeration- Necessity and applications, unit of refrigeration and C.O.P- Refrigerator and Heat pump, Methods of refrigeration.

AIR REFRIGERATION SYSTEM: Introduction-Air refrigeration system working on Reversed Carnot cycle – Air refrigeration system working on Bell Coleman cycle- COP- Open and Dense air systems, Necessity of cooling Aeroplane, Air craft refrigeration systems.

UNIT – II

VAPOUR COMPRESSION REFRIGERATION (VCR) SYSTEM: Working principle-Simple Vapour Compression Refrigeration cycle – COP- Representation of cycle on T-s and P-h charts- Effect of Sub cooling and Superheating --Actual Vapor compression cycle. **REFRIGERANTS**: Classification of refrigerants- Desirable and thermodynamic properties-Designation of refrigerants-Commonly used refrigerants, Globalwarming and Ozone depleting aspects.

UNIT – III

VCR SYSTEM COMPONENTS: Compressors – Classification, Working, Condensers – Classification, working, Evaporators – Classification, working of flooded and dry expansion types, Expansion devices – Classification, working of Automatic Expansion Valve, Thermostatic Expansion Valve and capillary tube**.**

UNIT – IV

VAPOUR ABSORPTION REFRIGERATION (VAR) SYSTEM: Working principle, , Properties of Mixtures, Simple absorption refrigeration system, *COP*, description and working of practical Aqua-Ammonia system, Lithium Bromide - Water system, Electrolux Refrigeration system.

STEAM JET REFRIGERATION SYSTEM: Principle of working, analysis, applications, and **Non-conventional refrigeration methods*:*** Principle and operation of Thermoelectric refrigeration and Vortex tube.

UNIT – V

PSYCHROMETRY: Introduction - Psychrometric properties and relations, Psychrometric chart Psychrometry of air conditioning processes, sensible, latent and total heat, sensible heat factor and bypass factor, summer air conditioning, ADP, winter air conditioning,

Load Calculations: sources of load, internal heat gains and system heat gains, cooling and *heating load* estimation.

UNIT – VI

HUMAN COMFORT: Thermal Comfort - Effective temperature – Comfort chart- Comfort and Industrial Air conditioning.

AIR CONDITIONING SYSTEMS & COMPONENTS: Classification of Air conditioning systems-Central and Unitary systems, summer, winter and year round systems

Air conditioning Equipment: Air Cleaning, Air Filters, Humidifiers, Dehumidifiers, Fans & Blowers, Grills and Registers. **Heat Pump**: Different Heat Pump Circuits

TEXT BOOKS:

1. 1Refrigeration and air conditioning, C. P. Arora, Tata McGraw Hill 2000
2. A course in Refrigeration and Air Conditionin, S. C. Arora, Domkundwar, Dhanapat Rai and Sons 2012.
3. Principles of Refrigeration, R. Dossat, Pearson Education 2002.

REFERENCES:

1. Refrigeration and Air Conditioning, W. F. Stoecker and J. W. Jones, McGraw Hill
2. Refrigeration and Air conditioning - Manohar Prasad,Second Edition, New Age International (P) Ltd Publishers 1958
3. Refrigeration and Air conditioning – R. S. Khurmi and J. K. Gupta, S. Chand Publications 2007

DATA BOOK:

Refrigerants &Psychrometric Properties, M.L. Mathur& F.S. Mehta 2010.

V SEMESTER	L	T	P	C
	3	-	-	3
16ME5E03:TOOL DESIGN				

COURSE OUTCOMES: Students are able to.

CO1: Explain the design requirements of single point and multi point cutting tools and design single point cutting tools.[K2 & K6]

CO2: Describe the importance of cutting tools and work holding device in design.[K2]

CO3: Classify jigs, illustrate the function of jigs for several operations and simple design of jigs.[K3]

CO4: Illustrate the design principles of fixtures and describe the application of fixtures for machine tools.[K3]

CO5: Explain the fundamentals of die cutting operations and design of simple progressive and compound die sets. [K2& K3]

CO6: Describe the tool design requirements, tool holding methods and tool presetting for NC machines.[K2]

UNIT – I

Design of Cutting Tools: Metal cutting process: Selection of tool materials - Design of single point and multipoint cutting tool - Form tools, Drills, Milling cutters, broaches and chip breakers – Problems on design of single point cutting tools only.

UNIT – II

Locating and Clamping Methods: Basic Principles of Location - Locating methods and devices - Principles of clamping - Mechanical, Pneumatic and Hydraulic actuation - Clamping force analysis – Design problems.

UNIT – III

Design of Jigs: Types of drill jigs - General considerations in the design of drill jigs - Drill bushings - Types, methods of construction - Simple designs of Plate, Channel, Boxes, Post, Angle plate, Turnovers and Pot Jigs.

UNIT – IV

Design of Fixtures: Design principles - Types of fixtures - Fixtures for machine tools: Lathe, Milling, Boring, Broaching and grinding - Assembly fixtures - Inspection and Welding fixtures.

UNIT – V

Design of Dies: Fundamentals of die-cutting operations - Cutting action in punch and die operations - Die clearance - Blanking and Piercing Die construction – Pilots - Strippers and
Pressure Pads - Press work materials - Strip layout - Design of simple progressive and compound die sets - Forging Die – Flow lines, parting lines, open and close die forging; Materials for die block.

UNIT –VI

Tool design for NC machines: An introduction, Fixture design for NC Machine, Cutting tools for NC Machine, Tool holding methods for NC Machine, ATC and APC for NC Machine, Tool presetting for NC Machine.

Text Books:

1. F.W.Wilson.F.W. "Fundamentals of Tool Design", ASME, PHI, New Delhi, 2010.
2. Donaldson.C, G.H.Lecain and V.C.Goold "Tool Design", TMH, New Delhi, 2010.

References:

1. Joshi P. H., (2004) Jigs and Fixtures, 2nd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi.
2. Edward G. Hoffman (2004) Jigs and Fixtures Design, Thomson - Delmar Learning Series, Singapore.
3. Jeff Lantrip, David A. Smith and John G. Nee, (2003) Fundamentals of Tool Design, 5th Edition, Society of Manufacturing Engineers.

V SEMESTER	L	T	P	C
	3	-	-	3
16ME5E04:PRODUCTION PLANNING AND CONTROL				

COURSE OUTCOMES: Students are able to

CO1. Explain the objectives and functions in production planning and control[K2]

CO2. Apply the forecasting methods in production planning [K3]

CO3. Calculate the required quantities of materials by using ABC, VED and EOQ models and Inventory control systems [K3]

CO4. Explain the material requirement, line of balance and lean manufacturing [K2]

CO5. Apply scheduling techniques to planning, routing andDispatching [K3]

CO6.Explainvariousaggregate planning technics and solve assembling line balancing problems [K2,K3]

UNIT – I

INTRODUCTION : Definition, Objectives of production Planning and Control, Functions of production planning and control, Elements of production control, Types of production, Organization of production planning and control department, Internal organization of department.

UNIT – II

FORECASTING: Importance of forecasting, Types of forecasting, their uses, General principles of forecasting, Forecasting techniques, qualitative methods and quantitative methods.

UNIT – III

INVENTORY MANAGEMENT: Functions of inventories, relevant inventory costs, ABC analysis, VED analysis, EOQ model, Inventory control systems, P–Systems and Q-Systems.

UNIT – IV

DISAGGRIGATION: Master Production Schedule,Bill of materials, Material Requirement Planning, Introduction to lean manufacturing.

UNIT – V

ROUTING–SCHEDULING:

Routing – Definition, Routing procedure, Route sheets, Factors affecting routing procedure. Schedule – Definition, Difference with loading Scheduling Policies, Techniques, Standard scheduling methods: One-machine n job problem, Two-machine n job problem, Three-machine n job problem, Line Balancing

UNIT – VI

DISPATCHING – Activities of dispatcher, dispatching procedure

FOLLOW-UP –definition, Reason for existence of functions

AGGREGATE PLANNING – purestrategies, LDR, graphical approach, Mathematical progressing, Line of Balance, Expediting, and controlling aspects

TEXT BOOKS:

1. Production Planning and Control - S.K. Mukhopadhyay/ PHI Learning Pvt. Ltd 2015
2. Production Planning and Control –Samuel Ellian / McGraw Hill Education (India) Private Limited
3. Operations Management – S.N. Chary / McGraw Hill Education (India) Private Limited 1998.
4. Inventory Control Theory and Practice – MartinK. Starr and David W. Miller/ Prentice-Hall 1962.

REFERENCES:

1. Industrial Management and Production Management/Martand T Telsung/S Chand Publishers 2014.

2. Production and Operation Management - R.Panneerselvam/ PHI Learning Pvt. Ltd 2012.

V SEMESTER	L	T	P	C
	3	-	-	3
16EC5E06: OPERATING SYSTEMS				

COURSE OUTCOMES: Students are able to

1: Definefundamental concepts about operating systems.

2: Describe process management and CPU scheduling.

3: Describe concurrency control mechanisms.

4: Analyze memory management Technique.

5: StateDeadlocks and Write solution to it.

6: Define file systems interface and Implementation.

UNIT-I

Computer System and Operating System Overview: Overview of computer operating systems, operating systemsfunctions, protection and security, distributed systems, special purpose systems, operating systems structures and systems calls, operating systems generation.

UNIT-II

Process Management – Process concept- process scheduling, operations, Inter process communication. Multi Threadprogramming models. Process scheduling criteria and algorithms, and their evaluation.

UNIT-III

Concurrency: Process synchronization, the critical- section problem, Peterson's Solution, synchronization Hardware,semaphores, classic problems of synchronization, monitors, Synchronization examples

UNIT-IV

Memory Management: Swapping, contiguous memory allocation, paging, structure of the page table, segmentation

Virtual Memory Management:

virtual memory, demand paging, page-Replacement, algorithms, Allocation of Frames, Thrashing

UNIT-V

Principles of deadlock – system model, deadlock characterization, deadlock prevention, detection and avoidance,recovery form deadlock,

UNIT-VI

File system Interface- the concept of a file, Access Methods, Directory structure, File system mounting, file sharing,protection.

File System implementation- File system structure, allocation methods, free-space management **Mass-storage structure** overview of Mass-storage structure, Disk structure, disk attachment, disk scheduling

TEXT BOOKS:

1. Operating System Concepts- Abraham Silberchatz, Peter B. Galvin,Gagne 7th Edition, John Wiley.
2. Operating Systems' – Internal and Design Principles Stallings, Sixth Edition–2005, Pearson education.

V SEMESTER	L	T	P	C
	3	-	-	3
16EC5E04: MICROPROCESSORS				

COURSE OUTCOMES: Students are able to

CO1. Explain about various microprocessors/microcontrollers

CO2. Analyze various peripherals to microprocessors/microcontrollers.

CO3. Develop assembly language programs.

CO4. Describe basic systems using microprocessor/microcontroller.

UNIT I

Introduction and 8085 microprocessor: Introduction to Microprocessors and Microcomputers, Family of Intel processors. 8085 microprocessor Features, Architecture, Register organization, Timing diagrams

UNIT II

8086 Microprocessor: Features, Architecture, Memory organization, Pin diagram, Minimum mode and Maximum mode of operations.

UNIT III

8086 Programming: Addressing modes, Instruction set, Assembler directives, Procedures and Macros, Assembly language programming, Example programs

UNIT IV

Interfacing:8255 PPI, Interfacing with 8086 ADC, DAC, DC motor and stepper motor.

UNIT V

ARM Processor:ARM processors introduction to 16/32 bit processors, ARM architecture and organization, Thumb programming model, thumb instruction set and development tools.

UNIT VI

8051 Microcontroller:Microprocessor Vs Microcontroller, 8051 Features, Architecture, Pin diagram, Ports, Memory organization.

TEXT BOOKS

1.Microprocessor Architecture, Programming, and Applications with the 8085 Ramesh S.Gaonkar, 4th Edition, Penram International, 1999

2. Advanced microprocessor & Peripherals A K Ray and K M Bhurchand TMH, 2000

REFERENCE BOOKS:

1. Microcomputer Systems: 8086/8088 Family Architecture, Programming and Design, by YuCheng Liu and Glenn A. Gibson, PHI,1986

2. Microprocessors And Interfacing 2E by Douglas V. Hall, Tata McGrawHill Education, 1974

V SEMESTER	L	T	P	C
	-	-	4	2
16ME5L01: THERMAL ENGINEERING LAB				

1. Study of Boilers.

2. I.C. Engine Valve timing Diagram.

3. Performance test on single cylinder four stroke Diesel Engine.

4. Performance test on single cylinder four stroke Petrol Engine.

5. Morse test on multi cylinder, four stroke Petrol Engine.

6. Motoring test on single cylinder four stroke Petrol engine.

7. I.C.Engine heat balance on single cylinder four stroke Diesel Engine.

8. Performance test on Multi cylinder four stroke Petrol Engine.

9. Performance test on Reciprocating Air Compressor.

10. Dis-assembly / Assembly of I.C.Engine.

V SEMESTER	L	T	P	C
	---	-	4	2
16ME5L02:MACHINE TOOLS LAB				

1. Study of general purpose machines – lathe machine, drilling machine, milling machine, shaper machine, slotting machine, grinding machine, and Surface grinder.
2. Step turning on lathe machine.
3. Taper turning on lathe machine
4. Thread cutting on lathe machine.
5. Knurling on lathe machine.
6. Drilling and Tapping.
7. Shaping.
8. Slotting.
9. Milling.
10. Surface grinding

V SEMESTER	L	T	P	C
	-	-	-	-
PROFESSIONAL ETHICS &INTELLECTUAL PROPERTY RIGHTS				

UNIT I

Engineering Ethics: Importance of Engineering Ethics-–Professional and Professionalism –Professional Roles to be played by an Engineer –Professional Ethics.

UNIT II

Engineering as Social Experimentation: Role of engineering in knowledge society- Knowledge acquired – Conscientiousness – Relevant Information –Engineers as Managers, Consultants, and Leaders.

Engineers' Responsibility for Safety and Risk: Role and importance of Safety and risk- Types of Risks – Threshold Levels for Risk– Risk Benefit Analysis.

UNIT III

Engineers' Responsibilities and Rights: Collegiality-Conflict of Interest-solving conflict problems – Ethical egoism-Collective bargaining -Confidentiality-Acceptance of Bribes/Gifts--Occupational Crimes-industrial espionage-Whistle Blowing-types of whistle blowing.

UNIT IV

Intellectual property and Copy Rights: Introduction to Intellectual Property Law - Types of Intellectual Property - Infringement

Copyrights: Introduction to Copyrights – Principles of Copyright – Rights Afforded byCopyright Law – Copyright Formalities and Registration.

UNIT V

Patents and Trademarks: Introduction to Patent Law –Rights under Patent Law – Patent Requirements – Patent Application Process and Granting of Patent – Double Patenting – Patent Cooperation Treaty.

Trademarks: Introduction to Trade Mark – Trade Mark Registration Process – Trade Mark maintenance – Likelihood of confusion

UNIT VI

Trade secrets and Cyber Law

Introduction to Trade Secrets – Maintaining Trade Secret – Physical Security –Unfair Competition –Breach of Contract .**Cyber law:** Introduction to Cyber Law – Information Technology Act - Cyber Crime and E-commerce – Data Security .

TEXT BOOKS:

1. "Engineering Ethics and Human Values" by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd-2009.
2. "Professional Ethics and Morals" by Prof.A.R.Aryasri, DharanikotaSuyodhana-Maruthi Publications.
3. Deborah E.Bouchoux: "Intellectual Property". Cengagelearning , NewDelhi, BS Publications (Press)
4. Prabhuddha Ganguli: ' Intellectual Property Rights" Tata Mc-Graw – Hill, New Delhi
5. "Professional Ethics and Human Values" by A.Alavudeen, R.KalilRahman and M.Jayakumaran-Laxmi Publications.
6. "Engineering Ethics" by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009
7. Richard Stim: "Intellectual Property", Cengage Learning, New Delhi.
8. R. Radha Krishnan, S. Balasubramanian: "Intellectual Property Rights", Excel Books. New Delhi.

VI SEMESTER	L	T	P	C
	3	1	-	4
16ME6T01: HEAT TRANSFER				

COURSE OUTCOMES: Students are able to

CO1: describe modes of heat transfer and solve one-dimensional heat conduction problems without and with heat generation. [K2, K3]

CO2: develop heat transfer relations for different fin configurations and solve one dimensional transient heat conduction problems. [K3]

CO3: apply different correlations developed for estimation of forced and natural convection heat transfer. [K3, K5]

CO4: describe various regimes of boiling and types of condensation heat transfer. [K2]

CO5: Classify and analyze different heat exchangers [K2, K4]

CO6: state and apply laws of radiation and estimate radiation heat transfer between bodies.
[K1, K2, K3]

UNIT – I

Introduction to Heat transfer and Conduction:

Basic modes of heat transfer, law of conservation mass and energy applied to a control volume (rate equations), multi – mode heat transfer (simple problems involving conduction, convection and radiation), General conduction equation in Cartesian coordinates, cylindrical and spherical coordinates, boundary and initial conditions, steady, one – dimensional conduction heat transfer with and without heat generation (Cartesian and Cylindrical coordinates only), thermal contact resistance, overall heat transfer coefficient, conduction shape factor.

UNIT – II

Conduction – convection systems

Fin heat transfer, general fin heat transfer equation, pin - fin heat transfer with different tip conditions, fin effectiveness and fin efficiency, different types of finned surfaces.

Transient heat conduction – Lumped system analysis, distributed system analysis (either using one term approximation of series solutions or Heisler charts) of infinite slabs and long cylinders, Semi – infinite body and finite bodies (cylinders and cubes only)

UNIT –III

Forced Convection Heat Transfer

Introduction to convective heat transfer, Nusselt number, differential mass, momentum and energy equations of laminar boundary layer on a flat plate (qualitative treatment only), Integral mass, momentum and energy equations applied to laminar boundary layer on a flat plate (approximate solutions), Reynold's and Colburn analogy, Empirical relations of laminar and turbulent flows over geometries of different shapes.

UNIT – IV

Flow through pipes& Natural convection heat transfer

Flow through pipes: Hydrodynamic considerations, velocity profile in the fully developed region, pressure gradient and friction factor, Laminar and turbulent flow in circular tubes: Thermal analysis and convection correlations

Natural convection heat transfer- Laminar Free Convection on a vertical surface, effects of turbulence, empirical correlations for External Free Convection Flows: Vertical Plate, Inclined and Horizontal Plates, long Horizontal Cylinder, Spheres.

UNIT – V

Boiling and Condensation & Heat Exchangers

Boiling and Condensation – Pool boiling, different regimes of pool boiling, empirical relation for heat flux in nucleate boiling, maximum or critical heat flux and Leiden frost point (minimum heat flux in film boiling. Film wise and drop wise condensation, Nusselt theory of film condensation, applications of boiling and condensations.

Heat Exchangers: Parallel and counter flow double pipe heat exchangers, LMTD and effectiveness - NTU methods. Cross flow heat exchangers and shell and tube heat exchangers.

UNIT – VI

Radiation Heat Transfer

Radiation Heat Transfer – Plank's theory of radiation, Stefan – Boltzmann's law of radiation, Wein's displacement law, emissivity, absorbvity and transmissivity, Kirchof's law, shape factor algebra, radiation heat transfer between infinite and finite surfaces, radiation shields.

TEXT BOOKS:

1. Heat Transfer, J. P. Holman, Ninth Edition, Tata McGraw-Hill publishing Company Limited, New Delhi 2008.
2. Heat and Mass Transfer, P. K. Nag, Third Edition, Tata McGraw-Hill Education 2011.
3. Heat Transfer, D.S. Kumar, Eighth Edition, S. K. Kataria, & Sons 2015.

REFERENCES:

1. Heat Transfer, S. P. Sukhatme, Orient Longman Private Limited, 2005
2. Introduction to Heat Transfer, Incropera and Dewitt, Wiley Publishers, 2001
3. Heat and Mass Transfer, S. C Arora, S. Domkundwar and Anand V. Domkundwar, Dhanpat Rai & Co, 2007

DATA BOOK:

Heat and Mass Transfer Data Book - C. P. Kothandaraman & S. Subramanyam, , Sixth Edition, New Age International Publishers 2009.

	L	T	P	C
VI SEMESTER	**3**	**1**	**-**	**4**
16ME6T02: DESIGN OF MECHANICAL TRANSMISSION SYSTEMS				

COURSE OUTCOMES: Students are able to

CO1: Select a suitable Bearing for both static and dynamic loads. **[K3]**

CO2: Design the connecting rod and crank shaft with help of bending and shear stresses. **[K4**].

CO3: Design the piston and cylinders based on strength and heat dissipation capacity. [**K4]**

CO4: Design suitable power transmission system like belt drives, chain drives. **[K4**]

CO5: Design spur and helical gears based on contact and beam strength. **[K4]**

CO6: Design the curved beams like crane hook, c-clamps etc. **[K4]**

UNIT – I

SLIDING CONTACT BEARINGS:

Types of Bearings, Bearing materials, Lubrication, properties of lubricants, Journal bearings design.

ROLLING CONTACT BEARINGS:

Types of Bearings, Static load, Dynamic load, Equivalent radial load, selection of suitable bearings.

UNIT – II

CONNECTING ROD AND CRANK SHAFT:

Design of Connecting Rod, Design of crank shaft- center crank shaft and overhung crankshaft

UNIT –III

PISTON AND CYLINDER:

Design of Piston, Design of cylinder, cylinder liners

UNIT – IV

BELT DRIVES AND CHAIN DRIVES:

Flat belts, Belt constructions, Geometrical relationships, Analysis of belt tensions, condition for maximum power, Selection of Flat belts, Selection of V belts, Chain drives, selection of chains.

UNIT – V

SPUR GEARS:

Classification of gears, Terminology of spur gears, Force analysis, Gear tooth failures, Beam strength of Gear teeth, Dynamic tooth load, wear tooth load, Lewis Equation.

HELICAL GEARS:

Terminology of helical gears, force analysis, Beam strength of helical gears, Effective load on gear tooth, Wear strength of helical gears, Lewis Equation.

UNIT – VI

DESIGN OF CURVED BEAMS: Introduction, stresses in curved beams. Design of crane hooks and C – clamps for rectangular section, circular section, trapezoidal section, T –section andI- section.

TEXT BOOKS:

1. Machine Design - V.B.Bandari / TMH Publishers, New Delhi

2. Machine Design - R.S. khurmi, J.K.Guptha / S Chand publications

3. Machine Design - P.C. Sharma., D.K. Agarwal / S.K.Kataria& Sons

4. Machine Design- S MD Jalaludin / Anuradha Publishers

5. Design Data hand Book- PSG College of engineering, Coimbatore

REFERENCES:

1. Design of Machine Elements - V.M. Faires / Macmillan

2. Machine design - Schaum Series / McGraw Hill Professional

3. Machine design - Pandya & shah / Charotar Publishing House Pvt. Limited.

VI SEMESTER	L	T	P	C
	3	-	-	3
16ME6T03: METROLOGY AND INSTRUMENTATION				

COURSE OUTCOMES: Students are able to

CO1. Apply and analyze the limits and tolerances for engineering components. [K3, K4]

CO 2. Explain the principles of linear and angular measurement various methods. [K2, K3]

CO 3. Describe surface roughness measurement through various methods. [K3]

CO 4.Infer the working of comparators, screw thread and gear teeth measuring instruments. [K3]

CO 5. Explain the measurement of displacement, stress strain and temperature. [K2, K3]

CO 6. Explain the principles of pressure and flow measurement through various methods. [K2, K3]

UNIT – I

Limits, Fits and Tolerances: Introduction to Systems of limits and fits, normal size, tolerance& limits, deviations, allowance, fits and their types

Limit Gauges: Go and No go gauges, plug ring, snap, gap, taper, profile and position gauges

UNIT – II

Linear measurements: Linear measurement standards, Venire calipers, Micrometer, Telescopic gauge, Height gauge, and Depth gauge.Slip gauge-types.

Angular measurement: Bevel protractor, Sine bar, angle Dekker, Spirit level, and Auto collimator.

UNIT – III

Surface Roughness Measurement: Differences between surface roughness and surface waviness-Numerical assessment of surface finish, Talysurf.

Optical Measuring Instruments: Tool maker's microscope and its uses –autocollimators, optical projector – optical flats and their uses, interferometers.

UNIT – IV

Comparators: Comparators – Mechanical, Electrical and Electronic Comparators, optical and pneumatic comparators and their uses in mass production

Screw Thread Measurement: Element of measurement – errors in screw threads, measurement of effective diameter, angle of thread and thread pitch, major and minor diameter.

Gear Measurement:

Gear measuring instruments, Gear tooth profile measurement.

UNIT – V

Measurement of Displacement: Theory and construction of various transducers to measure displacement – piezo electric, inductive, capacitance, resistance, ionization and photo electric transducers, calibration procedures.

Stress Strain Measurements Various types of stress and strain measurements – electrical strain gauge.

Measurement of Temperature: temperature measuring instruments- Electrical resistance thermometers, thermocouple, pyrometers, temperature indicators.

UNIT – VI

Pressure measurement: Dead weight pressure gauge, Bourdon pressure gauges, bellows, diaphragm gauges. Low pressure measurement: thermal conductivity gauges, ionization pressure gauges, McLeod pressure gauge.

Flowmeasurement: Pitot tube, Orifice meter, Venturi meter, Rota meter.

TEXT BOOKS:

1. Engineering Metrology / I C Gupta/ Danpath Rai publications.
2. Engineering Metrology / R.K. Jain / Khanna Publishers
3. Measurement Systems: Applications & design / D.S Kumar.
4. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.

REFERENCES:

1. Engineering Metrology / mahajan/ Danpath Rai.
2. Precision engineering in manufacturing by R.L.Murthy/New age
3. Measurement systems: Application and design/Doeblin Earnest. O. Adaptation/ TMH

VI SEMESTER	L	T	P	C
	3	-	-	3
16ME6E01:MECHANICAL VIBRATIONS				

COURSE OUTCOMES: Students are able to

CO1: Summarize the basic concepts of vibrations and **Analyze** simple vibration problems. **[K2, K4]**

CO2: Apply Equilibrium, Energy and Raleigh's methods in analyzing simple free damped and undamped vibrations. **[K3]**

CO3: Analyze the response of damped and undamped systems subjected to harmonic excitation. **[K4]**

CO4: Analyze the response of systems subjected to forced vibrations with different kinds of loads. **[K4]**

CO5: Modelthe vibration response of multi degrees of freedom systems. **[K3]**

CO6: Model the vibration response of continuous systems. **[K3]**

UNIT – I

FUNDAMENTALS OF VIBRATIONS

Brief history of vibrations, Importance of the study of vibrations, Basic concepts of vibration, Classification of vibrations, Vibration analysis procedure, spring elements, Mass or inertia elements, damping elements, Harmonic analysis.

UNIT – II

FREE VIBRATIONS

Introduction, Free vibration of an undamped translational system, Free vibration of an undamped torsional system, Stability conditions, Raleigh's energy method, Free vibration with viscous damping, Free vibration with coulomb damping, Free vibration with hysteretic damping.

UNIT – III

HARMONICALLY EXITED VIBRATIONS

Introduction, Equation of motion, Response of an undamped system under harmonic force, Response of a damped system under harmonic force, Response of a damped system under harmonic motion of the base, Response of a damped system under rotating unbalance, Forced vibration with coulomb damping, Forced vibration with hysteresis damping.

UNIT – IV

Vibration Under General Forcing Conditions: Introduction, Response under a general periodic force, Response under a periodic force of irregular form, Response under a non periodic force, Convolution integral.

Two Degree of Freedom Systems: Introduction, Equation of motion for forced vibration, Free vibration analysis of an undamped system, Torsional system, Coordinate coupling and principal coordinates, Forced vibration analysis.

UNIT – V

Multi-degree of Freedom Systems: Introduction, Modeling of Continuous systems as multi degree of freedom systems, Using Newton's second law to derive equations of motion, Influence coefficients, Free and Forced vibration of undamped systems, Forced vibration of viscously damped systems.

Determination Of Natural Frequencies and Mode Shapes: Introduction, Dunkerley's formula, Rayleigh's method, Holzers method, Matrix iteration method, Jacobi' s method.

UNIT – VI

Continuous Systems: Transverse vibration of a spring or a cable, Longitudinal vibration of bar or rod, Torsional vibration of a bar or rod, Lateral vibration of beams, critical speed of rotors.

TEXT BOOKS:

1. Mechanical Vibrations by S.S.Rao, Addison Wesley Publishing (or Pearson education)

REFERENCES:

1. Mechanical Vibrations by G.K. Grover, Nem Chand Publishers
2. Mechanical Vibrations by W.T. Thomson, Addison-Wesley Publishing

VI SEMESTER	L	T	P	C
	3	-	-	3

16ME6E02: POWER PLANT ENGINEERING

COURSE OUTCOMES: Students are able to

CO1: Describe the layout of steam power plant and various handling equipment of coal, ash etc. [K2]

CO2: Describe the equipment used for combustion of coal and other supporting systems. [K2]

CO3: Describe the working of diesel and gas turbine power plants. [K2]

CO4: Identify the basic requirements and working of different hydro electric power plants. [K2]

CO5: Describe the working of nuclear power plant and classify nuclear reactors. [K2]

CO6: Estimate various costs and load calculations involved in a power plant and identify environmental considerations. [K2, K4]

Unit – I

Introduction to the sources of energy –Resources and Development of Power in India.

STEAM POWER PLANT: General layout of modern thermal power Plant, site selection and different materials required for thermal power plants, classification of coal, out-plant handling of coal, coal storage, in-plant handling of coal, pulverized fuel handling system, ash handling systems.

Unit – II

BURNING OF COAL AND COMBUSTION NEEDS: Coal burning methods, overfeed and underfeed stokers-chain grate, traveling grate, spreader stokers, single and multi retort stokers, pulverized fuel burning system and its components, draught system, dust collectors, cooling towers and feed water treatment.

Unit –III

DIESEL ELECTRIC POWER PLANT: Fields of use, general layout of diesel power plant, types of diesel engines used for diesel power plants, different systems of diesel power plant – fuel supply system, air-supply system, water-cooling system, lubrication system , starting system, super charging of diesel engines, advantages and disadvantages of diesel plants over thermal plants.

GAS TURBINE PLANT: Introduction, classification, construction, layout with auxiliaries, – principles of working of closed and open cycle gas turbines, combined cycle power plants and comparison.

Unit – IV

HYDRO ELECTRIC POWER PLANT: Hydrology, hydrological cycle, rain fall and run-off its measurement, hydrographs, flow duration curves, mass curve and storage, classification of dams and spill ways, water hammer and surge tanks.

HYDRO PROJECTS AND PLANT: Classification, typical layouts of hydro electric power plants, plant auxiliaries, plant operation pumped storage plants.

Unit – V

NUCLEAR POWER STATION: Nuclear fuel, breeding and fertile materials, nuclear reactor, reactor operation.

TYPES OF REACTORS: Pressurized Water Reactor (PWR), Boiling Water Reactor (BWR), Sodium-Graphite Reactor (SGR), Fast Breeder Reactor (FBR), Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.

Unit –VI

POWER PLANT ECONOMICS AND ENVIRONMENTAL CONSIDERATIONS: Capital cost, investment, of fixed charges, operating costs, general arrangement of power distribution, Load curves and load duration curve, definitions of connected load, maximum demand, demand factor, average load, load factor, diversity factor – related exercises.

Effluents from power plants and impact on environment, pollutants and pollution standards methods of pollution control.

TEXT BOOKS:

1. A Course in Power Plant Engineering, Arora and Domkundwar. Dhanpatrai & Co.
2. Power Plant Engineering, P. C. Sharma and S.K.Kataria Publishers

REFERENCES:

1. Power Plant Engineering: P. K. Nag, Second Edition, Tata McGraw Hill.
2. A Text Book of Power Plant Engineering, Rajput , Laxmi Publications
3. An Introduction to Power Plant Technology, G.D. Rai.

VI SEMESTER	L	T	P	C
	3	-	-	3
16ME6E03:NUMERICAL CONTROL & COMPUTER NUMERICAL CONTROL				

Course Outcomes: Students are able to.

CO1: Explain the construction features of CNC machine tools.

CO2: Illustrate the various types of Accessories and feedback devices used in CNC machines.

CO3: Explain the working of Position transducer as well as Control systems and Interfaces.

CO4: Analyze the Automatically Programming Tool Language and develop a program on different examples

CO5: Analyze the CNC Programming tools and develop a program on different examples.

CO6: Explain the concept of Computer Integrated Manufacturing systems.

Unit – I

Introduction to CNC Machine tools: Evolution of Computerized control in manufacturing, Components, Working principle of CNC, DNC and Machining centers.

Constructional features of CNC machine tools: Introduction, Spindle drives, Transmission belting, axes feed drives, Slide ways, Ball screws.

Unit – II

Accessories: Work tables, Spindles, Spindle heads, Beds and Columns, Tooling – Automatic Tool changer (ATC).

Feedback devices: Introduction, Digital incremental displacement measuring systems, Incremental rotary encoders, Digital absolute measuring system.

Unit –III

Electro-magnetic analogue position transducers: Principle, advantages, characteristics, Synchros, Synchro-Resolvers, Inductos, Laser interferometer.

Control Systems and interface: Open and closed loop systems, Microprocessor based CNC systems, block diagram of typical CNC system, description of hard ware and soft interpolation systems, Standard and optional features of CNC control systems.

Unit – IV

APT programming: APT language structure, APT geometry, Definition of point, time, vector, circle, plane, patterns and matrices. APT motion commands: setup commands, point-to point motion commands, continuous path motion commands, post processor commands, control commands, Macro subroutines, Part programming preparation for typical examples.

Unit – V

CNC Programming: Part programming fundamentals, Preparatory functions, Miscellaneous functions, Programming number, Canned cycles, Tool length compensation, Cutter Radius compensation, Sub Programs, Part programming preparation for typical examples.

Unit –VI

Computer Integrated manufacturing system: Introduction, manufacturing cell, Flexible manufacturing systems-Components of FMS, FMS Work stations, Material Handling Systems, and Computer Control system, FMS layout configurations and benefits of FMS.

TEXT BOOKS:

1. Computer Numerical Control Machines – Dr.RadhaKrishnanan, New Central Book Agency
2. Computer Control of manufacturing systems – YoramKoren, McGraw Hill Education
3. CAD/CAM Principles and Applications – P N RAO McGraw Hill Education

REFERENCES:

1. Computer Numerical Control Machines – Hans B.Keif and T. Frederick Waters Macmillan/McGraw Hill
2. CNC Programming Hand book –Peter Smid
3. Numerical Control and Computer – Aided Manufacturing - T K Kundra / TMH Education

VI SEMESTER	L	T	P	C
	3	-	-	3
16ME6E04:ROBOTICS				

Course Outcomes: Students are able to

CO1: Summarizeprinciples of Automation, Classification and Applications of industrial Robots.[K2]

CO2: Classify Robotic Arms, calculate Degree of Freedom and summarize various drives of the Robots. [K2]

CO3: Applyvarious motion analysis principles to solve problems involving Manipulator Kinematics.

CO4: Apply Jacobian and Lagrangian principles to solve manipulator Dynamics Problems.[K2]

CO5: Summarize different types of trajectories and **apply**their principles for trajectory planning and Robot Programming Methods. [K2]

CO6: Summarize Industrial Applications of Robots in various fields. [K2]

UNIT – I

INTRODUCTION: Automation and Robotics - CAD/CAM and Robotics - over view of Robotics - Robot Generations - Robot Anatomy - Classification of Robots.

UNIT – II

FUNDAMENTALS OF ROBOT TECHNOLOGY*:* Function line diagram representation of Robot Arms - Work Volume – Robot Drive Systems – Control Systems and Dynamic Performance – Precision of Movement – End Effectors – Robotic Sensors – Robot Actuators – Feedback Components.

UNIT – III

MOTION ANALYSIS*:* Homogeneous transformations as applicable to rotation and translation, problems– Direction Cosine Representation, Euler Angles.

MANIPULATOR KINEMATICS*:* D-H Notations, joint coordinates and world coordinates, Forward and inverse kinematics, problems of simple robotic manipulators.

UNIT – IV

MANIPULATOR DYNAMICS: Differential transformation of manipulators, Jacobians, Lagrange, Euler and Newton, Euler formulations, Problems.

UNIT – V

TRAJECTORY PLANNING: Path Planning, Skew motion, joint integrated motion, straight line motion.

ROBOT PROGRAMMING: Programming Methods – Motion Interpolation – WAIT, SIGNAL & DELAY Commands - Robot Languages.

UNIT – VI

ROBOT APPLICATIONS IN MANUFACTURING*:* Material Transfer, Machine loading and un-loading Operations, Processing Operations - Assembly Operations – Inspection – Safety in Robotics – Training - Maintenance.

TEXT BOOKS:

1. Industrial Robotics -Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey/ TATA McGraw-Hill Education

2. Robotics and Control - R.K. Mittal, I. J. Nagrath / Tata Mc Graw Hill Publishing Company Ltd

3. A Textbook on Industrial Robotics - Ganesh S. Hegde, Lakshmi Publications (P) Ltd. / New Delhi.

REFERENCES:

1. Robotics, control Sensing, vision and intelligence - K.S. Fu, R.C.Gonzalez, C.S.G Lee / Tata Mc Graw Hill Education.

2. Robot Analysis – Mechanics of Serial and Parallel Manipulators - Lung-Wen Tsai, John-Wiley Publications, New York.

3. Industrial Robotics - M. P. Groover / Pearson Education

4. Introduction to Robotics – Analysis, Systems, Applications – Saeed B. Niku / Pearson Education

VI SEMESTER	L	T	P	C
	3	-	-	3
16CS6E05: DATA STRUCTURES				

COURSE OUTCOMES: Students areable to

1. Illustrate single, circular and double linked list.
2. Analyze stacks and queues using arrays and linked lists.
3. Explain various operations on binary trees.
4. Apply appropriate sorting and searching techniques for the given data.
5. Analyze various concepts in binary tree
5. Illustrate various operations on Graphs.

UNIT – I

Introduction- Concept of data structures, overview of data structures, implementation of data structures. Searching: Linear Search, Binary Search, Fibonacci search. Sorting (Internal): Basic concepts, Sorting by: insertion (Insertion sort), selection (selection sort), exchange (Bubble sort, quick sort), distribution (radix sort) and merging (merge sort).

UNIT – II

Stacks Representation using Arrays and Linked List, operations on stack, factorial calculation, evaluation of arithmetic expression.

UNIT – III

Queues Representation using Arrays and Linked List, operations on queue, circular queue, queue using stack.

UNIT – IV

Linked lists: Linked Lists- Single linked list, Circular linked list, Double linked list, Circular double linked list.

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UNIT – V

Trees Binary Trees: Basic tree concepts, Properties, Representation of Binary Trees using Arrays and Linked List, Binary Tree Traversals, threaded binary tree. Binary search trees: Basic concepts, BST operations: Search, insertion, deletion and traversals, Creation of binary search tree from in-order and pre (post)order traversals.

UNIT – VI

Graphs Basic concepts, representations of graphs, operations on graphs- vertex insertion, vertex deletion, find vertex, edge addition, edge deletion, graph traversals (BFS & DFS)(No Programs required)

Text Books:

1. Richard F, Gilberg ,Forouzan, Data Structures, 2nd edition, , Cengage.
2. Debasissamanta, Classic Data Structures, PHI, 2 nd edition, 2011.

Reference Books:

1. Seymour Lipschutz, Data Structure with C, TMH.
2. G. A. V. Pai, Data Structures and Algorithms, TMH, 2008.
3. Horowitz, Sahni, Anderson Freed, Fundamentals of Data Structure in C, University Press, 2nd editi

VI SEMESTER	L	T	P	C
	3	-	-	3
16EE6E04: CONTROL SYSTEMS				

COURSE OUTCOMES: Students areable to

1) Derive the transfer function of physical systems and determination of transfer function using block diagram algebra and signal flow graph
2) Analyze absolute and relative stability of LTI Systems
3) Design different compensators to improve system performances
4) Explain the concepts of controllability and observability

UNIT I

Mathematical Modeling of Control Systems: Introduction, Open Loop and Closed Loop control systems and their differences, Classification of control systems, Feedback characteristics, and Transfer function of linear systems. Differential equations of electrical networks, Translational and Rotational mechanical systems, Transfer function of DC Servo motor, Transfer function of AC Servo motor, Synchro transmitter and Receiver, Block diagram algebra and Problems, Signal flow graph – Reduction using Mason's gain formula with Problems

UNIT II

Time Response Analysis: Standard test signals, Time response of first order systems, Time response of second order systems, Time domain specifications, Steady state errors and error constants, Effects of PI, PD and PID controllers, Problems

UNIT III

Stability and Root locus technique: The concept of stability, Location of poles on s-plane for stability, Routh's stability criterion and problems, Limitations of Routh's stability, The Root locus concept, Construction of root loci and simple problems

UNIT IV

Frequency response analysis: Introduction, Frequency domain specifications, Bode diagrams and Procedure for magnitude and phase plot of Bode plot, Problems on Bode plot, Stability analysis from Polar plots and problems, Nyquist stability criterion and problems

UNIT V

Compensation techniques: Lag and Lead compensators, Lag-Lead compensators, Design of compensators using Bode plots

UNIT VI

State space analysis of continuous systems:

Concepts of state, state variables and state model, State space representation of transfer function, Diagonalization – Solving the Time invariant state equations, State transition Matrix and its Properties, Concept of Controllability and Observability

TEXT BOOKS

1. Modern control Engineering, Kotsuhiko Ogata, Prentice Hall of India.
2. Automatic control systems, BenjamanC.Kuo, Prentice Hall of India, 2nd Edition.

REFERENCE BOOKS

1. Control Systems, ManikDhanesh N, Cengage publications.
2. Control Systems principles and design, M. Gopal, Tata McGraw Hill education Pvt Ltd., 4th Edition.
3. Control Systems Engineering, S.Palani, Tata McGraw Hill Publications.
4. Control Systems by A. NagoorKani, RBA Publications.

	L	T	P	C
VI SEMESTER	**-**	**-**	**4**	**2**
16ME6L01:METROLOGY LAB				

List of Experiments:

1. Measurement of lengths and diameters by using Vernier calliper and micrometer.
2. Measurement of central distance between two holes by using vernier height gauge.
3. Measurement of bores by using internal micrometer and dial bore indicator.
4. Measurement of gear tooth profile using gear tooth vernier.
5. Angle and taper measurements by Bevel protractor, Sine bar.
6. Thread measurement by using Tool maker's microscope.
7. Surface roughness measurement by Talysurf.
8. Use of spirit level in finding the straightness of a bed as of a surface
9. Machine tool alignment test on lathe.
10. Machine tool alignment test on milling machine.

VI SEMESTER	L	T	P	C
	-	-	4	2
16ME6L02:HEAT TRANFER LAB				

1. Determine the thermal resistance, thermal conductivity of composite wall.
2. Determine the thermal conductivity of lagged material for the given pipe.
3. Determine the thermal conductivity of given insulating powder.
4. Determine the thermal conductivity of given metal rod.
5. Determine the temperature distribution, efficiency and effectiveness of a pin fin.
6. Determine heat transfer co efficient and heat transfer rate for a heated vertical cylinder in natural convection.
7. Determine the convective heat transfer co- efficient and the rate of heat transfer by forced convection for flow of air.
8. Determine LMTD, Effectiveness and overall heat transfer coefficient for the parallel flow and counter flow heat exchangers.
9. Determine critical heat flux of given Nicrome wire.
10. Determine the Emissivity of the given gray body.

SEMESTER-VI	L	T	P	C
	-	-	4	2
16BS6T01: SOFT SKILLS AND APTITUDE LAB				

COURSE OUTCOMES:

Students are able to

CO1. Describe the fundamental concepts of hardware description language (HDL).

CO2. Design and simulate combinational and sequential digital circuits using Modelsim & Xilinx – VHDL language

CO3. Analyze the Read and Write operations of RAM and Arithmetic and Logical units.

CO4. Develop different logic gates and logic cells using micro wind tool.

Minimum Twelve Experiments 8 from Part-A and 4 from Part-B to be conducted:

PART-A

1. Develop VHDL Programs in different models for all logic gates.

2. Write the VHDL Programs for half adder and full adder.

3. Explain operation of both binary encoder and binary decoder using HDL programs.

4. Construct 32:1 multiplexer using 8:1 multiplexers and write VHDL program.

5. Implement (7, 4) Hamming code generator and develop VHDL program for it .

6. Verify the outputs for different input combinations in 4 bit comparator using VHDL program.

7. Simulate the operation of D- Flip-flop in behavioral model VHDL Program.

8. Design and develop HDL program for 3 bit Johnson counter.

9. Explain the operation of 4 bit counter using structural model VHDL Program.

10. Demonstrate PIPO Shift register operation using mixed model VHDL Program.

11. Universal shift register operation explanation using VHDL Program.

12. VHDL program for verifying different operations of 16*4 RAM .

13. Stack and Queue implementation using 16*4 RAM by VHDL Program.

14. Perform both Arithmetic and Logical operation using ALU and develop VHDL Program.

PART-B

1. Sketch the Layout of Invertor using Microwind tool.

2. Develop the Universal gates layout using Microwind tool.

3. Design XOR gate layout using Microwind tool.

4. Construct SRAM cell Layout using Microwind tool.

5. Draw the Layout of R-S Latch using Microwind tool.

6. D- flip-flop layout design using Microwind tool.

EQUIPMENT REQUIRED FOR LABORATORIES:

1. XILINK SOFTWARE ISE TOOLS
2. CPLD & FPGA Trainer Kits
3. Microwind tool.

- Total Number of Laboratory Sessions: 10
- Total Number of Modules: 4

List of Modules:

- **Module-I:** Communicative Grammar and Language Skills
  i) Grammar:a) Parts of Speech
  b) Articles and useful prepositions
  c) Sentence and its types
  d) Verb forms and Tenses
  e) Question Tags
  f) Do-Forms and Wh-questions
  g) Common mistakes at proficiency

  ii) Language Skills

  a) Listening activity with a CD on Parts of Speech
  b) Listening activity with a CD on Articles and Prepositions
  c) Listening activity through CD on sentence and its types
  d) Listening activity with a CD on Verb forms and Tenses
  e) Reading activity on Question Tags
  f) Reading activity on Do-Forms and Wh-questions
  g) Writing activity (Resume)
  h) Writing activity (E-mail)
  i) Writing activity (Guided Composition)
  j) Writing activity (Guided Composition)

- **Module-II:** Communication Skills
  a) JAM/J2M on a given topic

b) Introduce yourself (Strengths and weaknesses)
c) Conversations
d) Body Language
e) Presentations
f) Group Discussion
g) Interview Skills

- **Module-III:** Vocabulary
  a) 20 useful vocabulary for an engineering resume
  b) Commonly confused words
  c) One-word Substitutes
  d) Useful phrases or expressions for a Telephonic Interview
  e) Useful phrases or expressions for introduction and conclusion at a speech, interview, presentation, seminar, conference, GD etc.
  f) GRE words
  g) Useful phrases for an interview

- **Module-IV:** Soft Skills
  a) Positive Attitude- Courtesy and etiquette
  b) Motivation
  c) Adaptability
  d) Goal Setting
  e) Leadership Qualities
  f) Team Work
  g) Problem Solving
  h) Time and Stress Management
  i) Negotiation and conflict resolution
  j) Interpersonal Skills

- **Method/Approach to be Adopted:** Communicative, implicit, incidental and activity based method to create enthusiasm among the students.

Division of Syllabus for each Laboratory Session

Lab-I: Time allotted 4 periods

Part-I: Communicative Grammar and Language Skills

Grammar Topic: Parts of Speech

Language Skills Topic: Listening activity with a CD on Parts of Speech

Activity follows

Part-II: Communication Skills

Topic: JAM/J2M on a given topic

Part –III: Vocabulary

Topic: 20 useful vocabulary for an engineering resume

Part-IV: Soft Skills

Topic: Positive Attitude- Courtesy and etiquette

Lab-II: Time allotted 4 periods

Part-I: Communicative Grammar and Language Skills

Grammar Topic: Articles and useful prepositions

Language Skills Topic: Listening activity with a CD on Articles and Prepositions Follow-up Activity: Articles and Prepositions For E.g., Picture Description on Articles and Prepositions

Part-II: Communication Skills

Topic: Introduce yourself (Strengths and weaknesses)

Activity: Role Play/Simulation

Part –III: Vocabulary

Topic: Commonly confused words

Part-IV: Soft Skills

Topic: Motivation

Lab-IX: Time allotted 4 periods

Part-I: Communicative Grammar and Language Skills

Grammar Topic: Common mistakes at proficiency

Language Skills Topic: Writing (Guided Composition)

Part-II: Communication Skills

Topic: Group Discussion

Part –III: Vocabulary

Topic: Common mistakes at proficiency

Part-IV: Soft Skills

Topic: Negotiation and conflict resolution

Lab-X: Time allotted 4 periods

Part-I: Communicative Grammar and Language Skills

Grammar Topic: Common mistakes at proficiency

Language Skills Topic: Writing (Guided Composition)

Part-II: Communication Skills

Topic: Interview Skills

Part –III: Vocabulary

Topic: Common mistakes at proficiency

Part-IV: Soft Skills

Topic: Interpersonal Skills

APTITUDE LAB FOR VI SEM (40 HOURS)

TOPICS

APTITUDE		REASONING	
• PERCENTAGES	(3)	BLOOD RELATIONS	(2)
• RATIO AND PROPORTIONS	(3)	DIRECTIONS	(2)
• AVERAGES	(2)	SYLLOGISM	(2)
• TIME AND WORK	(2)	CODING AND DECODING	(2)
• PIPES AND CISTERNS	(1)	ANOLOGY	(2)
• PROFIT AND LOSS	(3)	CLASSIFICATION	(2)
• LCM & HCF	(3)	SERIES	(2)
• SIMPLE INTEREST	(2)		
• COMPOUND INTEREST	(3)		
• TIME AND DISTANCE	(2)		
• TRAINS ,BOATS & STREAMS	(2)		

VII SEMESTER	L	P	C
	3	-	4
16MA7T01: OPERATION RESEARCH			

COURSE OUTCOME: Students are able to

CO1: Apply linear programming techniques to solve industrial optimization problems.

CO2: solve transportation and assignment problems using operation research techniques.

CO3: Solve sequencingproblems using operation research techniques.

CO4: Solve replacement problems for optimization.

CO5: Analyze game theory and apply them for optimization.

CO6: Analyze queuing theory and apply it for optimization and also analyze inventory models for various industrial problems.

UNIT—I

LINEAR PROGRAMMING: Linear programming problem formulation – Graphical solution – simplex method- artificial variables techniques -two–phase method, Big-M method – Duality principle.

UNIT – II

TRANSPORTATION PROBLEM: Formulation – optimal solution, unbalanced transportation problem – Degeneracy

ASSIGNMENT PROBLEM- Formulation – optimal solution - variants of assignment problem- traveling salesman problem.

UNIT – III

SEQUENCING PROBLEM: Introduction – Optimal Solution for processing n jobs through two machines - processing n jobs through three machines - processing n jobs through m machines - processing two jobs through m machines

UNIT – IV

REPLACEMENT: Introduction – replacement of items that deteriorate with time – when money value is not counted and counted – replacement of items that fail completely, group replacement.

UNIT – V

THEORY OF GAMES: Introduction – minimax (maxmin) – criterion and optimal strategy –solution of games with saddle points – rectangular games without saddle points – 2 x 2 games– dominance principle – m x 2 & 2 x n games -graphicalmethod.

UNIT – VI

WAITING LINES: Introduction- Single channel-Possion arrivals-Exponential service times-with infinite population model (M/M/1:FIFO/∞/∞)

INVENTORY : Introduction – single item – deterministic models – purchase inventory models with one price break and multiple price breaks – shortages are not allowed .

TEXT BOOKS:

1. Operations Research / S.D.Sharma, Ramnath co,Meerut
2. Operations Research, P.K.Gupta, D.S.Hira,S.Chand

REFERENCE BOOKS:

1. Operations Research /A.M.Natarajan,P.Balasubramani, A.Tamilarasi/PearsonEducation.
2. Operations Research / R.Pannerselvam,PHIPublications.

VII SEMESTER	L	T	P	C
	3	1	-	4
16ME7T01: FINITE ELEMENT METHODS				

COURSE OUTCOMES: Students are able to

CO1: Explain the basic concept and application of FEM and compare with other method [K2]

CO2: Solve one dimensional problem using potential energy approach [K3]

CO3: Calculate the displacement, stress and reactions in trusses and beans [K4]

CO4: Solve two dimensional problems using CST and higher order elements and apply numerical integration for higher order element problem analysis [K3]

CO5: Apply finite element analysis to solve steady state heat transfer problems [K3]

CO6: Determine the natural frequencies and mode shapes for bar and beams [k4]

UNIT – I

INTRODUCTION TO FEM: Basic concept, historical background, application of FEM, general description, comparison of FEM with other methods. Basic equations of elasticity, Stress- Strain relations, Strain- Displacement relations. Concept of potential energy - Rayleigh – Ritz method, Galerkin's method.

UNIT – II

ONE DIMENSIONAL PROBLEM: Finite element modeling, Coordinates and shape functions for one dimensional bar element. Potential Energy approach: formulation and assembly of Global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions using elimination and penalty approaches.

UNIT – III

ANALYSIS OF TRUSSES: Stiffness Matrix for plane truss element. Assembly consideration, calculations of displacement and reactions.

ANALYSIS OF BEAMS: Hermite shape functions-Element stiffness matrix for simple beam element, load vector, calculations of displacement and stresses.

UNIT – IV

2-D PROBLEMS: CST-Stiffness matrix and load vectors, Isoperametric element representation, Shape functions, convergence requirements, Problems. Quadrilateral elements and Numerical integration.

UNIT – V

STEADY STATE HEAT TRANSFER ANALYSIS: one dimensional analysis of a fins, one and two dimensional analysis of conduction in plates with convective boundary conditions.

UNIT – VI

DYNAMIC ANALYSIS: Formulation of finite element model, element matrices, Lumped and consistent mass matrices evaluation of Eigen values and Eigen vectors for a stepped bar and a beam.

TEXT BOOKS:

1. Introduction to Finite Elements in Engineering- R. Tirupathi Chandrapatla / Pearson Education, India.
2. The Finite Element Methods in Engineering - S. S. Rao , 5th edition, Elsevier, USA.

REFERENCE:

1. Fundamentals of finite elements analysis - V. David. Hutton, 1st edition / Tata McGraw-Hill education (P) Ltd, New Delhi, India.

VII SEMESTER	L	P	C
	3	-	3
16ME7T02: CAD/CAM			

COURSE OUTCOMES: Students are able to

CO1: Explain the hardware and software of CAD systems. [K2]

CO2: Apply mathematical principles in solving problems such as curve representation and surface representation. [K3]

CO3: Define NC and CNC systems and write the basic programs using both G-Codes, M-Codes and APT.[K1]

CO4: Summarize the principles of Group Technology and Apply them in grouping parts as well as Explain CAPP.[K2][K4]

CO5: Explain about Computer Aided Quality Control and various inspection methods.[K2]

CO6: Explain about Computer Integrated Manufacturing, and also benefits of CIM.[K2]

UNIT—I

INTRODUCTION AND COMPUTER GRAPHICS: Computers in Industrial Manufacturing, Product life cycle, CAD/CAM Hardware Basic structure, CPU, Memory Types, Input Devices, Display Devices, Hard copy Devices, and Storage Devices.

COMPUTER GRAPHICS: Raster scangraphics coordinate system, Data base structure for graphics modelling, Transformation of geometry, Clipping, Hidden surface removal.

UNIT – II

GEOMETRIC MODELING: Requirements of GM, geometric models, geometric construction methods, curve representation methods, surface representation methods,

Modelling Systems - Basic Geometric commands, Layers, Display control commands, Editing, Dimensioning, Solid Modelling.

UNIT – III

PART PROGRAMMING FOR NC MACHINES:

NC, NC Modes, NC Elements, NC Machine Tools, Structure of CNC machine tools, Features of Machining Centre & Turning Centre.

CNC PART PROGRAMMING: Fundamentals, Manual part Programming, Computer Aided Part Programming.

UNIT – IV

GROUP TECHNOLOGY: Group Technology, Part family, coding and Classification, Production flow Analysis, Advantages & Limitations.

COMPUTER AIDED PROCESS PLANNING: Importance, Types - Retrieval type & Generative type.

UNIT – V

COMPUTER AIDED QUALITY CONTROL: Terminology in QC, The Computer in QC.Inspection Methods -Contact inspection methods,Non contact Inspection Methods, Non optical Inspection Methods, Computer aided testing, Integration of CAQC with CAD/CAM.

UNIT – VI

COMPUTER INTEGRATED MANUFACTURING SYSTEMS: Types of manufacturing systems, Machine Tools & Related Equipment, Material Handling Systems, Material requirement planning,Computer control systems, Human labour in manufacturing systems, CIM Benefits.

TEXT BOOKS:

1. CAD/CAM - P.N.RAO /McGraw Hill Education (India) Private Limited.
2. CAD/CAM --- A Zimmer's & P.Groover/PE/PHI.

REFERENCE BOOKS:

1. Automation, Production systems& Computer Integrated Manufacturing- Mikell P Groover / Pearson Education.
2. Principles of computer aided design and manufacturing - Farid Amirouche/ Pearson.
3. Computer Numerical Control Concepts and programming - warren s seames/ Thomson Learning

VII SEMESTER	L	T	P	C
	3	-	-	3
16ME7E01: TRIBOLOGY				

COURSE OUTCOMES: Students are able to

CO1: Demonstrate the fundamental of the friction concept.

CO2: Explain the concepts of wear and its mechanism.

CO3: Explain the concepts of viscosity and properties of lubricants and theories of lubricant.

CO4: Explain theories of hydrodynamic lubrication and its application.

CO5: Explain the theories of hydrostatic and application.

CO6: Identify the various bearing materials and explain anti-friction bearing.

UNIT – I

FRICTION: Types of friction, Theories of friction, Study of current concepts of boundary friction and dry friction, friction reducing measures.

UNIT – II

WEAR: Wear Causes of wear, Types of wear, Mechanism of various types of wear, laws of wear, effects of wear.

UNIT – III

VISCOSITY AND LUBRICANTS: Viscosity, flow of fluids, viscosity and its variation -absolute and kinematic viscosity, temperature variation, viscosity index determination of viscosity, different viscometers used, Viscosity standards, Lubricants and their physical properties, Various theories of lubrication.

UNIT – IV

THEORY OF HYDRODYNAMIC LUBRICATION: Petroffs equation, Reynold's equation in two dimensions, bearing modulus, Sommerfeld number, Effects of side leakage, pressure, flow, Load capacity and friction calculations, heat balance, minimum oil film thickness, oil whip and whirl.

UNIT – V

THEORY OF HYDROSTATIC LUBRICATION: Hydrostatic step bearing, pivoted pad thrust bearing, hydrostatic lifts, hydrostatic squeeze films, pressure, flow, load capacity and friction calculations, oil rings, pressure feed bearing, partial bearings, externally pressurized bearings, Air lubricated bearing, Advantages and disadvantages.

UNIT – VI

ANTI-FRICTION BEARINGS AND BEARING MATERIALS : Anti-friction bearings, types, Advantages and disadvantages, General requirements of bearing materials, types of bearing materials, General bearing design considerations.

TEXT BOOKS:

1. Fundamentals of Tribology - Basu, SenGupta and Ahuja/PHI.

REFERENCES:

1. Tribology in Industry - Sushil Kumar Srivatsava / S. Chand &Co.
2. Tribology – B.C. Majumdar / S Chand Publications.
3. Friction and Wear of materials – Rabinowicz / John willey & Sons.
4. Principles of Tribology - Halling. J / Macmillian. Audio Book Publishing.
5. Engineering Tribology - Williams .J.A / Oxford University Press.

VII SEMESTER	L	T	P	C
	3	-	-	3
16ME7E02: AUTOMOBILE ENGINEERING				

COURSE OUTCOMES: Students are able to

CO1: Identify the components of automobile, types of drives and engine specifications. [K2]

CO2: Describe the working of different elements of automobile transmission system. [K2]

CO3: Describe the steering geometry, steering mechanisms and steering gears of an automobile. [K2]

CO4: Describe and compare different suspension and braking systems of an automobile. [K2, K4]

CO5: Describe the starting system and electrical accessories of electrical system of an automobile. [K2]

CO6: Describe the engine lubrication system and use of safety systems of an automobile. [K2, K3]

UNIT – I

INTRODUCTION : classification of automobiles, Major components of four wheeler automobile – chassis and body , power plant,power transmission, Types of drives - Rear wheel drive, Front wheel drive, Four wheel drive, car body styles, super chargers and turbo chargers, crank case ventilation.

ENGINE SPECIFICATIONS: Engine Specifications with regard to power, speed, torque, number of cylinders and arrangement, lubrication and cooling systems.

UNIT – II

TRANSMISSION SYSTEM:

Clutches – Single and Multi plate clutches, Magnetic Centrifugal and Semi centrifugal clutches, Fluid fly wheel. Gear boxes – Sliding mesh, Constant mesh and Synchromesh gear boxes, Epicyclic gear box, Torque converter.Propeller shaft, universal joint, differential, rear axle, rear axle drives – Hotchkiss drive, Torque tube drive, rear axle shaft supporting – semi Floating, full floating, and three quarter floating axles.

UNIT – III

STEERING SYSTEM: - Steering geometry – camber, castor, king pin, combined angle, toe-in, toe-out, center point steering,steering mechanisms –Ackerman steering mechanism, Davis steering mechanism, steering gears, steering linkages.

UNIT – IV

BRAKING SYSTEM : Braking Requirements, Types of Brakes - Drum Brakes, Disc Brakes, Mechanical brakes, Hydraulic brakes - Master cylinder, wheel cylinder, Tandem master cylinder, bleeding of hydraulic brakes, pneumatic and vacuum brakes.

SUSPENSION SYSTEM: Object of suspension systems, types of suspension springs - Steel springs – Leaf springs, Tapered leaf spring, Coil spring and Torsion bar, telescopic shock absorber, Rigid axle suspension system, independent axle suspension system – Wishbone type, Mac Pherson strut type, vertical guide type and swinging half axle type.

UNIT – V

ELECTRICAL SYSTEM: Charging circuit, generator circuit and need for cut-out - current voltage regulator, Bendix drive mechanism (Starting System), Solenoid switch, Horn, Wiper, Fuel gauge indicator, Lighting system.

UNIT – VI

ENGINE LUBRICATION & SAFETY SYSTEMS:

Engine lubrication- splash and pressure lubrication systems, oil filters – Cartridge type, edge type and centrifugal type, oil pumps – Gear Pump, Rotor Pump, Vane Pump and Plunger Pump.

Safety systems - Introduction, seat belt, air bags, bumper, anti lock brake system (ABS), wind shield, suspension sensors, traction control, mirrors, central locking and electric windows, speed control.

TEXT BOOKS:

1. Automotive Engineering – Volume 1 & 2 - Kirpal Singh/ Standard Publications

2. A Text book of Automobile Engineering- R.K.Rajput/Lakshmi Publications

REFERENCES:

1. Automobile Engineering - G. B. S. Narang/Khanna Publishers
2. Automobile Engineering - R.B.Gupta/ Satya Prakashan Publications
3. Automobile Engineering - P.S Gill/ S.K. Kataria & Sons.

VII SEMESTER	L	T	P	C
	3	-	-	3
16ME7E03: FLEXIBLE MANUFACTURING SYSTEMS				

COURSE OUTCOMES: Students are able to

CO1: Explain the basic components, various hardware and software requirements of Flexible Manufacturing Systems.[K2]

CO2: Explain the concepts of Manufacturing cell and Just In Time.[K2]

CO3: Classify the turning and machining centres and Explain their automated features. [K2]

CO4: Describe and Classify the Coordinate Measuring Machine and Explain about the Automated Material Movement and Storage Systems.[K2]

CO5: Explain about the control of cutting tool management, strategies and discuss the system hardware and general functionality.[K2]

CO6: Explain the structure of Flexible Manufacturing System Software and Classify their Software modules.[K2]

UNIT—I

FMS Introduction and Description

Introduction, Definition, Basic Component of FMS, Significance of FMS, General layout and configuration of FMS, Principle Objectives of FMS, Benefits and limitations of FMS, Area of Application of a FMS in Industry, Various Hardware and Software required for an FMS, CIM Technology, Hierarchy of CIM, and FMS Justification.

UNIT – II

Manufacturing Cell

Introduction, Description and Classifications of Cell, Unattended Machining, Cellular versus Flexible Manufacturing.

Just In Time (JIT): Introduction, Concepts, Goals and Objectives, Ingredients, Quality and Quantity principles of JIT, Benefits and Implementation.

UNIT – III

Turning and Machining Centres

Introduction, Types, Construction and Operation Performed on Turning enter, Automated Features and Capabilities of Turning Centres, General Advantages and Disadvantages of Vertical and Horizontal Machining Centres, Pallet and Part Loading and Programming Options in Machining Centres, Automated features and capabilities of a Machining Centres

UNIT – IV

Coordinate Measuring Machine: Introduction, Construction, Types of CMM, Functions, Operational cycle description, Advantages & Limitations.

Automated Material Movement and Storage System: Introduction, Types of AGV and Their principle of working, Advantages, Limitation and General AGV Guide path, Robots, Benefits of using Industrial Robots, Basic components and benefits of Automated Storage and Retrieval Systems, Conveyors and Pallet Flotation System, Queuing Carrousels and Automatic Work Changers, Coolant and Chip Disposal and Recovery system.

UNIT – V

Cutting Tools and Tool Management

Introduction, Control of Cutting Tools, Tool Management, Tool Strategies, Tool Preset, Identification and Data Transfer, Tool Monitoring and Fault Detection

System Hardware and General Functionality: Introduction**,** Programmable logic controller, cell controllers, communication Networks.

UNIT – VI

FMS Software Structure, Functions and Description: Introduction, General Structure and Requirements, Advantages Of Modular Software Design and Development, Activities and Functions to be performed by FMS Software, within the System, Requirements of FMS Software, Types of FMS software Modules.

TEXT BOOKS:

3. Flexible Manufacturing System - H. K. Shivanand, M. M. Benal, V. Koti/ New Age Publishers.
4. Automation, Production Systems and Computer Integrated Manufacturing - Groover M.P/ Prentice Hall of India.
5. CAD/CAM – Groover M.P, Zimmers E.W/Prentice Hall of India

REFERENCE BOOKS:

1. Approach to Computer Integrated Design and Manufacturing - Nanua Singh/ John Wiley and Sons.

VII SEMESTER	L	T	P	C
	3	-	-	3
16ME7E04: TOTAL QUALITY MANAGEMENT				

COURSE OUTCOMES: Students are able to

CO1: Explain the concept of Total Quality Management and discriminate product and service quality (K2)

CO2: Analyze various principles of Total Quality Management that are practically applicable(k4)

CO3: Illustrate different Statistical Quality Control methods(K3)

CO4: Distinguish various tools and techniques of Total Quality Management(K4)

CO5: Recognize the importance of six sigma in Quality Management(K1)

CO6: Evaluate various ISO standards that are used for testing the quality of a product in the present scenario (K5)

UNIT—I

INTRODUCTION

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming - Barriers to TQM

UNIT – II

TQM PRINCIPLES

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

UNIT – III

STATASTICAL PROCESS CONTROL

Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed, Process capability – meaning, significance and measurement –concepts of processcapability.Business process Improvement (BPI)– principles, applications, reengineering process, benefits and limitations

UNIT – IV

TQM TOOLS AND TECHNIQUES I

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

UNIT – V

TQM TOOL AND TECHNIQUES II

Control Charts - Process Capability - Quality Function Development (QFD) - Taguchi quality loss function –Total Productive Maintenance (TPM)– Concepts, Terotechnology, improvement needs - Performance measures.

UNIT – VI

QUALITY SYSTEMS

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

TEXT BOOKS:

1. Total Quality Management - Dale H. Besterfield / Pearson Education
2. Beyond Total Quality Management - Greg Bounds / McGraw Hill Education.
3. TQM in New Product manufacturing, H. G. Menon/ McGraw Hill Education.
4. Total Quality Management – Suri / John Wiley Publications.

VII SEMESTER	L	T	P	C
	3	-	-	3
16CS7E05: OOPS THROUGH JAVA				

COURSE OUTCOMES: Students are able to

1: Difference between procedural oriented programming and object oriented programming (OOP) paradigms, Java features, Apply OOP Concepts.

2: Define java control statements and String Class.

3: Apply the concept of Inheritance and polymorphism.

4: Explain the Packages and Interfaces.

5: Define Exception handling and Applets.

6: Implement the concepts of Multithreading.

Unit I

Introduction to OOPS

Java: History – Java features – Java Environment – JDK1.8 – API. - Types of java program – Creating and Executing a Java program – Java Tokens: Keywords, Character set, Identifiers, Literals, Separator – Java Virtual Machine (JVM) – Command Line Arguments – Comments in Java program.

Introduction to OOPS: Paradigms of Programming Languages - Basic concepts of Object Oriented Programming – Differences between Procedure Oriented Programming and Object Oriented Programming - Objects and Classes – Data abstraction and Encapsulation, Inheritance, Polymorphism – Benefits of OOP – Application of OOPs.

Unit II

Java Basics

Java Basics: Constants – Variables – Data types - Scope of variables – Type casting – Operators: Arithmetic - Logical – Bit wise operator – Increment and Decrement – Relational – Assignment – Conditional – Special operator – Expressions – Evaluation of Expressions.

Decision making andBranching: Simple if statement – if – else statement – Nesting if – else – else if Ladder – switchstatement – Decision making and Looping: while loop – do – while loop - for loop – break – – continueStatement. – Simple programs.

Arrays: One Dimensional Array – Creating an array – Array processing– Multidimensional Array.

Class and objects: Defining a class – Methods – Creating objects – Accessingclass members – Constructors – Method overloading – Static members – Nesting of Methods – thiskeyword – Command line input – Simple programs.

Strings: String Array – String Methods – StringBuffer and StringBuilder Class – Simple programs

Unit III

Inheritance and Access Modifiers

Inheritance: Defining a subclass – Deriving a sub class – Single Inheritance – Multilevel Inheritance – Hierarchical Inheritance – Overriding methods – Final Classes - Final variables and methods - Abstract methods and classes – super keyword - Visibility Control: public access, private access, protected.

Unit 4: Interfaces and Packages

Interfaces: Multiple Inheritance - Defining interface – Extending interface - Implementing Interface - Accessing interface variables – Simple programs. Member access rules, super uses, using final with inheritance,polymorphism, abstract classes.

Packages: Java API Packages – System Packages – Naming Conventions – Creating & Accessing a Package – Adding Class to a Package – Hiding Classes – Programs.

Unit 5: Exception Handling and Applets

Exception Handling: Limitations of Error handling – Advantages of Exception Handling - Types of Errors – Basics of Exception Handling - Exception Hierarchy – try blocks – throwing an exception – catching an exception – finally statement, built-in and user defined exceptions.

Applets: Introduction – Applet Life cycle – Creating & Executing an Applet.

Unit 6: Multithreading

Multithreading: Differences between multi-threading and multitasking, Creating Threads – Life Cycle of a Thread – Defining & Running Thread – Thread Methods – Thread Priority – Synchronization – Implementing runnable interface – Thread Scheduling.

TEXT BOOKS:

1. Java: The complete reference, 7/e, Herbert schildt, TMH.

2. Java: How to Program, 8/e, Dietal, Dietal, PHIE.Balaguruswamy: “Programming with Java A Primer”, 4th Edition, Tata McGraw Hill, 2009.

REFERENCE BOOKS:

1. Core JAVA, Black Book, NageswaraRao, Wiley, Dream Tech.
2. Programming in Java2, Dr K SomaSundaram, JAICO Publishing house.
3. Object Oriented Programming through Java, P. Radha Krishna, University Press.

Elective-III

VII SEMESTER	L	T	P	C
	3	-	-	3
16EE7E01: UTILIZATION OF ELECTRICAL ENERGY				

COURSE OUTCOMES: Students are able to

- Identify a suitable motor for electric drives and industrial applications
- Identify most appropriate heating or welding techniques for suitable applications.
- Estimate the illumination levels produced by various sources and recommend the most efficient illuminating sources and should be able to design different lighting systems by taking inputs and constraints in view.
- Determine the speed/time characteristics of different types of traction motors.
- Estimate energy consumption levels at various modes of operation.
- Demonstrate UPS system

UNIT – I

Selection of Motors: Choice of motor, type of electric drives, starting and running characteristics, speed control, temperature rise, applications of electric drives, types of industrial loads, continuous, intermittent and variable loads, load equalization.

UNIT – II

Electric Heating & Electric Welding: Advantages and methods of electric heating, resistance heating induction heating and dielectric heating. - Electric welding: Resistance and arc welding, electric welding equipment, comparison between A.C. and D.C. Welding.

UNIT – III

Illumination fundamentals & Various Methods: Introduction, terms used in illumination, laws of illumination, polar curves, integrating sphere, lux meter, sources of light.- Discharge lamps, MV and SV lamps – comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of lighting and flood lighting, LED lighting.

UNIT – IV

Electric Traction – I: System of electric traction and track electrification– Review of existing electric traction systems in India– Special features of traction motor– Mechanics of train movement–Speed–time curves for different services – Trapezoidal and quadrilateral speed time curves.

UNIT – V

Electric Traction – II: Calculations of tractive effort– power –Specific energy consumption for given run– Effect of varying acceleration and braking retardation–Adhesive weight and braking retardation adhesive weight and coefficient of adhesion– Principles of energy efficient motors.

UNIT – VI

UPS Systems: Introduction- Types and principles of UPS -types of batteries- Design and selection of UPS- Testing of UPS and its protection- Installation Procedure to maintain UPS.

TEXT BOOK:

1. Utilization of Electric Energy – by E. Openshaw Taylor, Orient Longman.
2. Art & Science of Utilization of electrical Energy – by Partab, Dhanpat Rai & Sons.

REFERENCE BOOKS:

1. Utilization of Electrical Power including Electric drives and Electric traction – by N.V.Suryanarayana, New Age International (P) Limited, Publishers, 1996.
2. Generation, Distribution and Utilization of electrical Energy – by C.L. Wadhwa, New Age International (P) Limited, Publishers,1997.
3. Technical manual on uninterruptible power supply system by headquarters, department of the army available at: http://webbooks.net/freestuff/ups.pdf

VII SEMESTER	L	T	P	C
	-	-	-	-
16ME7L01:CAD/CAM LAB				

I. COMPUTER AIDED DESIGN

1. **2D DRAFTING**: Introduction to CAD, Elements of Drawing, Development of 2D Drawings like Orthographic and Isometric Drawings, Applying Dimensions to the Drawings, Scanning and plotting procedures.

2. **3D MODELLING**: Sketching, Part drawing and Assembly process for the mechanical components.

3. **ANALYSIS:** Determination of Deflection and stresses in 2D and 3D Trusses and Beams,

Determination of Stresses in 3D structure, Estimation of Natural Frequencies and Steady state heat transfer analysis of plane components.

II. COMPUTER AIDED MANUFACTURING

1. **CNC Lathe:** Machining of simple components like Step Turning, Taper Turning using CNC Lathe.

2. **CNC Milling:** Machining of simple components like Linear Interpolation and Circular Interpolation.

	L	T	P	C
VII SEMESTER	**-**	**-**	**4**	**2**
16ME7L02:INSTRUMENTATION LAB				

LIST OF EXPERIMENTS

1. Study and calibration of LVDT transducer for displacement measurement.
2. Calibration of strain gauge.
3. Calibration of thermocouple.
4. Calibration of capacitive transducer.
5. Study and calibration of photo and magnetic speed pickups.
6. Calibration of resistance temperature detector.
7. Study and calibration of a rotameter.
8. Study and use of a seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
9. Study and calibration of Mcleod gauge for low pressure.
10. Calibration of bourdon pressure gauge.

SKILL BASED LABORATORY-ELECTIVE

VII SEMESTER	L	T	P	C
	-	-	4	2
16ME7LE1:COMPUTATION FLUID DYNAMICS LAB				

PART-A

Writing Programs in C and MATLAB for the following:

1. Solution of Transcendental equations
2. Solution of Simultaneous algebraic equations
3. Numerical differentiation and Integration
4. Solution of Ordinary Differential Equation
5. Solution of a Tri-diagonal matrix using Thomas Algorithm.

PART-B

Using ANSYS-FLUENT solve the following problems of heat transfer analysis

1. steady state conduction
2. Lumped heat transfer
3. Convective heat transfer – Internal flow (study both velocity and thermal boundary layers)
4. Convective heat transfer – External flow (study both velocity and thermal boundary layers)
5. Radiation heat transfer– Emissivity

SKILL BASED LABORATORY-ELECTIVE

Any 10 experiments of the following

VII SEMESTER	L	T	P	C
	-	-	4	2
16ME7LE2:MATLAB APPLICATIONS IN MECHANICAL ENGINEERING				

COMPUTATIONAL METHODS IN ENGINEERING

1. MATLAB Program for Bisection Method.
2. MATLAB Program for Newton-Raphson method.
3. MATLAB Program for Simpson's Rule.

FINITE ELEMENT METHOD

1. Analysis of 2D Trusses
2. Analysis of 3D Trusses
3. Plate in traction

ROBOTICS

1. MATLAB Program to show the use of transformation.
2. MATLAB Program to show Homogeneous transformation.
3. MATLAB Program to show Euler-angle rotation.
4. MATLAB Program to derive D-H parameter for planar RRR Manipulator
5. MATLAB Program to derive inverse solution for planar RRR Manipulator
6. MATLAB Program to calculate the velocity of the tip of the two-link, planar, RR manipulator arm.

HEAT TRANSFER

1. MATLAB program to Compute Heat Transfer in Free Form Extrusion
2. MATLAB program to determining the subsurface temperature fluctuations of rock as the result of daily or seasonal temperature variations.

SKILL BASED LABORATORY-ELECTIVE

VII SEMESTER	L	T	P	C
	-	-	4	2
16ME7LE3:FLEXIBLE MANUFACTURING SYSTEM LAB				

1. **CNC Lathe:**

Machining of Mechanical components like

Facing Operation

Turning Operation

Multiple Turning Operation

Threading Operation

2. **CNC Milling:** Machining of simple components like

Linear and Circular Interpolation.

Mirroring

Rotation

Circular Pocketing

Rectangular Pocketing

3. ROBOT Programming:

Programming for Pick and Place Operation

Programming for Repetitive Operation

4. FMS Programming:

Total FMS Programming for various components.

SKILL BASED LABORATORY-ELECTIVE

VII SEMESTER	L	T	P	C
	-	-	4	2
16ME7LE5:JAVA PROGRAMMING LAB				

LAB EXPERIMENTS

1. Installation of JDK, setting CLASSPATH and executing simple java program.
2. Write a Java Program to define a class, describe its constructor, overload the Constructors and instantiate its object.
3. Write a Java Program to define a class, define instance methods for setting and retrieving values of instance variables and instantiate its object.
4. Write a Java Program to define a class, define instance methods and overload them and use them for dynamic method invocation.
5. Write a Java Program to demonstrate use of sub class.
6. Write a Java Program to implement array of objects.
7. Write a Java program to practice using String class and its methods.
8. Write a Java program to practice using String Buffer class and its methods.
9. Write a Java Program to implement inheritance and demonstrate use of method overriding.
10. Write a Java Program to implement multilevel inheritance by applying various access controls to its data members and methods.
11. Write a program to demonstrate use of implementing interfaces.
12. Write a Java program to implement the concept of importing classes from user defined package and creating packages.
13. Write a program to implement the concept of Exception Handling using predefined exception.
14. Write a program to implement the concept of Exception Handling by creating user defined exceptions.

TEXT BOOKS

1. Herbert Schildt: “Java The complete reference”, 7th Edition, Tata McGraw Hill, 2011.
2. E.Balaguruswamy: “Programming with Java A Primer”, 4th Edition, Tata McGraw Hill, 2009.

Elective-IV

VIII SEMESTER	L	T	P	C
	3	-	-	3
16ME8E01: PIPE LINE DESIGN				

COURSE OUTCOMES: Students are able to

CO1: Demonstrate various piping process [K2]

CO2: Classify various pipe manufacturing methods and their standards. [K2]

CO3: Explain various piping material specifications [K2]

CO4: Identify various pipe fitting [K3]

CO5: Identify various flanges and their applications [K3]

CO6: Analyze stresses in pipe for static and dynamic loads [k4]

UNIT – I

FUNDAMENTALS OF PIPING: Definition and Application of Piping, Pipe Manufacturing, Pipe Fabrication, Pipe Designations ASME Pressure Piping Design Codes.

UNIT – II

CLASSIFICATION OF PIPE: Manufacturing Methods Weight and Size – Standards STD, Extra Strong XS, Double Extra Strong XXS etc. Pressure Temperature Rating System

UNIT – III

PIPING MATERIAL SPECIFICATIONS: Ferrous Material Specifications Non Ferrous Material Specifications, Several Examples of Calculation of Standards Properties of Commercial Piping Materials.

UNIT – IV

PIPE FITTINGS: Types of Fitting - Butt Weld, Threaded and Socket Weld Elbow – 90 degree (LR & SR), 45 degree, Reducing Ell. Ranch Connections – Straight & Out let Tees Reducers – Concentric & Eccentric, Reducer Offsets.

UNIT – V

FLANGES: Definition of Flange. Types of Flanges based on Face and Application, Forged Steel and Cast Iron Flanges. Threaded Flanges, Slip-on Flanges, Socket Welded Flanges, Welded-Neck Flanges, Blind Flanges.

UNIT – VI

PIPE STRESS ANALYSIS: Objectives & Definition of Stress Analysis Critical Line List Information required for Stress Analysis Piping Loads – Static & Dynamic.

TEXT BOOKS:

1. Pipe Drafting and Design - Roy A. Parishes, Robert A. Rhea / Gulf Professional Publishing.
2. Piping and Pipeline Engineering: Design, Construction, Maintenance By George A. Antaki / CRC Press.

VIII SEMESTER	L	T	P	C
	3	-	-	3
16ME8E02: GREEN ENGINEERING SYSTEMS				

COURSE OUTCOMES: Students are able to

CO1:**Recognize** the energy scenario and **explain** solar radiation conversion and collection phenomena. [K3]

CO2: **Illustrate** solar energy storage methods and applications and also explain the principles of wind energy, classification, conversion and applications [K4]

CO3: **Explain** the principle, classification, conversion and applications of Bio mass, geothermal energy and ocean energy. [K3]

CO4: Describe the importance of energy efficient systems and **interpret** working of a few mechanical and electrical efficient systems. [K3]

CO5: Identify the need of energy efficient processes and **analyze** their significance in view of their importance in the current scenario and their potential future applications. [K4]

CO6: **Analyze** the need of green construction in view of their importance on environmental impact due to conventional constructions. [K4]

UNIT – I

INTRODUCTION: Energy chain and common forms of usable energy – Present energy scenario – World energy status – Energy scenario in India, Traditional energy systems, Renewable energy – sources and features.

SOLAR RADIATION:

Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems. Photo voltaic energy conversion – typesof PV cells, I-V characteristics.

SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT – II

SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement.

UNIT – III

BIO-MASS: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, bio fuels, I.C. engine operation and economicaspects.

GEOTHERMAL ENERGY: Resources, types of wells, methods of harnessing the energy, potential in india.

OCEAN ENERGY: OTEC, Principles of utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

UNIT – IV

ENERGY EFFICIENT SYSTEMS:

(**A) ELECTRICAL SYSTEMS:**

Energy efficient motors, energy efficient lighting and control, selection of luminaire, variable voltage variable frequency drives (adjustable speed drives), controls for HVAC (heating, ventilation and air conditioning), demand site management.

(B) MECHANICAL SYSTEMS:

Fuel cells- principle, thermodynamic aspects, selection of fuels & working of various types of fuel cells, environmental friendly and energy efficient compressors and pumps

UNIT – V

ENERGY EFFICIENT PROCESSES: Environmental impact of the current manufacturing practices and systems, benefits of green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of efficient and sustainable green production systems with examples like environmental friendly machining, vegetable based cutting fluids, alternate casting and joining techniques, zero waste manufacturing.

UNIT – VI

GREEN BUILDINGS: Definition features and benefits. site selection and planning of buildings for maximum comfort. Environmental friendly building materials like bamboo, timber, rammed earth, hollow blocks, lime & lime pozzolana cement, agro materials and industrial waste, Ferro cement and Ferro-concrete, alternate roofing systems, paints to reduce heat gain of the buildings, Energy management.

TEXT BOOKS:

1. Sukhatme S.P. and J. K. Nayak, Solar Energy – Principles of Thermal Collection and Storage, Tata McGraw Hill
2. Khan B.H., Non-Conventional Energy Resources, Tata McGraw Hill, New Delhi, 2006.
3. Green Manufacturing Processes and Systems, Edited by J. Paulo Davim, Springer 2013

REFERENCES

1. Alternative Building Materials and Technologies, K. S. Jagadeesh, B.V. Venkata Rama Reddy and K. S. Nanjunda Rao, New Age International (P) Ltd.
2. Principles of Solar Engineering, Yogi Goswami, Frank Krieth and John F Kreider, Taylor and Francis
3. Non-Conventional Energy , Ashok V Desai, Wiley Eastern
4. Renewable Energy Technologies, Ramesh & Kumar, Narosa
5. Non-Conventional Energy Sources, G. D. Rai, Kanna Publishers, New Delhi, 2011

VIII SEMESTER	L	T	P	C
	3	-	-	3
16ME8E03:UN-CONVENTIONAL MACHINING PROCESSES				

COURSE OUTCOMES: Students are able to

CO1: Explain the need of unconventional machining processes and classify modern machining processes [K2]

CO2: Explain the working principle, mechanism of metal removal, parametric analysis cold working unconventional machining processes and ultrasonic machining processes [K2]

CO3: Explain the working principle, mechanism of metal removal, Advantages & applications of electrochemical machining processes [K2]

CO4: Explain the working principle, mechanism of metal removal, Advantages & applications of electric discharging machining processes [K2]

CO5: Explain the working principle, metal removal rate, applications of electron beam, laser beam, plasma arc machining processes [K2]

CO6: Explain the working principle, mechanism of material removal, surface quality, applications of advanced finishing processes[k2]

UNIT – I

INTRODUCTION: Need for non-traditional machining methods-Classification of modern machining processes, considerations in process selection, Materials, Applications. Comparison of traditionaland non-traditional machining methods

UNIT – II

COLD CUTTING PROCESS: Abrasive Jet Machining (AJM), Water Jet Machining (WJM) and

Abrasive Water Jet Machining (AWJM) - Basic principles, process variables, process Mechanism of metal removal, applications and limitations.

ULTRASONIC MACHINING: Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent development.

UNIT – III

ELECTRO CHEMICAL PROCESSES: Fundamentals of electro chemical machining, electrochemical grinding, electrochemical honing and debarring process. Metal removal rate in ECM, Tool design, Surface finish and accuracy economic aspects of ECM, Simple problems for estimation of metal removal rate, Fundamentals of chemical machining, advantages and applications.

UNIT – IV

ELECTRIC DISCHARGE MACHINING : General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes, Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM, principle, applications.

UNIT – V

HIGH ENERGY BEAM MACHINING: Laser Beam Machining (LBM) – Electron Beam Machining (EBM) – Plasma Beam Machining (PBM) - Mechanism of metal removal, Process characteristics, Accuracy and surface quality, Application

UNIT – VI

ADVANCED FINISHING PROCESS: Abrasive Flow Machining (AFM) – Magnetic Abrasive Finishing (MAF) – Magneto rheological Finishing (MRH) - Chemo Mechanical Polishing (CMP) – Working principle – Mechanism of material removal – Surface quality – Applications.

TEXT BOOKS:

1. P. C. Pandey, H. S. Shah (2012), *Modern machining process*, 1st edition, Tata McGraw- Hill Publishing Company Ltd., New Delhi.
2. H. El-Hofy (2005), Advanced Machining Processes, McGraw-Hill, New York.

REFERENCE BOOKS:

1. V. K. Jain (2008), A*dvanced machining processes*, 3rd edition, Allied Publishers, New Delhi.

VIII SEMESTER	L	T	P	C
	3	-	-	3
16ME8E04: SUPPLY CHAIN MANAGEMENT				

COURSE OUTCOMES: Students are able to

C01: Explain fundamental supply chain management concepts (K2)

C02: Apply strategically knowledge to evaluate and manage an effective supply chain(K3)

C03: Develop optimization models for supply chain management(K3)

C04: Relate the demand forecasting for inventory and supply chain concepts(K3)

C05: Explain the current supply chain trends(K4)

C06: Determine information system developments(K3)

UNIT – I

INTRODUCTION

Supply Chain – Fundamentals, Importance, Decision Phases, Process View. Supplier- Manufacturer – Customer chain, Drivers of Supply Chain Performance. Overview of Supply Chain Models and Modeling Systems.

UNIT – II

STRATEGIC SOURCING

In-sourcing and out-sourcing –Types of purchasing strategies. Supplier Evaluation, Selection and Measurement. Supplier Quality Management. Creating a world-class supply base. World Wide Sourcing

UNIT – III

SUPPLY CHAIN NETWORK

Distribution Network Design –Role, Factors Influencing, Models for Facility Location and Capacity Location. Impact of uncertainty on Network Design. Network Design decisions using Decision trees. Distribution Centre Location Models. Supply Chain Network Optimization Models.

UNIT – IV

PLANNING DEMAND, INVENTORY AND SUPPLY

Overview of Demand forecasting in the supply chain. Aggregate planning in the supply chain. Managing supply chain cycle inventory. Uncertainty in the supply chain –Safety inventory. Determination of Optimal level of product availability. Coordination in the Supply Chain.

UNIT – V

CURRENT TRENDS

E-Business –Framework and Role of Supply Chain in e-business and b2b practices. Supply Chain IT Framework Internal Supply Chain Management. Fundamentals of transaction management. Supply Chain in IT Practice.

UNIT – VI

INFORMATION SYSTEM DEVELOPMENTS

Supplier relationship management. Packages in Supply Chain –ESupplier Relationship Management (eSRM),E Customer Relationship Management (eCRM), E Supply Chain Management(eSCM). Supply Base Management.

TEXT BOOKS:

1. Sunil Chopra and Peter Meindi, Supply Chain Management –Strategy Planning and Operation, Pearson Education, Third Indian Reprint, 2004.
2. Monczka et al., Purchasing and Supply Chain Management, Thomson Learning, Second edition, Second Reprint, 2002.
3. Altekar Rahul V, Supply Chain Management – Concept and cases, Prentice Hall India, 2005.
4. Shapiro Jeremy F, Modeling the Supply Chain, Thomson Learning, Second Reprint, 2002.
5. Ballou Ronald H, Business Logistics and Supply Chain Management, Pearson Education, Second Indian Reprint, 2004.

VIII SEMESTER	L	T	P	C
	3	-	-	3
16CS8E05: SOFTWARE ENGINEERING				

Course Outcomes: Students are able to

1. Identify software development life cycle phases.
2. Analyze and specify software requirements with various stakeholders of a software development project.
3. Participate in design, development, deployment and maintenance of a medium scale software development project.
4. Evaluate the impact of potential solutions to software engineering problems using the knowledge of models, tools, and techniques.
5. Define various testing strategies and debugging process.
6. Identify various software quality management and concepts.

UNIT I :

Introduction to Software Engineering :The evolving role of software, Changing Nature of Software, Software myths. A Generic view of process: Software engineering- A layered technology, a process framework, The Capability Maturity Model Integration (CMMI), process assessment.

UNIT II :

Process models :The waterfall model, Incremental process models, Evolutionary process models, The Unified process.

Software Requirements: Functional and non-functional requirements, User requirements, System requirements, Interface specification, the software requirements document.

UNIT III :

Requirements engineering process :Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management.

UNIT IV :

Design Engineering :Design process and Design quality, Design concepts, the design model. Software architecture, Architectural styles and patterns

UNIT V :

Performing User interface design :Golden rules, User interface analysis and design, interface analysis, interface design steps, Design evaluation. Quality Management : Quality concepts, Software quality assurance, Software Reviews, Formal technical reviews, Statistical Software quality Assurance, Software reliability, The ISO 9000 quality standards.

UNIT VI:

Testing Strategies: A strategic approach to software testing, test strategies for conventional software, Black-Box and White-Box testing, Validation testing, System testing, the art of Debugging. Metrics for Process and Products: Software Measurement, Metrics for software quality.

TEXT BOOKS:

1. Software Engineering, A practitioner's Approach- Roger S. Pressman, 7th edition, McGraw-Hill International Edition.

2. Software Engineering- Sommerville, 7th edition, Pearson education.

REFERENCES:

1. Software Engineering- K.K. Agarwal &Yogesh Singh, New Age International Publishers

2. Software Engineering, an Engineering approach- James F. Peters, WitoldPedrycz, John Wiely.

3. Systems Analysis and Design- Shely Cashman Rosenblatt,Thomson Publications.

4. Software Engineering principles and practice- Waman S Jawadekar, The McGraw-Hill Companies.

VIII SEMESTER	L	T	P	C
	3	-	-	3
16ME8E05: MECHATRONICS				

COURSE OUTCOMES: students are able to

CO1. Demonstrate the mechatronics systems and sensors used in building mechatronics systems.[K3]

CO2. Illustrate various types of actuation systems. [K3]

CO3. Discuss the modeling of basic systems and their dynamic response. [K2]

CO 4. Explain the need and working of digital logic control, micro processor and micro Controllers. [K2,K3]

CO5. Explain data acquisition systems, digital signal processing. [K3]

CO 6. Explain process controllers and PLCs, and their applications in mechatronics systems. [K2,K3]

UNIT – I

Introduction: Definition of Mechatronics, evolution of mechatronics, systems,measurement systems, control systems, mechatronic design process, traditional design and mechatronic design, applications of mechatronic systems, advantages and disadvantages of mechatronic systems.

Sensors: classification of sensors, basic working principles, Velocity sensors – Proximity and Range sensors, ultrasonic sensor, laser interferometer transducer, Hall Effect sensor, inductive proximity switch. Light sensors – Photodiodes, phototransistors, tactile sensors –PVDF tactile sensor, micro-switch and reed switch Piezoelectric sensors, vision sensor.

UNIT – II

Pneumatic And Hydraulic Actuation Systems: Actuation systems, Pneumatic and Hydraulic systems-constructional details of filter, lubricator, regulator, direction control valves, pressure control valves, flow control valves, actuators-linear androtary.

Electrical Actuation Systems: Electrical systems, Mechanical switches, solid state switches, solenoids, DC motors, AC motors, stepper motors. Characteristics of pneumatic, hydraulic, electrical actuators and their limitations.

UNIT –III

Basic System Models: Mathematical models, mechanical system building blocks,

electricl system building blocks, fluid system building blocks, thermal system building blocks,

Dynamic Responses Of Systems: Transfer function, Modelling dynamic systems,first order systems, second order systems.

UNIT – IV

Digital electronics and systems, digital logic control, micro processors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.

UNIT – V

System and interfacing and data acquisition – Data Acquisition Systems, Analog to Digital and Digital to Analog conversions; Digital Signal Processing – data flow in DSPs, block diagrams, typical layouts, Interfacing motor drives.

UNIT – VI

Dynamic models and analogies, System response. Process Controllers – Digital Controllers, Programmable Logic Controllers, Design of mechatronics systems & future trends.

TEXT BOOKS:

1. W. Bolton, "Mechatronics", 5 th edition, Addison Wesley Longman Ltd, 2010

2. Devdas Shetty & Richard Kolk "Mechatronics System Design", 3rd edition. PWS Publishing, 2009.

3. Mechatronics Integrated Mechanical Electronics Systems/KP Ramachandran, GK Vijaya Raghavan &MS Balasundaram/WILEY India Edition.

REFERENCES:

1. Alciatore David G & Histand Michael B, "Introduction to Mechatronics and Measurement systems", 4th edition, Tata McGraw Hill, 2006.

2. Mechatronics – N. Shanmugam / Anuradha Agencies Publishers.

3.Mechatronics /Smaili A, Mrad F/ Oxford Higher Education.

LIST OF OPEN ELECTIVES

S. No.	Course Code	Name of the Course	Offering Dept.
1	16CEXO01	Green Buildings and Infrastructure	CIVIL
2	16CEXO02	Disaster Management	
3	16EEXO01	Electrical Safety Management	EEE
4	16EEXO02	Non-Conventional Energy Sources	
5	16MEXO01	Composite Materials	MECH
6	16MEXO02	Operation Research	
7	16ECXO01	Introductionto Nanotechnology and its Applications	ECE
8	16ECXO02	Global Positioning and Navigation Satellite Systems	
9	16CSXO01	Data Base Management Systems	CSE
10	16CSXO02	Big Data Analytics	
11	16ITXO01	Software Project Management	IT
12	16ITXO02	Internet of Things (IOT)	
13	16BMXO01	Innovations and Entrepreneurship	MBA
14	16BMXO02	Industrial Sociology And Psychology	

Note: The student has to choose one Open Elective subject in Sem VI and Sem VIII from the above list other than offered by Parent department, which was not studied in earlier semesters.

VI / VIII SEMESTER	L	T	P	C
	3	-	-	3
16CEXO01: GREEN BUILDINGS AND INFRASTRUCTURE				

COURSE OUTCOMES: Students are able to

1. Recognize existing energy codes, green building codes and green rating systems.
2. Compare cost and performance of building materials with recycled components.
3. List out construction materials and methods that more easily allow for salvage and re-use of building materials.
4. List out available renewable energy resources.
5. Develop the techniques and benefits of building performance testing, monitoring and metering.
6. Identify techniques for weatherization and sustainable remodeling of existing structures.

Unit – I

Green Buildings: Definition of Green Buildings, typical features of green buildings, benefits of Green Buildings- Sustainable site selection and planning of buildings to maximize comfort, day lighting, ventilation, planning for storm water drainage.

Unit - II

Environmentally friendly building materials and technologies: Natural Materials like bamboo, timber, rammed earth, stabilized mud blocks, hollow blocks, lime & lime-pozzolana cements, materials from agro and industrial waste, Ferro-cement and Ferro-concrete.

Unit - III

Energy and resource conservation: Need for energy conservation, various forms of energy used in buildings, embodied energy of materials, energy used in transportation and construction processes- water conservation systems in buildings-water harvesting in buildings.

Unit - IV

Use of renewable energy resources: Wind and Solar Energy Harvesting, potential of solar energy in India and world, construction and operation of various solar appliances, success case studies of fully solar energy based buildings in India.

Unit – V

Climate Design: Local climatic conditions-temperature, humidity, wind speed and direction-impact of climate change on built environment - comforts: the desirable conditions - Principles of thermal design - means of thermal -light and lighting-building acoustics- energy efficient lighting, Ventilation and air quality requirement, various techniques for passive cooling, case studies for passive cooling and thermal comfort.

Unit - VI

Green Building Rating Systems: Introduction to Leadership in Energy and Environment Design (LEED), Green Rating systems for Integrated Habitat Assessment - Modular wastewater treatment systems for built environment.

TEXT BOOKS:

1. "Alternative building materials and technologies" by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao, New age international publishers, New Delhi.

2. "Non-Conventional Energy Resources" by G. D. Rai, Khanna Publishers.

REFERENCES:

1. Kibert, C. (2005) Sustainable Construction: Green Building Design and Delivery (Hoboken, NJ: John Wiley & Sons).

2. McDonough, W. and M. Braungart (2002) Cradle to Cradle: Remaking the Way We Make Things (New York: Farrar, Straus and Giroux).

VI / VIII SEMESTER	L	T	P	C
	3	-	-	3
16CEXO02: DISASTER MANAGEMENT				

COURSE OUTCOMES: Students are able to

1. Identify the tools of integrating disaster management principles in disaster mitigation process.
2. Distinguish between the different approaches needed to manage pre and post- disaster activities.
3. Explain the process of risk management.
4. Recognize the 'relief system', 'disaster victim' and relate them.

5.Evaluate the planning strategies useful in risk mitigation processes.

6. Explain about public awareness and economic incentive possibilities.

UNIT-I

Natural Hazards and Disaster management: Introduction of DM – Inter Disciplinary -nature of the subject- Disaster Management cycle- Five priorities for action. Case study methods of the following: floods, draughts -Earthquakes- global warming, cyclones & Tsunamis- Post Tsunami hazards along the Indian coast - landslides.

UNIT-II

Man Made Disaster and their management along with case study methods of the following: Fire hazards - transport hazard dynamics -Solid waste management- post disaster – bio terrotirism -threat in mega cities, rail and air craft's accidents, and Emerging infectious diseases & Aids and their management.

UNIT-III

Risk and Vulnerability: Building codes and land use planning - social vulnerability - environmental vulnerability - Macroeconomic management and sustainable development, climate change risk rendition - financial management of disaster - related losses.

UNIT-IV

Role of Technology in Disaster managements: Disaster management for infra structures, taxonomy of infrastructure - treatment plants and process facilities-electrical substations- roads and bridges- mitigation programme for earth quakes -flowchart, geospatial information in agriculture drought assessment- multimedia technology in disaster risk management and training transformable indigenous knowledge in disaster reduction.

UNIT-V

Education and Community Preparedness: Education in disaster risk reduction-Essentials of school disaster education-Community capacity and disaster resilience-Community based disaster recovery - Community based disaster management and social capital-Designing resilience- building community capacity for action.

UNIT-VI

Multi-sectional Issues: Impact of disaster on poverty and deprivation-Climate change adaptation and human health -Exposure , health hazards and environmental risk-Forest management and disaster risk reduction.-Institutional capacity in disaster management -The Red cross and red crescent movement.-Corporate sector and disaster risk reduction-A community focused approach.

TEXTBOOKS:

1. 'Disaster Management - Global Challenges and Local Solutions' by Rajib shah & R. Krishnamurthy (2009), Universities press.
2. 'Disaster Science & Management' by Tushar Bhattacharya, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
3. 'Disaster Management - Future Challenges and Opportunities' by Jagbir Singh (2007), I K International Publishing House Pvt. Ltd.

REFERENCE BOOKS:

1**. '**Disaster Management' edited by H K Gupta (2003), Universities press.

2. "Disaster Management and Mitigation" by Prof. R.B. Singh (2016), World Focus

VI / VIII SEMESTER	L	T	P	C
	3	-	-	3
16EEXO01: ELECTRICAL SAFETY MANAGEMENT				

COURSE OUTCOMES: Students are able to

1. Explain the objectives and precautions of Electrical safety, effects of shocks and their prevention.
2. Summarize the safety aspects during installation of plant and equipment.
3. Describe the electrical safety in residential, commercial and agricultural installations.
4. Describe the various Electrical safety in hazardous areas, Equipment earthing and system neutral earthing.
5. State the electrical systems safety management and IE rules.

UNIT-I

Introduction to Electrical Safety, Shocks and their Prevention: Terms and definitions- objectives of safety and security measures- Hazards associated with electric current, and voltage who is exposed, principles of electrical safety- Approaches to prevent Accidents- scope of subject electrical safety. Primary and secondary electrical shocks -possibilities of getting electrical shock and its severity- medical analysis of electric shocks and its effects - shocks due to flash/ Spark over's - prevention and safety precautions against contact shocks - flash shocks, burns, residential buildings and shops.

UNIT-II

Safety during Installation of Plant and Equipment: Introduction, preliminary preparations, preconditions during installation electrical plant and equipment, safety aspects. Field quality and safety during erection, personal protective equipment installation of a large oil immersed power transformer, installation of outdoor switchyard equipment, safety during installation of electrical rotating machines, drying out and insulation resistance measurement of rotating machines.

UNIT-III

Electrical Safety In Residential, Commercial And Agricultural Installations Wiring and fitting – Domestic appliances – shock from wet wall and water taps – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.

UNIT-IV

Electrical Safety In Hazardous Areas : Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipments for hazardous locations Classification of equipment provided for various hazardous gases and vapours – classification of equipment/enclosure for hazardous locations.

UNIT-V

Equipment Earthing and System Neutral Earthing : Introduction description of earth system between system grounding and Equipment Grounding, Equipment Earthing, Functional Requirement of earthing system, neutral grounding(System Grounding), Types of Grounding, Methods of Earthing Generators Neutrals.

UNIT-VI

Safety Management of Electrical Systems: Principles of Safety Management, Management Safety Policy, Safety organization, safety auditing, Motivation to managers, supervisors, employees towards safety.

TEXT BOOKS:

1. S. Rao, Prof. H.L. Saluja, "Electrical safety, fire safety Engineering and safety management", Khanna Publishers. New Delhi, 1988.(units-I to V)

REFERENCE BOOK:

1. Pradeep Chaturvedi, "Energy management policy, planning and utilization", Concept Publishing company, New Delhi, 1997.

VI / VIII SEMESTER	L	T	P	C
	3	-	-	3
16EEXO02: NON CONVENTIONAL ENERGY SOURCES				

COURSE OUTCOMES: Students are able to

- Analyze solar radiation data, extraterrestrial radiation, radiation on earth's surface.
- Design solar thermal collections.
- Design solar photo voltaic systems.
- Develop maximum power point techniques in solar PV and wind.
- Explain wind energy conversion systems, Betz coefficient , tip speed ratio.
- Explain basic principle and working of hydro, tidal, biomass ,fuel cell and geothermal systems.

UNIT–I

Fundamentals of Energy Systems : Energy conservation principle – Energy scenario (world and India) – Solar radiation: Outside earth's atmosphere – Earth surface – Analysis of solar radiation data – Geometry – Radiation on tilted surfaces – Numerical problems.

UNIT–II

Solar Thermal Systems: Liquid flat plate collections: Performance analysis – Transmissivity – Absorptivity – Product collector efficiency factor – Collector heat removal factor – Numerical problems – Introduction to solar air heaters – Concentrating collectors and solar pond.

UNIT–III

Solar Photovoltaic Systems : Balance of systems – IV characteristics – System design: Storage sizing, PV system sizing, Maximum power point techniques: Perturb and observe (P&O) technique – Hill climbing technique.

UNIT–IV

Wind Energy: Wind patterns – Types of turbines – Kinetic energy of wind – Betz coefficient – Tip–speed ratio – efficiency – Power output of wind turbine – Selection of generator(synchronous, induction) – Maximum power point tracking.

UNIT–V

Hydro and Tidal power systems: Basic working principle – Classification of hydro systems: large, small, micro – Measurement of head and flow – Energy equation – Types of turbines – Numerical problems. Tidal power – Basics – Kinetic energy equation – Numerical problems – Wave power – Basics – Kinetic energy equation.

UNIT–VI

Biomass, fuel cells and geothermal systems: Biomass Energy: Fuel classification – Pyrolysis – Direct combustion of heat – Different digesters and sizing.

- **Fuel cell:** classification – Efficiency – VI characteristics.
- **Geothermal**: classification – Dry rock and acquifer – Energy analysis.

TEXT BOOKS

- Solar Energy: Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rd Edition.
- Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis.
- Energy Science: Principles, Technologies and Impacts, John Andrews and Nick Jelly, Oxford.

REFERENCE BOOKS

- Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal,World scientific, Singapore.
- Renewable Energy Technologies /Ramesh & Kumar /Narosa.
- Renewable energy technologies – A practical guide for beginners – Chetong Singh Solanki, PHI.

VI / VIII SEMESTER	L	T	P	C
	3	-	-	3
16MEXO01:COMPOSITE MATERIALS				

COURSE OUTCOMES: Student are able to

CO1: Summarize the basic terminology and advantages of composite materials. **[K2]**

CO2: Classify and **Analyze** various types of laminates.**[K2, K4]**

CO3: Analyze the mechanical behavior of composite material as well as summarize various manufacturing methods of Laminated Fiber Reinforced Composite Material.**[K4]**

CO4: Analyze the micromechanical behavior of composite material. **[K4]**

CO5: Analyze the macromechanical behavior of composite material. **[K4]**

CO6: Explain various applications of Composite material in detail. **[K2]**

UNIT – I

INTRODUCTION TO COMPOSITE MATERIALS:

Definitions: Composite material, Fiber, Matrix. Types of fibers and Raw Fiber Properties, Types of Matrix, Prepegs, Fillers and other Additives.Advantages of Composite Materials and Structures – Strength and Stiffness advantages, Cost advantages, Weight advantages, Applications

UNIT – II

ANALYSIS OF LAMINATED COMPOSITES:

Laminates, Basic Assumptions, Strain-Displacement Relationship, Stress-Strain Relationships, Equilibrium Equations, Laminate Stiffness, Determination of Lamina Stresses and Strains, Types of Laminate Configuration, Balanced Laminate, Anti-symmetric Laminate, Examples

UNIT – III

BASICS OF COMPOSITE MATERIALS:

Mechanical Behavior of Composite Materials - Lamina, Laminate: The basic building block of a composite material.

Manufacturing of Laminated Fiber-Reinforced Composite Materials

UNIT – IV

MICROMECHANICAL ANALYSIS OF COMPOSITE STRENGTH AND STIFFNESS:

Properties of typical composite materials, Volume and Weight Fractions, Longitudinal Strength and Stiffness. Transverse Modulus, In-plane shear Modulus, Poisson’s ratio.

UNIT – V

ELASTIC PROPERTIES OF UNIDIRECTIONAL LAMINA:

Stress-strain relationships. Engineering Constants. Stress strain relations of a Thin Lamina. Examples

UNIT – VI

APPLICATIONS OF COMPOSITE MATERIALS:

Use of Composite materials in present world – Aeronautical Applications, Space applications, Automotive applications and commercial applications.

TEXT BOOKS:

1. Mechanics of Composite Materials - R M Jones / Taylor & Francis

2. Mechanics of Composite Materials and Structures - Madhujit Mukhopadhyay / Universities Press

VI / VIII SEMESTER	L	T	P	C
	3	-	-	3
16MEX002: OPERATION RESEARCH				

COURSE OUTCOMES: Students are able to

CO1: Apply linear programming techniques to solve industrial optimization problems.[K3]

CO2: solve transportation and assignment problems using operation research techniques. [K3]

CO3: Solve sequencingproblems using operation research techniques. [K3]

CO4: Solve replacement problems for optimization. [K3]

CO5: Analyze game theory and apply them for optimization. [K4]

CO6: Analyze queuing theory and apply it for optimization and also analyze inventory models for various industrial problems. [K4]

UNIT—I

LINEAR PROGRAMMING: Linear programming problem formulation – Graphical solution – simplex method- artificial variables techniques -two–phase method, Big-M method – Duality principle.

UNIT – II

TRANSPORTATION PROBLEM: Formulation – optimal solution, unbalanced transportation problem – Degeneracy

ASSIGNMENT PROBLEM- Formulation – optimal solution - variants of assignment problem- traveling salesman problem.

UNIT – III

SEQUENCING PROBLEM: Introduction – Optimal Solution for processing n jobs through two machines - processing n jobs through three machines - processing n jobs through m machines - processing two jobs through m machines

UNIT – IV

REPLACEMENT: Introduction – replacement of items that deteriorate with time – when money value is not counted and counted – replacement of items that fail completely, group replacement.

UNIT – V

THEORY OF GAMES: Introduction – minimax (maxmin) – criterion and optimal strategy –solution of games with saddle points – rectangular games without saddle points – 2 x 2 games– dominance principle – m x 2 & 2 x n games -graphicalmethod.

UNIT – VI

WAITING LINES: Introduction- Single channel-Possion arrivals-Exponential service times-with infinite population model (M/M/1:FIFO/∞/∞)

INVENTORY : Introduction – single item – deterministic models – purchase inventory models with one price break and multiple price breaks – shortages are not allowed .

TEXT BOOKS:

1. Operations Research / S.D.Sharma, Ramnath co,Meerut
2. Operations Research, P.K.Gupta, D.S.Hira,S.Chand

REFERENCE BOOKS:

1. Operations Research /A.M.Natarajan,P.Balasubramani, A.Tamilarasi/PearsonEducation.
2. Operations Research / R.Pannerselvam,PHIPublications.

VI / VIII SEMESTER	L	T	P	C
	3	-	-	3
16ECXO01 : INTRODUCTION TO NANO TECHNOLOGY AND ITS APPLICATIONS				

COURSE OUTCOMES: Students are able to

- **CO1**. Define Nano materials and Nano Technology with properties
- **CO2**. Explain Synthesis as Fabrication methods of Nano Technology
- **CO3**. Demonstrate Characterization techniques of Nano Materials
- **CO4**. Analyze carbon Nano technology and application of Nano technology.

UNIT-I : INTRODUCTION: History of nano science, definition of nano meter, nano materials, nano technology. Classification of nano materials.Crystal symmetries, crystal directions, crystal planes.Band structure.**(T1)**

UNIT-II : PROPERTIES OF MATERIALS: Mechanical properties, electrical properties, dielectric properties, thermal properties, magnetic properties, opto electronic properties. Effect of size reduction on properties, electronic structure of nano materials..**(T1)**

UNIT-III : SYNTHESIS & FABRICATIONMETHODS: Synthesis of bulk polycrystalline samples, growth of single crystals. Synthesis techniques for preparation of nano particle – Bottom Up Approach – sol gel synthesis, hydro thermal growth, thin film growth, PVD and CVD; Top Down Approach – Ball milling, micro fabrication, lithography. .**(T1)**

UNIT-IV : CHARECTERIZATION TECHNIQUES: X-Ray diffraction and Scherrer method, scanning electron microscopy, transmission electron microscopy, scanning probe microscopy, atomic force microscopy, piezoresponse microscopy, X-ray photoelectron spectroscopy, XANES and XAFS, angle resolved photoemission spectroscopy, diffuse reflectance spectra, photoluminescence spectra, Raman spectroscopy..**(T2)**

UNIT-V : CARBON NANO TECHNOLOGY: Characterization of carbon allotropes, synthesis of diamond – nucleation of diamond, growth and morphology. Applications of nanocrystalling diamond films, grapheme, applications of carbon nanotubes, carbon nanotubes for nanoelectronics devices..**(T2)**

UNIT-VI :NANO TECHNOLOGYAPPLICATIONS: Applications in material science, biology and medicine, surface science, energy and environment. Applications of nano structured thin fins, applications of quantum dots..**(T2)**

TEXT BOOKS

1.Nano science and nano technology by M.S RamachandraRao, Shubra Singh, Wiley publishers. **(Unit-I,II,III)**

2.Fundamentals of nanoelectronics by George W Hanson Pearson publications, India 2008**(Unit-IV,V,VI)**

REFERENCE BOOKS

1.Introduction to Nano Technology by Charles P. Poole, Jr., Frank J.Owens, Wiley publishers.

2.Principles of Nanotechnology by Phani Kumar, Scitech.

VI / VIII SEMESTER	L	T	P	C
	3	-	-	3
16ECXO02 : GLOBAL POSITIONING AND NAVIGATION SATELLITE SYSTEMS				

COURSE OUTCOMES: Students are able to

CO1: Describe the principles of GNSS based positioning methods, the main components in a satellite navigation system and their functions**.**

CO2: Estimate and represent the GPS coordinate frames & GPS orbits..

CO3:Analyze the influence of different error sources on the positioning precision.

CO4: Describe examples of the role of GNSS, or GNSS based products and services, in sustainable development**.**

UNIT - I

Overview of GPS: Basic concept, system architecture, space segment, user segment, services of GPS, applications of GPS.

UNIT - II

GPS Signals: Signal structure, anti spoofing (AS), selective availability, Difference between GPS and GALILEO satellite construction.

UNIT - III

GPS coordinate frames, Time references: Geodetic and Geo centric coordinate systems, ECEF coordinate world geodetic 1984 (WGS 84), GPS time.

UNIT - IV

GPS orbits and satellite position determination: GPS orbital parameters, description of receiver independent exchange format (RINEX) – Observation data and navigation message data parameters, GPS position determination.

UNIT - V

GPS Errors: GPS error sources – clock error, ionospheric error, tropospheric error, multipath, ionospheric error estimation using dual frequency GPS receiver.

UNIT - VI

GPS Aided Geo-Augmented Navigation (GAGAN) architecture, Indian Regional Navigation Satellite System. GNSS augmentation, Wide Area Augmentation System (WAAS), applications

TEXT BOOKS:

1. G S RAO, Global Navigation Satellite Systems, McGraw-Hill publications, New Delhi, 2010 **(Unit-I,III,IV,V,VI)**

2. B. Hoffman – Wellenhof, H. Liehtenegger and J. Collins, 'GPS – Theory and Practice', Springer – Wien, New York (2001). **(Unit-I,II,IV)**

REFERENCE BOOKS :

1. James Ba – Yen Tsui, 'Fundamentals of GPS receivers – A software Approach', John Wiley & Sons,2001.

	L	T	P	C
VI / VIII SEMESTER	**3**	**1**	**-**	**4**
16CSXO01: DATABASE MANAGEMENT SYSTEMS				

COURSE OUTCOMES: Student are able to

1. Identify the different issues involved in the design and implementation of a database system
2. Design entity relationship and convert entity relationship diagrams into RDBMS and formulate SQL queries on the respect data.
3. Predict different concurrency control techniques while implementing real time applications
4. Solve real time database issues through SQL concepts
5. Organaise the data from unstructured to structured using different normal forms
6. Justify various kinds of secondary storage devices to store data

UNIT-I

History of DBMS, File Systems vs DBMS, Advantages of DBMS, Describing and Storing Data in DBMS, Transaction Management, Structure of a DBMS, people who work with Databases, Database Design and ER Diagrams, Entities, Attributes and Entity Sets, Relationships and Relationship sets

UNIT-II

Additional Features of ER Models, Conceptual Design with ER Models, Conceptual Design for Large Enterprise. Relational Model- Introduction to Relational Model, Integrity constraints over relations, Enforcing Integrity constraints, Logical Database Design, Views.

UNIT-III

Relational Algebra-Selection and projection, Set Operators, Renaming, joins, divisions. Form of Basic SQL Query, Nested Queries, Correlated Nested Queries, Set Comparison Operators, Aggregate Operators, Logical Connectivity Operators, Joins and Types, introduction to Triggers.

UNIT-IV

Introduction to Schema Refinement, functional Dependencies, Normal forms-1NF, 2NF,3NF, BCNF, Properties of decompositions, Multivalued Dependencies, Fourth Normal Form and Fifth Normal Form, Transaction Management-ACID properties, Transaction and schedules, concurrent execution of transactions.

UNIT –V

Lock based Concurrency Control-Strict 2PL, Dead Locks. Concurrency Control without Locking, Crash Recovery-Introduction to ARIES, LOG, Write a Head Log Protocol, Check Point, Recovery from a System Crash.

UNIT-VI

Data on External Storage, File Organization and indexing, Index Data Structures, Comparison of File Organizations, Tree structured indexing-Indexed Sequential Access Method, B+ trees.

TEXT BOOKS:

1. Database Management Systems- Raghurama Krishnan, Johannes Gehrke, Tata McGraw-Hill., 3rd Edition.

REFERENCE BOOKS:

1. Database System Concepts, Silberschatz, Korth, McGraw hill, 5th edition.
2. Database Management Systems, Elmasri Navathe-5th Edition.

VI / VIII SEMESTER	L	T	P	C
	3	-	-	3
16CSXO02: BIG DATA ANALYTICS				

Course Outcomes: Students are able to

1. Distinguish efficient big data solutions for various application areas using appropriately selected algorithms and data structures.
2. Analyze methods and algorithms, to compare and real-world problems.
3. Explain trade-offs in big data processing technique.
4. Explain the Big Data Fundamentals, including the evolution and the characteristics of Big Data
5. Solve non-relational databases, the techniques for storing and processing large volumes of structured and unstructured data.
6. Apply the novel architectures and platforms introduced for Big data.

UNIT-I

Introduction to Big Data Analytics:

Definition of Big data, Big data characteristics and considerations, Unstructured data fueling big data analytics, Analyst perspective data repositories, Key roles of the New Data Eco system, applications.

UNIT-II

Data Analytics Life Cycle: Data analytics life cycle, Roles of Successful Analytics project

UNIT-III

Working with Big Data using R: How to use R Graphical user interface, How to get data into R, Data types used in R, and the basic operations, generic functions, Data analytic methods in R

UNIT-IV

Advanced Analytics Theory and methods: Categorization: K-means clustering, association rules, Regression: Linear & Logistic Classification: Nave Bayesian, Decision trees, time series analysis, text analysis.

UNIT-V

Advanced Analytics _Technology and tools: Mapreduce and Hadoop, HDFS, Using R with Hadoop

UNIT-VI

Hadoop Ecosystem: Using Query Languages HIVE and PIG for data analytics, HBASE, Mahout-machine learning algorithms using Hadoop mapreduce HDFS

TEXT BOOKS:

1 Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data by EMC Education Services- Wiley

2 Big Data Analytics with R, by Simon Walkowiak

REFERENCE:

1 R For data science-Dan Toomey

2 Big Data Analyticswith R and Hadoop-Vignesh Prajapati

VI / VIII SEMESTER	L	T	P	C
	3	-	-	3
16ITXO01: SOFTWARE PROJECT MANAGEMENT				

COURSE OUTCOMES: Students are able to

1. Explain the basic concepts of Software Engineering and Process framework.
2. Define the various software process models and its requirements.
3. Outline software project management principles based on conventional software project Management.
4. Distinguish different Software Management life cycle phases
5. Define the artifacts and knowledge on Model Based Software Architecture.
6. Illustrate various software workflows and checkpoints of the process.

UNIT-I

Introduction to Software Engineering: The evolving role of software, Software Characteristics, Changing Nature of Software, Software myths.

A Generic view of Process: Software engineering- A layered technology, a Process framework, The Capability Maturity Model Integration (CMMI), Process assessment, Product and Process.

UNIT-II

Process models: The waterfall model, Incremental process models, Evolutionary process models, The Unified process.

Software Requirements: User requirements, System requirements, Functional and non-functional requirements, the Software Requirements Document (SRS).

UNIT–III

Conventional Software Management and Economics: Conventional software Management performance, Software Economics.

Improving Software Economics: Reducing Software product size, improving software processes, improving team effectiveness, improving automation, Achieving required quality, peer inspections.

UNIT–IV

The old way and the new: The principles of conventional software Engineering, principles of modern software management, transitioning to an iterative process.

Life cycle phases: Engineering and production stages, inception, Elaboration, construction, transition phases.

UNIT-V

Artifacts of the process: The artifacts sets, Management artifacts, Engineering artifacts, programmatic artifacts.

Model based software architectures: A Management perspective and technical perspective.

UNIT-VI

Work Flows of the process: Software process workflows, Iteration workflows.

Checkpoints of the process: Major mile stones, Minor Milestones, Periodic status assessments.

TEXT BOOKS:

1. Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th edition, McGraw Hill International Edition.
2. Software Project Management, Walker Royce: Pearson Education, 2005.

REFERENCE BOOKS:

1. Software Engineering- Somerville, 9th edition, Pearson education.
2. Software Project Management, Bob Hughes and Mike Cotterell: Tata McGraw-Hill Edition.
3. Software Project Management, Joel Henry, Pearson Education.

VI/VIII SEMESTER	L	T	P	C
	3	-	-	3
16ITXO02: INTERNET OF THINGS				

COURSE OUTCOMES: Students are able to

1. Define the fundamentals of IoT.
2. Illustrate the IoT design methodology.
3. Explain the Microcontroller and various IoT Platforms.
4. Construct the IoT using Raspberry Pi
5. Explain the basics of IoT sensors and communications.
6. Analyze applications of IoT in real time scenario.

UNIT-I

Fundamentals of IoT: Introduction-Characteristics-Physical design - Protocols – Logical design – Enabling technologies – IoT Levels – Domain Specific IoTs – IoT vs. M2M.

UNIT-II

IoT Design Methodology: IoT systems management – IoT Design Methodology – Specifications Integration and Application Development.

UNIT-III

8051 Microcontroller: Introduction to Microcontrollers, The 8051 Instruction Set, AT89S8253 Microcontroller, Assembly Language, Examples, Development systems.

IoT Platform: IoT Platform overview, Overview of IoT supported Hardware platforms such as: Raspberry pi, ARM Cortex Processors, Arduino and Intel Galileo boards.

UNIT-IV

Building IoT With Raspberry PI: Physical device – Raspberry Pi Interfaces – Programming – APIs / Packages – Web services.

UNIT-V

Programming The Microcontroller For IoT Basics of Sensors & Actuators: Basics of Sensors and actuators – examples and working principles of sensors and actuators – Cloud computing and IoT – RASPBERRY PI /Equivalent Microcontroller platform – Setting up the board - Programming for IOT – Reading from Sensors;

Communication: Connecting microcontroller with mobile devices – communication through Bluetooth and USB – connection with the internet using wifi / Ethernet.

UNIT-VI

Case Studies and Advanced Topics: Various Real time applications of IoT- Connecting IoT to cloud – Cloud Storage for IoT – Data Analytics for IoT – Software & Management Tools for IoT

TEXT BOOKS:

1. ArshdeepBahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.
2. Charalampos Doukas “Building Internet of Things With the Arduino”, CreateSpace Independent Publishing Platform, 2012.
3. Milan Verle, “Architecture and Programming of 8051 Microcontrollers” 1st Edition mikro
4. Dieter Uckelmann et.al, “Architecting the Internet of Things”, Springer, 2011
5. Matt Richardson & Shawn Wallace, “Getting Started with Raspberry Pi” O'Reilly (SPD), 2014.

REFERENCE BOOKS:

1. Luigi Atzor et.al, “The Internet of Things: A survey“, Journal on Networks, Elsevier Publications, October, 2010
2. Web Link 1: http://postscapes.com/(Accessed on 16 February 2016).
3. Web Link 2: http://www.theinternetofthings.eu/what-is-the-internet-of-things(Accessed on 16 February 2016).

VI / VIII SEMESTER	L	T	P	C
	3	-	-	3
16BMXO01: INNOVATION AND ENTREPRENEURSHIP				

COURSE OUTCOMES: Students are able to

CO1: Comprehend the concept and levels of Innovation.[K2]

CO2: Discriminate the Micro &Macro perspectives & Innovation.[K4]

CO3: Appraise the creative Intelligence abilities. [K4]

CO4: Define and explain the basic concepts of Entrepreneurship & social responsibilities of an entrepreneur [K1 &K2]

CO5: Estimates the importance of training for Entrepreneurs, Use feedback and Performance of trainees. [K2 & K3]

CO6: Discover the Challenges and Sickness in MSMEs.[K2]

UNIT-I

Innovation Management: Concept of Innovation –Levels of Innovation –Incremental Vs Radical Innovation -Inbound and Outbound Ideation –Open and Other Innovative Ideation Methods- Systems approach to innovation- Innovation in the context of emerging economies-leadership and innovation.

UNIT-II

Creative Intelligence: Creative Intelligence Abilities – A Model Of Creative Intelligence – Convergent Thinking Ability – Traits Congenial To Creativity – Creative Personality And Forms Of Creativity.

UNIT-III

Entrepreneurship: Entrepreneurship characteristics –classification Of Entrepreneurship – Incorporation of Business - Role of Entrepreneurship in economic development – startups.

UNIT-IV

Idea generation and opportunity assessment: Ideas in entrepreneurship – sources of new ideas- Techniques for generating ideas- Opportunity recognition – Steps in tapping opportunities

UNIT-V

Project Formulation and Appraisal: Preparation of Detailed project Report (DPR) – content-Guidelines for Report preparation – project Appraisal techniques-economic- steps Analysis; Financial analysis; Market analysis; Technical feasibility.

UNIT-VI

Institutions promoting small Business Enterprises: Central level Institutions; NABARD, SIDBI,NIC,KVIC,SIDIO,NSIC - State level Institutions- DICs – SFC- SSIDC- other financial assistance,Government policy and taxation benefits- government policy for SSIs – tax incentives and concessions- Non –tax concessions- Rehabilitation investment and Allowances

TEXT BOOKS:

1. Vasanth Desai, "Entrepreneurship' Himalaya Publishing House, New Delhi, 2012
2. Arya Kumar: "Entrepreneurship", Pearson, Publishing House, New Delhi, 2012.

REFERENCES:

1. Pradip N Khandwalla, Lifelong Creativity, An Unending Quest, Tata McGraw Hill, 2004.
2. Vinnie Jauhari, Sudanshu Bhushan, Innovation Management, Oxford Higher Education, 2014

VI / VIII SEMESTER	L	T	P	C
	3	-	-	3
16BMXO02: INDUSTRIAL SOCIOLOGY AND PSYCHOLOGY				

COURSE OUTCOMES: Students are able to

CO1: Demonstrate an appreciation on different areas of Industrial Psychology and Sociology that have contributed to organizational effectiveness.(K3)

CO2: Identify critical factors that affect behavior of individual and groups in an organization.(K2)

CO3: Analyze the importance of organizational design and culture prevailing in an organization.(K4)

CO4: Interpret the role and importance of Leadership and Motivation towards achieving objectives of individuals and groups in work environment.(K3)

CO5: Appraise the concept of change in the dynamic business organization (K5)

UNIT I

Industrial Sociology : Nature and Scope of Industrial Sociology-Development of Industrial Sociology, Factors of social change – the technological factors, the cultural factors, effects of technology on major social institutions, social status system, social relations in industry.

UNITII

Group Dynamics: Work Teams & Groups, Group Behavior, Group formation & development, Decision Making by Individuals, Groups Decision making process, individual influences, group decision process, Group dynamics

UNIT III

Organizational Conflicts:Concept - Causes and Consequences of Conflict-Conflict handling techniques-Emotional Intelligence - Inter Group Behavior and Collaboration.

UNIT IV

Industrial Psychology: Nature and Meaning of Industrial Psychology, Role of Industrial Psychology, Organizational Attitude, Motivation at work-Theories of Motivation (Theory X and Y, McClelland's Theory, Maslow's Need Theory, Herzberg's Two Factor Theory) Cultural Differences in Motivation

UNIT V

Organizational Design and Leadership :Organizational Design & Structure- Key organizational design process, Structural differentiations, factors influencing design of organizations, Leadership, Leadership vs. Management, Leadership Theories, Emerging issues in Leadership

UNIT VI

Organizational Culture:Functions of organizational culture, Organizational Socialization, Assessing Cultural Values and Fit, Cross Cultural issues, Managing Change Forces for change in Organization, Resistance to change and change management.

TEXT BOOKS:

1. Nelson, Quick and Khandelwal, ORGB : An innovative approach to learning and teaching Organizational Behaviour. A South Asian Perspective, Cengage Learning, 2012
2. Luthans, Fred, Organizational Behavior, McGraw Hill 2008

REFERENCES:

1. Gisbert Pascal, Fundamentals of Industrial sociology, Tata McGraw Hill Publishing Co., New Delhi, 1972.
2. Schneider Engno V., Industrial Sociology 2nd Edition, McGraw Hill Publishing Co., New Delhi,