Syllabus for 1st Sem CSE/CE/IT/ETC/EEE
INTRODUCTION TO PROGRAMMING
(Compulsory Course)

CSXXX	**Introduction to Programming**
Credits: 3(3-0-0)	
Prerequisites for this course:	Basic understanding of the principles of programming
Course Objective:	The course aims to provide exposure to problem-solving through programming. It aims to train the student to the basic concepts of the C-programming language. This course involves a lab component which is designed to give the student hands-on experience with the concepts.
Course Outcome:	After the course the students are expected to be able to: • Identify situations where computational methods and computers would be useful. • Given a computational problem, identify and abstractthe programming task involved. • Approach the programming tasks using techniques learned and write pseudo-code. • Choose the right data representation formats based on the requirements of the problem. • Use the comparisons and limitations of the various programming constructs and choose the right one for the task in hand. • Write the program on a computer, edit, compile, debug, correct, recompile, and run it. • Identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.

Prahapalan

Syllabus for 1st Sem CSE/CE/IT/ETC/EEE
INTRODUCTION TO PROGRAMMING
(Compulsory Course)

Syllabus	
Module-I	**Introduction to C:** The Structure of a C program, Some basic C commands, Character input and output. **Types, Operators and Expressions:**Variables and constants, Data Types, Operators, Expressions. **Control Flow:** if, switch, Conditional Expressions, while, break and continue, for loop.
Module-II	**Arraysand Pointers:** Pointers and addresses, Organization of Memory, Pointers and Arrays, Managing and manipulating memory. **Functions and Program Structure:** Passing parameters to C programs, Multi-file programs, Scoping, Recursion, The C Pre-processor, Pointers to functions.
Module-III	**Structures and Unions:** Basics, Passing and returning structures, Pointers and structures, Arrays of Structures, Self-referential pointers, Linked Lists. **Managing Memory in C:** malloc(), calloc(), realloc(), free(). **Manipulating files:** File Pointers, Opening and Closing Files, Reading from and writing to files, Reading from stdin and writing to stdout, stderr, Moving the file pointer.
Suggested Books:	1. Kernighan, Brian, and Dennis Ritchie. *The C Programming Language*. 2nd ed. Upper Saddle River, NJ: Prentice Hall, 1988. ISBN: 9780131103627. 2. E. Balagurusamy. *Programming in ANSI C.*8th ed.McGraw Hill Education, 2019. ISBN: 978-9351343202
Evaluation:	1. Quizzes: 15% 2. Mid-term: 30% 3. Teacher's Assessment: 5% 4. End-term Exam: 50%

Syllabus for 1st Sem CSE/CE/IT/ETC/EEE
INTRODUCTION TO PROGRAMMING LAB
(Compulsory Course)

CSXXX	**Introduction to Programming Lab**
Credits: 1(0-0-2)	
Prerequisites for this course:	Basic understanding of the principles of programming
Course Objective:	The course aims to provide exposure to problem-solving through programming. It aims to train the student to the basic concepts of the C-programming language. This course involves a lab component which is designed to give the student hands-on experience with the concepts.
Course Outcome:	After the course the students are expected to be able to: • Identify situations where computational methods and computers would be useful. • Given a computational problem, identify and abstractthe programming task involved. • Approach the programming tasks using techniques learned and write pseudo-code. • Choose the right data representation formats based on the requirements of the problem. • Use the comparisons and limitations of the various programming constructs and choose the right one for the task in hand. • Write the program on a computer, edit, compile, debug, correct, recompile, and run it. • Identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.

Syllabus for 1st Sem CSE/CE/IT/ETC/EEE
INTRODUCTION TO PROGRAMMING LAB
(Compulsory Course)

<table>
<tr><td colspan="2"><u>Syllabus</u></td></tr>
<tr><td colspan="2">

Assignments on statements, variables, constants, operators
Assignments on using control statements like if...else
Assignments on using loop statements
Assignments on using arrays
Assignments on using functions
Assignments on using pointers
Assignments on using structures and unions
Assignments on using dynamic memory management
Assignments on File Input Output
Assignments on numerical methods

</td></tr>
<tr><td>Suggested Books:</td><td>1. Kernighan, Brian, and Dennis Ritchie. The C Programming Language. 2nd ed. Upper Saddle River, NJ: Prentice Hall, 1988. ISBN: 9780131103627.
2. E. Balagurusamy. Programming in ANSI C.8th ed.McGraw Hill Education, 2019. ISBN: 978-9351343202</td></tr>
<tr><td>Evaluation:</td><td>1. Continuous Evaluation through assignments: 70%
2. Project-based Evaluation: 30%</td></tr>
</table>

CS 102	**Data Structure**
Credits: 3 (3-0-0)	
Pre-requisite for this course:	**Introduction to Programming**
Course Objective:	The course aims to: • To introduce the concept of data structure for easy access of data. • To distinguish between linear and non-linear data structures. • To introduce linear data structures like arrays, linked list, queues, dictionaries etc. • To introduce non-linear data structures like trees, graphs etc. • To teach the various searching and sorting techniques and hashing techniques.
Course Outcome:	On completion of the course, a student should be able to: • Identify suitable data structures to solve a given problem efficiently. • They can choose the appropriate sorting and searching technique to solve a real-world programming problem at hand. • They shall be able to use the suitable data structures to work on various problems on compiler design, graph theory, computer networking, social media analytics, database management systems etc.
Syllabus	
Module I **[8] Hours**	Introduction to Data Structures: arrays, strings, sparse matrices. Linear Data Structures: Stacks, Queues and Circular Queues: Operations and Applications. dequeue, priority queue, Linked lists: Single linked lists, linked list representation of Stacks and Queues. Operations on polynomials, Double linked list, Circular linked list. Dynamic storage management-garbage collection and compaction, infix to postfix conversion, postfix expression evaluation.

Mahapatra

Module II [8] Hours	Trees: Tree terminology, Binary tree, Binary search tree, General tree, B tree, B+ tree, AVL Tree, Complete Binary Tree (Heap), Tree representation, Tree traversals, operation on Binary search tree and AVL tree: find, insertion, deletion. expression manipulation, Heaps.
Module III [14] Hours	Graphs: Graph terminology, Representation of graphs, path matrix, BFS (breadth first search), DFS (depth first search), Minimum Spanning Tree, Shortest Path (Warshall's algorithm), All pairs Shortest Path (Dijkstra), topological sorting Sorting and Searching techniques – Bubble sort, selection sort, Insertion sort, Quick sort, merge sort, Heap sort, Radix sort. Linear and binary search methods, Hashing techniques and hash functions.
Suggested Books: [Minimum 4/5 Books] (Include E-books also, if any)	1. Seymour Lipschutz , "Fundamental of Data Structure" (Schaums Series) Tata-McGraw-Hill. 2. Mark A. Weiss Pai: "Data Structures & Algorithms; Concepts, Techniques & Algorithms" Tata McGraw Hill. 3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein , "Introduction to Algorithms", PHI publication 4. Horowitz, Sahani& Freed ,"Fundamentals of data structure in C", Computer Science Press. 5. Tanenbaum, "Data structure in C", PHI publication / Pearson publication. 6. Pal, Debdutta. "Data Structure and Algorithm with C", Alpha Science International, 2018. ProQuest Ebook Central,
Evaluation:	1. Quiz: 15% 2. Mid Term: 30% 3. End Term Exam: 50% 4. Teacher's Assessment: 5%

CS 402	Data Structure Lab
Credits: 1 (1-0-0)	
Pre-requisite for this course:	**Introduction to Programming**
Course Objective:	The course aims to: • To introduce the concept of data structure for easy access of data. • To distinguish between linear and non-linear data structures. • To introduce linear data structures like arrays, linked list, queues, dictionaries etc. • To introduce non-linear data structures like trees, graphs etc. • To teach the various searching and sorting techniques and hashing techniques.
Course Outcome:	On completion of the course, a student should be able to: • Identify suitable data structures to solve a given problem efficiently. • They can choose the appropriate sorting and searching technique to solve a real-world programming problem at hand. • They shall be able to use the suitable data structures to work on various problems on compiler design, graph theory, computer networking,social media analytics, database management systems etc.
Experiments	
	Experiment No.1 Basic C program review: matrix operation, string operation **Experiment No.2** (a) Write a C program to create a stack using an array and perform i) push operation ii) pop operation (b) Write a C program to create a queue and perform i) insert operation ii) delete operation

	Experiment No. 3 Write a C program that uses Stack operations to perform the following: i) Converting infix expression into postfix expression ii) Evaluating the postfix expression **Experiment No. 4** Write a C program that uses functions to perform the following operations on Single linked list: i) Creation ii) Insertion iii) Deletion iv) Traversal **Experiment No. 5** Write a C program that uses functions to perform the following operations on Double linked list and Circular linked list: i) Creation ii) Insertion iii) Deletion **Experiment No. 6** Write a C program that uses functions to perform the following operations on Binary Search Tree: i) Creation ii) Insertion iii) Deletion iv) Traversal (Inorder, Preorder, Postorder) **Experiment No. 7** (a) Write C program to perform the Linear search operation for a Key value in a given list of integers. (b) Write C program that use both recursive and non recursive functions to perform the Binary search operation for a Key value in a given list of integers. **Experiment No. 8** Write C programs that implement Bubble Sort, Insertion Sort and Selection Sort method to sort a given list of integers in ascending order. **Experiment No.9** Write C programs that implement Quick Sort, Merge Sort and Heap Sort method to sort a given list of integers in ascending order: **Experiment No.10** Write a C program that uses functions to perform the following operations on a Graph: i) Creation (Adjacency Matrix) ii) Node Insertion iii) Node Deletion iv) Edge insertion v) Edge deletion vi) Traversal (DFS, BFS)
Evaluation:	1. Experiments: 50 2. Project: 30 3. Viva: 20

ET ____	**Basic Electronics Engineering**
Credits: 3 (3-0-0)	
Pre-requisites:	Physics
Course Objective:	The course aims to: • To introduce the fundamental aspects of Electronics and Circuits. • Enable the students to design circuits using Diodes, BJTs, FETs, and Op-Amps. • Enable the students to determine the characteristics of amplifiers such as gain etc. • Enable the students to analyze oscillator circuits. • Enable the students to use simulation software for circuit analysis.
Course Outcome:	On completion of the course, a student should be able to: • Understand the fundamental concepts of electronics components, circuits and measuring instruments • Design and analysis of various electronic circuits using Diodes, BJTs, FETs, and Op-Amps • Understand the fundamental concepts amplifier and oscillator circuits
Syllabus	
Module I **[12] Hours**	Diodes: Physical operation of PN junction diode, Zener diode, and LED, Applications of PN junction diode (Rectifiers, Clippers, Clampers, Applications of Zener diode (Voltage regulators, Clippers), Applications of LED.
Module II **[12] Hours**	Bipolar Junction Transistors (BJTs): Physical operation of BJT: Active, Saturation, and Cut-off operating regions, DC biasing, Transistor as a switch, r_e Transistor model. CB, CE, CC amplifiers. Field Effect Transistors (JFETs & MOSFETs): Introduction, Physical Design and Operation, Input and output Characteristics.
Module III **[12] Hours**	Operational Amplifier (Op Amp): Differential amplifier, Ideal Op-Amp Characteristics and parameters, Feedback concepts, Applications of Op-Amp (Inverting and non-inverting amplifier, Difference amplifier, Summing amplifier, Integrator and Differentiator, Oscillator circuits- Wien-Bridge oscillator, RC phase-shift oscillator, Crystal oscillator). Electronic Instruments: Basic principle and function of Oscilloscope and Function generator, Application of oscilloscope for measurement of voltage, time period, frequency and phase.
Suggested Books:	1. Electronic Devices and Circuit Theory (Ninth Edition), Robert L. Boylestad and Louis Nashelsky, Pearson Education 2. Integrated Electronics: Analog Digital Circuits and Systems, Jacob

	Millman, Christos Halkias. McGraw-Hill, Inc., New York, NY, USA 1972 3. Microelectronic Circuits (Fifth Edition), Adel S. Sedra and Kenneth C. Smith. 4. Electronic Devices (Seventh Edition), Thomas L. Floyd, Pearson Education
Evaluation*:	1. Quiz: 15% 2. Mid Term/ Course Project: 30% 3. End Term Exam: 50% 4. Teacher's Assessment: 5%

ET405:	**Basic Electronics Engineering Lab**
Credits: 1 (0-0-2)	
Course Objective:	The course aims to • Familiar with basic electronic components and instruments. • Demonstrate the circuit simulation software. • Hand on experience on basic experiments like different types of diodes and transistor characterization using breadboard, multimeter, DC power supply, CRO etc. • Design and analysis of rectifier, clipper and clampers circuits using diode. • Design and analysis of basic operations using Op-Amp.
Course Outcome:	On completion of the Lab, a student should be able to: • Know how to use the electronic components on the breadboard and instruments. • Design and analyze any basic electronic circuits using software and as well as in hardware. • Understand the fundamental aspects of design and implementation of any electronic projects used for dedicated applications.
Syllabus	

Expt 1:

1. Familiarization of
    1. Components (R, L, C, Diode, Transistors, IC, Breadboard etc) and
    2. Instruments (CRO, Function Generators, Multi-meter, DC power supply)

Expt 2:

2. Study of RC series circuit
    1. RC circuit as integrator and differentiator
        i. Study integration of square, triangular, and sine wave
        ii. Study differentiation of square, triangular, and sine wave
    2. RC circuit as low pass and high pass filter
        i. Study the frequency response of low pass and high pass filter

Expt 3:

3. Series and parallel resonant circuit
    1. Study the frequency response of series and parallel RLC circuit

Expt 4:

4. V-I Characteristics of PN junction diode
    1. Plot the forward V-I characteristics of Silicon and Germanium PN junction diodes
    2. Determine the static and dynamic resistances
    3. Determine the cut-in voltage
5. V-I Characteristics of Zener junction diode
    1. Plot the reverse V-I characteristics of Zener diode
    2. Determine the breakdown voltage
6. V-I Characteristics of LED
    1. Plot the forward V-I characteristics of Blue, Yellow, and Red LEDs.
    2. Explain the difference in the V-I characteristics

Expt 5:

7. Rectifier circuits
    1. Study half-wave, bridge, and full-wave rectifier with center-tapped transformer without and with capacitor filter.
    2. Determine the peak, average, and rms output and ripple factor
    3. Application of Zener diode to regulate the rectified output.

Expt 6:

8. Clipping circuits
    1. Realize clipping circuits to obtain the given waveforms.

Expt 7:

9. Clamping circuits
    1. Realize clamping circuits to obtain the given waveforms.

Expt 8:

10. Transistor characteristics
    1. Obtain static input and output characteristics of BJT in common-emitter configuration.

Expt 9:

11. Op-Amp applications
    1. Inverting amplifier
    2. Non-inverting amplifier
    3. Integrator
    4. Differentiator

Expt 10:

12. Oscillator Design
    1. Coplitt Oscillator
    2. Heartly Oscillator
    3. RC Phase shift Oscillator

Course Project	List of experiments will be provided Student can also select a project based upon the theory course.
Evaluation:	1. Attendance [10%] 2. Performance: [20%] 3. Lab Record [20%] 4. Lab Test/ Course Project [30%] 5. Viva / Quiz [20%]

BASIC ELECTRICAL TRCHNOLOGY (3-1-0)

Objectives: This is a foundation course for all branches. A reasonable understanding on the basics of applied electricity is important for every engineer. Apart from dc and ac circuit analysis both under steady state and transient conditions; it will cover basic working principle and analysis of transformer, dc machines and induction motor. Finally working principles of some measuring instruments and basics of power systems are introduced.

Module-1 (10 Hours)

Introduction to electrical circuits: Essence of electricity, Electric field, electric current, potential and potential difference, electric power, basic circuit components, ohm's law, Ideal and Practical Sources, Source Conversion, independent, and dependent sources, Energy Stored in Inductor, and Capacitor. Series and parallel combination of circuit components.

DC Networks: Laws and Theorems applicable to DC networks (KCL & KVL, Node voltage & Mesh current analysis, Delta-Star & Star-Delta conversion, Superposition principle, Thevenin's & Norton's theorem), Transients in R-L and R-C circuits with DC excitation, Simple problems.

Module-2 (10 Hours)

Single-Phase AC Circuits: Single-phase EMF Generation, Average and Effective value of periodic ac signals, Peak factor & Form factor, Phasor and Complex representation of sinusoids, Power factor, Complex power, Phasor solution of circuits with sinusoidal excitations.

Three-Phase AC Circuits: Comparison between single-phase and three-phase systems, three phase EMF Generation, Line and Phase quantities in star and delta networks,

Module-3 (12 Hours)

Introduction to Magnetic Circuits: Introduction to Electromagnetism, B-H curve, Permeability, Reluctance, Solution of magnetic circuits, Hysteresis and Eddy current loss.

Single-Phase Transformers: Construction and principle of operation, EMF Equation, Transformation ratio, Practical and Ideal transformers, Transformer losses and efficiency, Brief idea on Transformer Phasor diagram, Equivalent circuit, transformer rating, Auto transformer.

A.C. Machines: Basic concept of rotating Electrical machine. Introduction to Three-phase Induction Motor, Concept of Slip, Equivalent circuit of induction motor, Single-phase Induction Motor, Basic concept of synchronous machine.

Module-4 (08 Hours)

D.C. Machines: Principle of operation, construction, classification of DC machines, EMF equation of DC generator, Speed Equation of DC Motor.

Measuring Instruments: PMMC Ammeters and Voltmeters with extension of range, Moving-Iron Ammeters and Voltmeters, Dynamometer type Wattmeter. Power measurement in three-phase balanced circuits (Two wattmeter method), energy meters.

Power Systems: Brief introduction to power system, Generation, transmission and distribution of AC power, Basic idea on grounding and safety, Illumination,

Renewable energy sources: Brief introduction to renewable energy sources, Common Forms of Energy, Salient Features of Non-Conventional Energy Sources, World Energy Status and Energy Scenario in India, Solar Cell Fundamentals and Cell Characteristics.

Text/reference books:

1. G. Rizzoni, "Principles and Applications of Electrical Engineering", McGraw-Hill
2. Hughes, "Electrical & Electronic Technology", Pearson Education
3. N. K. De and Dipu Sarkar "Basic Electrical Engineering", Universities Press
4. V. D. Toro, "Basic Electrical Engineering", Prentice-Hall of India
5. B. L. Theraja and A. K. Theraja, "A Textbook of Electrical Technology", S. Chand & Co. Ltd.
6. Rajendra Prasad, "Fundamentals of Electrical Engineering", Prentice-Hall of India
7. D.P. Kothari and I.J. Nagrath, "Basic Electrical Engineering", TMH
8. N. N. Parker Smith, "Problems in Electrical Engineering", CBS Publisher
9. Ravish R Singh, "Basic Electrical Engineering", McGraw Hill Education (India) Private Ltd.
10. C.L Wadhwa, "Basic Electrical Engineering", New age International Publishers

Basic Electrical Technology Laboratory (0-0-2)

Objectives: To explain the concept of circuit laws and network theorems and apply them inthe laboratory.To learn the practical experience with operation and applications of electromechanical energy conversion devices such as DC machines, Transformer and Single-Phase Induction Motor.It also makes the students to learn how to measure the electrical quantities with different measuring devices.To learn the practical experience of solar photovoltaic cell.

List of Experiments:

1. Connection and measurement of power consumption of various lamps.
2. Verification of superposition, Thevenin's and Norton's theorem.
3. Calculation of current, voltage and power in series R-L-C circuit excited by single phase AC supply and calculation of power factor.
4. V-I Characteristics of incandescent lamps and time fusing current characteristics of a fuse.
5. Study of single phase energy meter.
6. Open circuit and short circuit test of single phase transformer.
7. Study of various parts of DC machine.
8. Measurement of armature and field resistance of DC machine.
9. Study of single phase induction motor and fan motor.
10. Study of solar photovoltaic system.

Text/reference books:

1. G. Rizzoni, "Principles and Applications of Electrical Engineering", McGraw-Hill
2. Hughes, "Electrical & Electronic Technology", Pearson Education
3. N.K.De and Dipu Sarkar, "Basic Electrical Engineering", Universities Press
4. V.D.Toro, "Basic Electrical Engineering", Prentice-Hall of India
5. B.L.Theraja and A.K.Theraja, "A Textbook of Electrical Technology", S.Chand& Co. Ltd.
6. Rajendra Prasad, "Fundamentals of Electrical Engineering", Prentice-Hall of India
7. D.P.Kothari and I.J.Nagrath, "Basic Electrical Engineering", TMH
8. N.N.ParkerSmith,"Problems in Electrical Engineering", CBS Publisher
9. Ravish R Singh,"Basic Electrical Engineering",McGraw Hill Education (India) Private Ltd.
10. C.L Wadhwa,"Basic Electrical Engineering", New age International Publishers

Syllabus for First Year B.Tech (1st /2nd Semester): CSE, IT, CE, ETC, EEE

BASIC MECHANICAL ENGINEERING

(Compulsory Course)

MEXXX	**Basic Mechanical Engineering**
	Credit:4(3-1-0)
Prerequisites of the course	No prerequisites
Course Objective	This course is designed to give a platform to the engineering students as beginners, a smooth transition from science-based formulation of problems to engineering-based formulation. Analysis and design of basic structural elements used in engineering applications for dynamically changing society.
Course Outcome	**At the end of the course a student comes to know** • Different kinds of vectors and loads, free-body diagram of structural elements under different loading conditions • Physical nature of the internal forces in structural member in real complex loading situations • Importance of properties of area from design point of view • Basic thermodynamic principles and applications • Use of Matlab / Octave (Open source) to solve engineering problems.
	Syllabus
Module-I[13]	**Force systems, Equilibrium,** Free body diagram; problems in two dimensions; Moment of a force about a point and about an axis; System of parallel forces, plane trusses. **Properties of areas:** Centroid, Moments of inertia and product of inertia of areas, polar moment of inertia. Free vibration, damped free vibration and forced vibration of M-S-D system. (Simulation through Matlab/Octave (Open source)).
Module-II[12]	**Concept of stress and strain:** Normal stress, shear stress, state of stress at a point, ultimate strength, allowable stress, factor of safety; normal strain, shear strain, Hooke's law, Poisson's ratio, analysis of axially loaded members. Simple Bending: pure bending of beam. **Torsion:** Torsion of cylindrical bars, torsional stress, modulus of rigidity and deformation. **Flexural loading:** Shear force and bending moment in beams; shear and moment relationship; shear and moment diagrams; flexure formula; shear stress in beams

Syllabus for First Year B.Tech (1st /2nd Semester): CSE, IT, CE, ETC, EEE

BASIC MECHANICAL ENGINEERING

(Compulsory Course)

Module-III[8]	Basic concept of thermodynamics, Zeroth law and concept of thermal equilibrium, heat and work transfer principles. First law of thermodynamics: It's application to closed systems and open systems (only steady flow considered)
Module-IV[7]	Second law of thermodynamics: reversible and irreversible processes. Heat engines, heat pump and refrigerator, Equivalence of Kelvin-Plank and Clausius statement, Carnot cycle and its efficiency. Inequality of Clausius and entropy concept. Principle of increase of entropy. .
Suggested books	1. Engineering Mechanics - S. Timoshenko, D. H. Young, J. V. Rao and S. Pati (TMH) 2. Strength of Materials, G.H. Ryder, Macmillan Publishers India Limited, 2002 3. Mechanics of Materials, R.C Hibbeler, PHI 4. Elements of Strength of Materials - S. Timoshenko, D. H. Young (East West Press Private Ltd.) 5. Strength of Materials , R. Subramanium, Oxford University press 6. Mechanics of Materials - Ferdinand Beer , E. Russell Johnston, Jr., J. DeWolf (TMH) 7. Engineering Thermodynamics by P.K. Nag, Publisher: TMH 8. Fundamentals of Thermodynamics by R.E. Sontang, C. Borgnakke, and G.J. Van Wylen, Wiley- India 9. Fundamental of Engineering Thermodynamics by E. Rathakrishnan, publisher. PHI
Evaluation	1. Quiz:15% 2. Mid-sem: 30% 3. Teacher's Assessment: 5% 4. End-sem: 50%

Syllabus for 1st Year (1st/2nd Semester) CSE/CE/IT/ETC/EEE
Engineering Graphics
(Compulsory Course)

MEXXX	**Engineering Graphics**
	Credits: 1.5 **[0-0-3]**
Prerequisites for this course:	None
Course Objective:	Prepare students for graphical design of a system or component to meet desired needs within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability. Further it prepares one to communicate effectively and to use the techniques, skills, and modern engineering tools necessary for engineering practice
Course Outcome:	On completion of course, the students will learn 1. Exposure to the visual aspects of engineering design 2. Exposure to engineering graphics standards 3. Exposure to solid modeling 4. Exposure to computer-aided geometric design 5. Exposure to creating working drawings 6. Exposure to engineering communication
	Syllabus
Engineering Graphics (Manual Mode) Principles of Engineering Graphics; Drawing Instruments; Lines, Lettering & Dimensioning; Geometric constructions; Principles of Orthographic Projection(applied to points, lines, planes and Solids); Angle of Projections;Isometric Projection; Surface Development; Reading a Drawing; Sectional Views. **Engineering Graphics (Computer Mode)** Introduction to computer aided drafting software; Use of software to draw orthographic projection views, sectional views of different objects. Development of surface modeling and solid modeling of various machine elements.	
Suggested Books:	1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House 2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education 3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication

Syllabus for 1st Year (1st/2nd Semester) CSE/CE/IT/ETC/EEE

Engineering Graphics

(Compulsory Course)

Evaluation:	1. Continuous Evaluation through each class: 60% 2. Quiz:20% 3. End Sem. Exam:20

Syllabus for 1st Year (1st/2nd Semester) CSE/CE/IT/ETC/EEE

Workshop Practice

(Compulsory Course)

MEXXX	Workshop Practice
Credits: 1.5 **[0-0-3]**	
Prerequisites for this course:	None
Course Objective:	The students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.
Course Outcome:	Upon completion of this laboratory course, 1. Students will be able to fabricate components with their own hands. 2. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes. 3. By assembling different components, they will be able to produce small devices of their interest.

Syllabus

1. Introducing to various machine tools and demonstration on machining.

   Turning a cylindrical job according to a drawing that involves the following operations- straight turning, taper turning, grooving, threading

2. Milling a cylindrical job to hexagonal shape using indexing head

3. Practice on electric arc welding. Lap and butt joining of low carbon steel using manual metal arc welding method

4. Plastic moulding and glass cutting

5. Carpentry: Corner Lap joint and Devetail Lap joint

6. Fitting: Male-female joint

Suggested Books:	1. Elements of Workshop Technology, Vol. I and II by Hajra choudhary, Khanna Publishers 2. Workshop Technology by WAJ Chapman, Viva Books 3. Workshop Manual by Kannaiah/ Narayana, Scitech
Evaluation:	1. Continuous Evaluation through Job preparation: 60% 2. Quiz and viva: 20% 3. Record Evaluation:20%

Mathematics Syllabus for CSE, IT, CE Branches

Discrete Structures for CSE, IT & CE (Earlier it was under math Dept.) now is not under Math Department. It should be under CSE department (as per AICTE guidelines)

Math-I-Calculus, ODE and Complex analysis (4-0-0)

Detailed contents:

Module 1: Differential Calculus (Functions of one Variable): (8 lectures)

Rolle's theorem, Cauchy's mean value theorem (Lagrange's mean value theorem as a special case), Taylor's and Maclaurin's theorems with remainders, indeterminate forms, concavity and convexity of a curve, points of inflexion, asymptotes and curvature.

Module 2: Multivariable Calculus (Differential Calculus***): (8 lectures)***

Limit, continuity and differentiability of functions of several variables, partial derivatives and their geometrical interpretation, differentials, derivatives of composite and implicit functions, derivatives of higher order and their commutativity, Euler's theorem on homogeneous functions, harmonic functions, Taylor's expansion of functions of several variables, maxima and minima of functions of several variables – Lagrange's method of multipliers.

Module 3: First order ordinary differential equations: (12 lectures)

First order differential equations - exact, linear and Bernoulli's form, second order differential equations with constant coefficients, method of variation of parameters, general linear differential equations with constant coefficients, Euler's equations, system of differential equations.

Sequences and Series: Sequences and their limits, convergence of series, comparison test, Ratio test, Root test, Absolute and conditional convergence, alternating series, Power series.

Module 4:* Complex Variables: *(12 lectures)

Limit, continuity, differentiability and analyticity of functions, Cauchy-Riemann equations, line integrals in complex plane, Cauchy's integral theorem, independence of path, existence of indefinite integral, Cauchy's integral formula, derivatives of analytic functions, Taylor's series, Laurent's series, Zeros and singularities, Residue theorem, evaluation of real integrals.

Suggested Text/Reference Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons,
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Differential and Integral Calculus, N. Piskunov, Vo;-I, McGraw Hill, Moscow.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
5. Calculus: One-Variable Calculus with An Introduction to Linear Algebra, Vol 1, 2ed: Tom M. Apostol.
6. Calculus: Multi-Variable Calculus and Linear Algebra with Applications to Differential Equations and Probability, Vol 2, 2ed: Tom M. Apostol.

Course Outcomes

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines. The students will learn:

To apply differential and integral calculus to notions of curvature and to improper integrals.

The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.

The tool of power series and Fourier series for learning advanced Engineering Mathematics.

To deal with functions of several variables that are essential in most branches of engineering.

Math-II- Linear Algebra, Integral Calculus, Vector Calculus, Numerical Analysis (4-0-0)

Detailed contents

Module 1: Linear Algebra: (10 lectures)

Linear Algebra: Algebra of matrices. Vector spaces - linear dependence of vectors, basis, linear transformations, rank and inverse of a matrix, solution of algebraic equations - consistency conditions, Hermitian, skew Hermitian and unitary matrices, bilinear forms, eigenvalues and eigenvectors. Numerical solution of system of linear equations: Gauss, Gauss-Jordan elimination and Gauss-Seidel iteration methods.

Module 2: Integral Calculus: (10 lectures)

Integral Calculus: Fundamental theorem of integral calculus, mean value theorems, evaluation of definite integrals - reduction formulae. Convergence of improper integrals, tests of convergence, Beta and Gamma functions - elementary properties. Differentiation under integral sign, differentiation of integrals with variable limits - Leibnitz rule. Rectification, double and triple integrals, computations of area, surfaces and volumes, change of variables in double integrals - Jacobians of transformations, integrals dependent on parameters - applications.

Module 3: Vector Calculus: (10 lectures)

Vector Calculus: Scalar and vector fields, level surfaces, directional derivative, Gradient, Curl, Divergence, Laplacian, line and surface integrals, theorems of Green, Gauss and Stokes, line integrals independent of path.

Module 4: Numerical Analysis: (10 lectures)

Solution of polynomial and transcendental equations - bisection, Newton-Raphson and regula-falsi methods. Finite differences, Newtons forward and backward interpolation formulae, central difference interpolation formulae. Trapezoidal and Simpsons 1/3rd rules for numerical integration.

Suggested Text/Reference Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons,
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Differential and Integral Calculus, N. Piskunov, Vo;-I, McGraw Hill, Moscow.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
5. Calculus: One-Variable Calculus with An Introduction to Linear Algebra, Vol 1, 2ed: Tom M. Apostol.
6. Calculus: Multi-Variable Calculus and Linear Algebra with Applications to Differential Equations and Probability, Vol 2, 2ed: Tom M. Apostol.

Course Outcomes

The objective of this course is to familiarize the prospective engineers with techniques in

multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.
The students will learn:

The mathematical tools needed in evaluating multiple integrals and their usage.

.

The tools of differentiation and integration of vector functions that are used in various techniques dealing engineering problems.
Apart from some other applications they will have a basic understanding of Beta and Gamma functions.
The essential tool of matrices and linear algebra in a comprehensive manner.
To understand numerical computations of Transcendental equations.

Math-III-Probability and Statistics (3-0-0)

Module 1: Basic Probability: *(12 lectures)*

Probability: Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes' Theorem and independence.

Random Variables: Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, moment generating function, Chebyshev's inequality.

Module 2: Distributions (10 lectures)

Special Distributions: Discrete uniform, Binomial, Negative Binomial Distribution, Geometric, Poisson, Exponential, Gamma, Normal distributions. Functions of a Random Variable.

Joint Distributions: Joint, marginal and conditional distributions, product moments, correlation, independence of random variables, bivariate normal distribution.

Sampling Distributions: The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions.

Module 3: (8 lectures)

Estimation and Data analysis: Estimators, confidence intervals for the mean(s) and variance(s) of normal populations, exploratory data analysis.

Testing of Hypotheses: Null and alternative hypotheses, the critical and acceptance regions, two types of error, power of the test, the most powerful test and Neyman-Pearson Fundamental Lemma, tests for one sample problems for normal populations.

References:

- Probability & Statistics for Engineers & Scientists: R. E. Walpole, R. H. Myers, S.L. Myers, & K. Ye, Pearson Prentice Hall
- Fundamentals of probability and statistics for engineers: T.T. Soong, Wiley.
- Mathematical statistics & data analysis: J.A. Rice
- Probability and mathematical statistics: Prasanna Sahoo, Department of Mathematics University of Louisville, USA
- All of statistics: Larry A. Wasserman

Course Outcomes

The objective of this course is to familiarize the students with statistical techniques. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

The students will learn:

The ideas of probability and random variables and various discrete and continuous probability distributions and their properties.

The basic ideas of statistics including measures of central tendency, correlation and regression.

The statistical methods of studying data samples.

MATH-IV-Discrete Mathematics (CSE) (3-1-0)

Module-1 (10 lectures) Logic

Propositional logic, Propositional Equivalence, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Proof methods and Strategies, Sequences and Summations, Mathematical Induction, Recursive definition and structural induction, Program Correction.

Module-2: (10 lectures) Relation:

Recurrence relation, Solution to recurrence relation, Generating functions, Inclusion and exclusion, Application of Inclusion and Exclusion Principle, Relation and their properties, Closure of relations, Equivalence relations, Partial orderings.

Module-3: (10 lectures)-Graph & Tree

Introduction to graph theory, Graph terminology, Representation of graphs, Isomorphism, Connectivity, Euler and Hamiltonian paths, shortest path problems, Planar graph, Graph colouring, Introduction to trees, Application of trees, Tree Traversal, Minimum Spanning tree.

Module-4 (10 lectures) -Group & Boolean Algebra

Groups, Subgroups, Cossets, Lagrange theorem, Group codes. Algebraic systems, Lattices, Distributive and Complemented Lattices, Boolean Lattices and Boolean Algebra, Boolean Functions and Boolean Expressions.

References:

- Kenneth H. Rosen, "Discrete Mathematics and its Applications", Sixth Edition, 2008, Tata McGraw Hill Education, New Delhi.
- L. Liu and D. Mohapatra, "Elements of Discrete Mathematics", Third Edition, 2008, Tata McGraw Hill Education, New Delhi

MATH-VI-Optimization Techniques (Elective) (3-0-0)

Module-1: Idea of Engineering optimization problems, Classification of optimization algorithms, modelling of problems and principle of modelling. Linear programming: Formulation of LPP, Graphical solution, Simplex method, Big-M method, Revised simplex method, Duality theory and its application, Dual simplex method, Sensitivity analysis in linear programming.

Module-2:
Transportation problems: Finding an initial basic feasible solution by Northwest Corner rule, Least Cost rule, Vogel's approximation method, Degeneracy, Optimality test, MODI method, Stepping stone method;

Assignment problems: Hungarian method for solution of Assignment problems. Integer Programming: Branch and Bound algorithm for solution of integer Programming Problems.

Queuing models: General characteristics, Markovian queuing model, M/M/1 model, Limited queue capacity, Multiple servers, Finite sources, Queue discipline.

Module-3: Convex sets, convex functions and their properties, Non-linear programming: Introduction to non-linear programming. Unconstraint optimization: Fibonacci and Golden Section Search method. Constrained optimization with equality constraint: Lagrange multiplier, Constrained optimization with inequality constraint: Kuhn-Tucker condition, Quadratic programming.

Recommended Reference books:

- Stephen G. Nash, A. Sofer, *"Linear and Non-linear Programming"*, McGraw Hill
- 2. A. Ravindran, K. M. Ragsdell, G. V. Reklaitis," *Engineering Optimization*", Second edition, Wiley India Pvt. Ltd
- 3. H. A. Taha, A. M. Natarajan, P. Balasubramanie, A. Tamilarasi, "*Operations Research*", Eighth Edition, Pearson Education
- 4. F. S. Hiller, G. J. Lieberman, *"Operations Research"*, Eighth Edition, Tata McDraw Hill
- 5. P.K.Gupta, D.S.Hira, "*Operations Research*", S.Chand and Company Ltd.
- K. Swarup, P.K. Gupta, Man Mohan, "Operations Research", Sultan Chand and sons.

Course Learning Outcomes:

Upon successful completion of this course, the student will be able to understand:

- basic theoretical principles in optimization; formulation of optimization models;
- solution methods in optimization;
- methods of sensitivity analysis and post processing of results applications to a wide range of engineering problems

Mathematics Syllabus for ETC & EEE Branches

Math-I-Calculus, ODE and Complex analysis (4-0-0)

Detailed contents:
Module 1: Differential Calculus (Functions of one Variable): (8 lectures)
Rolle's theorem, Cauchy's mean value theorem (Lagrange's mean value theorem as a special case), Taylor's and Maclaurin's theorems with remainders, indeterminate forms, concavity and convexity of a curve, points of inflexion, asymptotes and curvature.

Module 2: Multivariable Calculus (Differential Calculus***): (8 lectures)***
Limit, continuity and differentiability of functions of several variables, partial derivatives and their geometrical interpretation, differentials, derivatives of composite and implicit functions, derivatives of higher order and their commutativity, Euler's theorem on homogeneous functions, harmonic functions, Taylor's expansion of functions of several variables, maxima and minima of functions of several variables – Lagrange's method of multipliers.

Module 3: First order ordinary differential equations: (12 lectures)
First order differential equations - exact, linear and Bernoulli's form, second order differential equations with constant coefficients, method of variation of parameters, general linear differential equations with constant coefficients, Euler's equations, system of differential equations.

Sequences and Series: Sequences and their limits, convergence of series, comparison test, Ratio test, Root test, Absolute and conditional convergence, alternating series, Power series.

Module 4: **Complex Variables:** ***(12 lectures)***
Limit, continuity, differentiability and analyticity of functions, Cauchy-Riemann equations, line integrals in complex plane, Cauchy's integral theorem, independence of path, existence of indefinite integral, Cauchy's integral formula, derivatives of analytic functions, Taylor's series, Laurent's series, Zeros and singularities, Residue theorem, evaluation of real integrals.

Suggested Text/Reference Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons,
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Differential and Integral Calculus, N. Piskunov, Vo;-I, McGraw Hill, Moscow.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
5. Calculus: One-Variable Calculus with An Introduction to Linear Algebra, Vol 1, 2ed: Tom M. Apostol.
6. Calculus: Multi-Variable Calculus and Linear Algebra with Applications to Differential Equations and Probability, Vol 2, 2ed: Tom M. Apostol.

Course Outcomes

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines. The students will learn:

To apply differential and integral calculus to notions of curvature and to improper integrals.

The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.

The tool of power series and Fourier series for learning advanced Engineering Mathematics.

To deal with functions of several variables that are essential in most branches of engineering.

Math-II- Linear Algebra, Integral Calculus, Vector Calculus, Numerical Analysis (4-0-0)

Detailed contents

Module 1: Linear Algebra: (10 lectures)

Linear Algebra: Algebra of matrices. Vector spaces - linear dependence of vectors, basis, linear transformations, rank and inverse of a matrix, solution of algebraic equations - consistency conditions, Hermitian, skew Hermitian and unitary matrices, bilinear forms, eigenvalues and eigenvectors. Numerical solution of system of linear equations: Gauss, Gauss-Jordan elimination and Gauss-Seidel iteration methods.

Module 2: Integral Calculus: (10 lectures)

Integral Calculus: Fundamental theorem of integral calculus, mean value theorems, evaluation of definite integrals - reduction formulae. Convergence of improper integrals, tests of convergence, Beta and Gamma functions - elementary properties. Differentiation under integral sign, differentiation of integrals with variable limits - Leibnitz rule. Rectification, double and triple integrals, computations of area, surfaces and volumes, change of variables in double integrals - Jacobians of transformations, integrals dependent on parameters - applications.

Module 3: Vector Calculus: (10 lectures)

Vector Calculus: Scalar and vector fields, level surfaces, directional derivative, Gradient, Curl, Divergence, Laplacian, line and surface integrals, theorems of Green, Gauss and Stokes, line integrals independent of path.

Module 4: Numerical Analysis: (10 lectures)

Solution of polynomial and transcendental equations - bisection, Newton-Raphson and regula-falsi methods. Finite differences, Newtons forward and backward interpolation formulae, central difference interpolation formulae. Trapezoidal and Simpsons 1/3rd rules for numerical integration.

Suggested Text/Reference Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons,
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Differential and Integral Calculus, N. Piskunov, Vo;-I, McGraw Hill, Moscow.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
5. Calculus: One-Variable Calculus with An Introduction to Linear Algebra, Vol 1, 2ed: Tom M. Apostol.
6. Calculus: Multi-Variable Calculus and Linear Algebra with Applications to Differential Equations and Probability, Vol 2, 2ed: Tom M. Apostol.

Course Outcomes

The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

The students will learn:

The mathematical tools needed in evaluating multiple integrals and their usage.

The tools of differentiation and integration of vector functions that are used in various techniques dealing engineering problems.

Apart from some other applications they will have a basic understanding of Beta and Gamma functions.

The essential tool of matrices and linear algebra in a comprehensive manner.

To understand numerical computations of Transcendental equations.

Math-III-Probability & Stochastic Process (3-0-0)

Module-1:

Module 1: Basic Probability: *(10 lectures)*
Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes' Theorem, and independence.

Random Variables: Discrete, continuous, and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, moment generating function, Chebyshev's inequality.

Module 2: **Special Distributions:** *(10 lectures)* Discrete uniform, Binomial, Geometric, Poisson, Exponential, Gamma, Normal distributions. Functions of a Random Variable.

Joint Distributions: Joint, marginal, and conditional distributions, product moments, correlation, independence of random variables, bivariate normal distribution.

Module-3: Stochastic Processes: *(10 lectures)*

Definition and classification of stochastic processes, Poisson process, birth and death process, applications to queues, discrete time Markov chains.

References:

- Fundamentals of probability and statistics for engineers: T.T. Soong, Wiley.
- Probability and mathematical statistics: Prasanna Sahoo, Department of Mathematics University of Louisville, USA
- Probability, Statistics, and Queuing Theory with computer Science Applications, A.O. ***Allen,*** Academic Press (ELSEVIER), Indian Reprint
- An Introduction to Probability Models, ***S. M. Ross,*** Academic Press (Elsevier-10th Edition), Indian reprint.

Math-IV-Transform Calculus & Matrix Algebra-(3-0-0)

Module-1: Transform Calculus-I: Laplace transformation and its use in getting solution to differential equations, Convolution, Integral equations.

Module-2: Transform Calculus-II: Fourier series, Fourier expansion of functions of any period, Even and odd functions, Half- range expansion, Fourier transform and Fourier Integral.

Brief Introduction of Z-Transform.

Module-3: Matrix Algebra:

Analytic geometry: Norms, Inner Products, lengths and distances, orthogonality, orthonormal basis, orthogonal projections, rotations, Gram-Schmidt's orthogonalization, orthogonal, unitary matrices and their properties, generalized inverse, Moore-Penrose inverse, minimum-norm g-inverse, idempotent matrix, projection matrices, quadratic forms, positive definite, non-negative definite, negative definite matrices and their properties.

Matrix Decomposition: QR, Cholesky, LDU, UDU, SVD,

References:

1. Erwin Kreysig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
3. Introduction to Linear Algebra, Gilbert Strang, 2016.

MATH-VI-Optimization Techniques (Elective) (3-0-0)

Module-1: Idea of Engineering optimization problems, Classification of optimization algorithms, modelling of problems and principle of modelling. Linear programming: Formulation of LPP, Graphical solution, Simplex method, Big-M method, Revised simplex method, Duality theory and its application, Dual simplex method, Sensitivity analysis in linear programming.

Module-2:
Transportation problems: Finding an initial basic feasible solution by Northwest Corner rule, Least Cost rule, Vogel's approximation method, Degeneracy, Optimality test, MODI method, Stepping stone method;

Assignment problems: Hungarian method for solution of Assignment problems. Integer Programming: Branch and Bound algorithm for solution of integer Programming Problems.

Queuing models: General characteristics, Markovian queuing model, M/M/1 model, Limited queue capacity, Multiple servers, Finite sources, Queue discipline.

Module-3: Convex sets, convex functions and their properties, Non-linear programming: Introduction to non-linear programming. Unconstraint optimization: Fibonacci and Golden Section Search method. Constrained optimization with equality constraint: Lagrange multiplier, Constrained optimization with inequality constraint: Kuhn-Tucker condition, Quadratic programming.

Recommended Reference books:

- Stephen G. Nash, A. Sofer, *"Linear and Non-linear Programming"*, McGraw Hill
- A. Ravindran, K. M. Ragsdell, G. V. Reklaitis," *Engineering Optimization*", Second edition, Wiley India Pvt. Ltd
- H. A. Taha, A. M. Natarajan, P. Balasubramanie, A. Tamilarasi, "*Operations Research*", Eighth Edition, Pearson Education
- F. S. Hiller, G. J. Lieberman, *"Operations Research"*, Eighth Edition, Tata McDraw Hill
- P. K. Gupta, D. S. Hira, "*Operations Research*", S. Chand and Company Ltd.
- K. Swarup, P.K. Gupta, Man Mohan, "Operations Research", Sultan Chand and sons.

Course Learning Outcomes:

Upon successful completion of this course, the student will be able to understand:

- basic theoretical principles in optimization; formulation of optimization models;
- solution methods in optimization;
- methods of sensitivity analysis and post processing of results applications to a wide range of engineering problems.

Hatapathy

Course: **Physics**
Code: PH101
Credits: **4**

Objective: *The main goal of this course is to familiarize the engineering students with the fundamental concepts and principles of physics, which will help to lay the foundation for the various engineering courses, and its applications in various engineering fields.*

Module-1: Oscillation & Optics

Chapter 1: Oscillation[1] **[5] lectures**

Various oscillatory systems- overview; harmonic oscillator: simple harmonic oscillation, damped harmonic oscillation and forced-damped harmonic oscillation; resonance; coupled oscillator: spring-mass system, pendulums, normal modes and frequencies.

Chapter 2: Optics[2] **[8] lectures**

Light as (electromagnetic) wave; superposition of waves, coherent and incoherent superposition (and their intensity distributions); coherent sources of light. *Interference of light*: Newton's rings. *Diffraction of light*: Fresnel and Fraunhofer diffractions; theory of diffraction (Fraunhofer diffraction due to a single slit): intensity distribution, principal maximum and secondary maxima; grating (diffraction due to large number of slits). *Polarization of light*: plane, circular and elliptically polarized light; optical effects: law's of Reflection and Refraction, total internal reflection, Brewster's law and Malus' law; double refracting crystal: ordinary ray (o-ray), extraordinary ray(e-ray) and optic axis; polarizer and analyzer; wave plates: quarter- and half-wave plates construction and use.

Module-2: Quantum Physics

Chapter 3: Basics of Quantum Physics[3,4] **[6] lectures**

Historical overviews: black body radiation, photoelectric effect and stability of hydrogen atom; wave-particle duality: wave nature of particles (Davisson-Germer expriment) and particle nature of waves (Compton scattering); de Broglie hypothesis and its applications; Heisenberg uncertainty principle, application of the uncertainty principle- nonzero minimum energy. Basic features (or formulation) of Quantum mechanics- a transition from deterministic to probabilistic description; wave function; probability density; superposition principle; Schrödinger equation-time dependent and time independent; observables and operators; eigenfunctions and eigenvalues; expectation values.

Chapter 4: Application of Quantum Mechanics[3,4] **[5] lectures**

Free particles- continuous states; potential steps- reflection and transmission; potential barrier-tunneling; infinite deep potential well (particle in a box)- energy eigenvalues and eigenfunctions; harmonic oscillator- eigenstates and energy eigenvalues.

Module-3: Electromagnetic Theory

Chapter 5: Electromagnetism[5] **[4] lectures**

Vector calculus: scalar and vector fields, gradient, divergence and curl operators; line-, surface- and volume integrals; Gauss divergence theorem, Stoke's theorem and Green's theorem. *Electrostatics*: Coulomb's law, electric field($\vec{E}$), electric displacement($\vec{D}$) and electric flux(ϕ_E); Gauss' law in free space and dielectric medium. *Magnetism*: Lorentz force, magnetic field($\vec{B}$), magnetic intensity ($\vec{H}$) and magnetic flux(ϕ_B); Biot-Savart law; Ampere's circuital law, displacement current; Faraday's law of electromagnetic induction; Maxwell's electromagnetic equations in differential form and in integral form.

Chapter 6: Electromagnetic waves[5] **[4] lectures**

Electromagnetic wave equations in (a) free space, (b) medium, (c) charge free conducting and nonconducting media; vector potential and scalar potential; gauge conditions; wave equation in terms of scalar and vector potentials; transverse nature of electromagnetic wave; electromagnetic energy, Poynting vector, Poynting theorem, intensity of electromagnetic wave.

Module-4: Statistical Physics

Chapter 7: Elementary Statistical Physics and Its Applications[3,4] **[9] lectures**

Statistical systems: classical and quantum; statistical distributions: Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein statistics. Molecular energies: molecular energy distribution and average molecular energy; molecular speeds: root-mean-square speed, average molecular speed and most probable speed. Blackbody radiation: Rayleigh-Jeans formula, Planck's radiation law, Wien's displacement law and Stefan-Boltzmann law; Bose-Einstein condensation. Einstein's theory of stimulated emission of radiation. Specific heat of solids: Dulong-Petit law, Einstein's theory and Debye's theory; free electrons in metal: fermi-energy, average electron energy and electron specific heat; dying stars: white dwarfs, neutron stars and black holes.

Text and Reference Books:

1. "Engineering Physics", H.K. Malik and A.K. Singh, McGraw-Hill.
2. "Optics", Ajoy K. Ghatak, McGraw-Hill.
3. "Concepts of Modern Physics", Arthur Beiser, McGraw-Hill.
4. "Quantum Physics", Robert Eisberg and Robert Resnick, Wiley.
5. "Introduction to Electrodynamics", David J. Griffiths, Pearson.
6. "Physics for Engineering Students", B.B Swain and P.K. Jena, Kitab Mahal.

PHYSICS LAB SYLLABUS

IIIT BHUBANESWAR

1. To determine frequencies of oscillation for

   (i) Uncoupled oscillation

   (ii) coupled pendulum oscillation (in phase, out of phase and beat case).

2. To determine wavelength of Sodium light by forming Newton's rings.

3. To determine grating element of a plane diffraction grating.

4. To determine damping constant in various medium (air & water).

5. To demonstrate the existence of discrete energy level in neon atom and determine its excitation energy using Frank Hertz unit.

6. To study the characteristics of polarization of light using half wave plate.

7. To determine the energy band gap of a given semiconductor by using four probe setup.

8. To determine the dielectric constant of various dielectric materials.

9. To study Hall effect and to determine

   (i) type of semiconductor

   (ii) Majority carrier concentration.

   (iii) Mobility of majority carrier by using Hall apparatus.

10. To determine Resonance frequency of the forced oscillation.

International Institute of Information Technology Bhubaneswar

Proposed Syllabus for English

Total Credit: 6

1.English for Communication	Semester-I	All Branches Compulsory	Credit-1+1=2	Full Marks: 100	Classes per week: I (I hour)	Lab per Week: I (II hours)
2. Professional English	Semester-II	All Branches Compulsory	Credit-1+1=2	Full Marks: 100	Classes per week: I (I hour)	Lab per Week: I (II hours)
3.Critical Reading and Communication	Semester-III	CSE, IT and CE Compulsory	Credit-1+1=2	Full Marks: 100	Classes per week: I (I hour)	Lab per Week: I (II hours)
4.Critical Reading and Communication	Semester-IV	ETC and EEE Compulsory	Credit-1+1=2	Full Marks: 100	Classes per week: I (I hour)	Lab per Week: I (II hours)
5. Open Elective: "Introduction to Digital Humanities"	Semester III/IV/V	Prerequisites for the Elective: None	Credit-3	Full Marks: 100	Classes per week: 3 (3 hours)	

Tanushree Panigrahi

Proposed Detail Syllabus for Semester I , II and III/IV

Semester I

Communication Skills I: English for Communication

Credit-2

B. Tech

All Branches

Course Objectives

a. To obtain a basic understanding of how human communication works
b. To obtain a general knowledge of the basic theories of human communication, their origin, and their proponents
c. To Develop an understanding of the various models of communication
d. To obtain a general knowledge of the various contexts of human communication and how they differ from each other: interpersonal, small group, organizational, intercultural and business
e. To develop an understanding of the processes of Oral and Written communication in English
f. To learn how to communicate effectively in English with others of varying professions, beliefs and values and in a variety of contexts
g. To develop listening skills
h. To develop analytical skills
i. To develop critical thinking skills

Course Outcomes

a. Students will improve their speaking ability in English both in terms of fluency andcomprehensibility.
b. Students will improve their accuracy and fluency in producing and understanding spoken and written English.

Tanushree Bhojwani

c. Students willdevelop their abilities in grammar, oral skills, reading, writing and study skills.
d. Students will attain and enhance competence in the four modes of language learning: writing, speaking, reading and listening.
e. Students will heighten their awareness of correct usage of English in writing and speaking and use them in specific communicative contexts.
f. Studentswill become a more competent, efficient, and perceptive academic reader who is able to communicate to others through writing and speaking the contents and main ideas of what is read.
g. Students will develop abilities as critical thinkers, readers and writers.
h. Students will learn to be sensitive, respectful and ethical communicators.
i. Students will develop public speaking abilities both informally and formally.
j. Students will develop self-awareness about the English language and the culturally-bound conventions of International academic and professional speaking and writing.
k. Students will learn to present ideas clearly and logically to achieve a specific purpose and to be appropriate for an intended audience.

Detail Syllabus

Module -I: Introduction to Communication

- Definition, Nature and Scope of Communication
- Importance and Purpose of Communication
- Process of Communication
- Models of Communication and Types of Communication
- Components of Communication
- Issues in Communication: Registers, Dialects, Home Language Influence and Interference and Bias free Communication
- Verbal and Non-verbal Communication

Module -II: Effective Communication

- Essentials of Effective Communication
- Communication Techniques
- Barriers to Communication
- Language for Communication
- Communication in English and Its Importance
- Age of Globalization and the Need for Communicating in English
- Uses of English in academic and professional situations

Module -III: Oral and Written Communication in English

- Difference between Speech and Writing
- International Phonetic Alphabet (IPA) Symbols
- Stress and Intonation
- English Pronunciation
- Writing Principles

Tanushree Pajnaki

- English Grammar for Communication
- Communication in Context: Speech and Writing

Semester II

Communication Skills II: Professional English

Credit-2

B. Tech

All Branches

Course Objectives

a. To develop communication skills in a professional/business context and to provide an overview of the prerequisites to Business Communication
b. To provide an outline to effective Organizational Communication and to underline the nuances of Business communication
c. To impart the correct practices of the strategies of Effective Business reading, speaking and writing
d. To introduce students to problem-solving, critical thinking, and professional communication through integrated skills. The emphasis is on how to use formal vocabulary and expressions in business-related environments both orally and in written form.
e. To enable students to manage and actively participate in business communication activities like meetings, discussions, presentations and debates
f. To enable students to express opinion, tendencies, cause and effect, and reasons; provide suggestions and recommendations and talk about advantages and disadvantages
g. To make them write descriptions, definitions, e-mails, memos, reports, business and information letters etc.
h. To enable the students toengage in telephone conversations with English-speakers, negotiate with English-speaking clients and customers and to give clear and compelling presentations and project updates to them
i. To develop in students productive skills through group/pair work, presentations, discussions, and role-plays etc.

Course Outcomes

Taantrushee Panigrahi

a. Students will develop improved reading comprehension, writing, and grammar skills; business vocabulary development and understanding of current global business culture.
b. Students will develop language skills for business management and marketing through role-playing, group, discussions, negotiations, oral interviews, and oral presentations.
c. Students will develop basic skills to deal with people in business situations
d. Students will increase their knowledge of key business concepts worldwide, expand vocabulary related to general business situations develop confidence to deal with people and basic issues in the business world.
e. Students will interpret and present information in graphs and charts.
f. Students will describe statistical trends and products.
g. Students will write and read business reports, faxes, and memos, proposals, letters, press documents, resumes, applications and other professional business scripts.
h. Students will prepare and formulate questionnaires/questions.
i. Students will categorize and use formal and informal registers in business/profession
j. Students will discuss, brainstorm, and evaluate ideas by listening and taking notes.
k. Students will listen and read for specific information, gist, key ideas, general ideas and understand implied ideas.

Detail Syllabus

Module I: Professional English Basics

- Professional English: Definition, Scope, Extent & Coverage, Dimensions and Limitations
- Professional English and Business English
- Business Communication in English
- Types, Patterns and Forms of Business Communication
- Business Communication Approaches: Direct and Indirect, Objective, Clear and Simple
- Oral and written Business Communication
- Role of Non-verbal Communication

Module II: Oral Business Communication in English

- Principles of Business Speaking
- Importance of Pronunciation and Right Speech
- Presentation Strategies: Analysis of situation and locale,Audience, Modulating Style & Content
- Speaking with confidence: Kinesics, Paralinguistic features of Voice-Dynamics like Pitch, Intonation, Stress & Rhythm
- Various Work-place Communications: Meetings, Interviews, Press Conferences, Conversations and Dialogues

Tanushree Ranjan

- Effective Listening in Business Communication
- Use of Appropriate Technology

Module-III: Written Business Communication in English

- Basic Business Writing Principles: Sentence Structure, Phrases & Clauses in Sentences, Coherence, Cohesion, Unity, Emphasis in Writing and Devices
- Writing Methods and Styles: Inductive, Deductive, Exposition, Linear, Spatial & Chronological etc.
- Writing Process: pre-writing, drafting, re-writing
- Various Work-place Communications: OfficialLetters, Memos, Reports, Proposals, Press Release, Agenda and Minutes of Meeting etc.
- Common Grammatical Errors: Subject-verb agreement, Correct Usage of Nouns, Pronouns, Agreement, Modifiers,Articles, Prepositions, Cliches and Redundancies
- Referencing
- Punctuations

Suggested Lab Activities: Semester I/II

Practice Exercises Oral/Written Business Communication Practice Syllabus

The Communication practices are oriented to practices of the prescribed modules. The faculty will design exercises following the prescribed guidelines mentioned below to improve and refine the communication skills of the students. The list below is suggestive and not exhaustive.

Communication Skills in Semester I will focus on General Communication using English language and Semester II on Professional/Business Communication using English language both oral and written. The practice outcomes include the following:

a. Linguistic and communicative proficiency in General/Business English
b. Interpretive Mode of Communication
c. Presentational Mode of Communication
d. Negotiation and influence mode of communication
e. Cultural communication in business
f. Interpersonal mode of communication
g. Critical Thinking Skills
h. Writing ability to generate relevant and sufficient content
i. Ability to organize his or her thoughts coherently in writing
j. Ability to adhere to the conventions of correct mechanics and sentence structure Ability to use correct terminology and rich vocabulary Practice Exercises/ Guidelines

1. Practice of the modules through role play and simulation exercises in many creative ways can be adopted by the faculty.

2. Presentations of ideas, concepts, cases, examples and discourses on communication

3. Expression and interpretation of business English through cases, role play, group discussions and visuals

4. Listening to a List of Recordings/online exercises/books. The resource may include the following list. The faculty can choose one or several of them and guide the students how to use the resource:

1. *A Communicative Grammar of English* by Geoffrey Leech
2. *English Pronunciation* by J.D. O'Connor (BBC)
3. *Listen and Read with Peter and Molly* by G. Bronghton (BBC)
4. *Stress, Rhythm and Intonation* by J.D. O'Connor (BBC)
5. *Pronunciation Practice* (BBC)
6. *What to Say by Viola Hughes* (BBC)
7. *Keep Up your English* by W. Stannard Allen (BBC)
8. *Getting On in English* by John Haycraft and Jo Barnett (BBC)
9. *Choosing your English* by John Haycraft and Terence Creed (BBC)
10. *The Play's the Thing* (BBC)
11. *The English Teaching Theatre* (BBC)
12. *Countdown to English* by Roger Owen (BBC)
13. *Better Spoken English* by Geoffrey Bernard (Macmillan)
14. *Say It Again* by Chris Faram and John Wright (BBC)
15. *Exercises in Spoken English: Accent, Rhythm, Intonation* (CIEFL, Hyderabad)
16. *English Course* (The Linguaphone Institute)
17. *Advanced English Course* (The Linguaphone Institute)
18. *American English Course* (The Linguaphone Institute)

5. English for Specific Purposes (Sets of Textbooks/ and Listening materials). Students will read and listen from these sources in the practice sessions.

a. *The Language of Business* by Angela Mack (BBC)

b. *English for International Co-operation* by Peter Roe (BBC)

c. *Scientifically Speaking* (BBC)

Tanushree Pajnali

d. *Project Aftermath* by Tim and Sue Hodlin (BBC)

e. *Export English* by Susan Norman (BBC)

f. *Going to Work in English* by Susan Norman and Chris Faram (BBC)

g. *The English Language Laboratory Drills for Students of Science and* Technology by G. Mauger

6. Write various business communication forms prescribed in the modules that include:

- Memos
- Letters
- Reports
- Proposals
- Minutes
- Agenda
- Press release
- Emails

7. Group Writing Projects (topics related to syllabus)

8. Individual Writing Projects (topics related to syllabus)

9. Writing mechanics and referencing

10. Bibliography

Semester III/IV

Communication Skills III:Critical Reading and Communication

Credit-2

B. Tech

All Branches

Course Objectives

a. To develop critical reading ability and the ability to link critical reading to critical thinking

b. To develop the ability to recognize the explicit and implicit features available in the texts

c. To be able to identify and analyse:

- Figurative language
- Intentions
- Attitude and tone
- Ambiguity
- Deep layer meanings

d. To be able to value conflicts, judgments and assumptions
e. To be able to develop contrasting perspectives
f. To be able to accurately assess differences and similarities in point of view
g. To be able to connect reading skills with effective communication

h. To be able to identify techniques for strengthening vocabulary

i. To be able to use reading material/input in communication

Course Outcomes

i. Students will be able to read a variety of authentic college level readings: academic prose, literary forms, journalistic articles, biographies and scientific readings, and respond thoughtfully and critically, by drawing connections between personal experience, world knowledge and/or other sources (lectures, readings, films) and the assigned text.
ii. Students will be able to expand vocabulary through practice.
iii. Students will be able to distinguish between definitions and any accompanying negative and/or positive connotations and use those to help determine facts, opinions, blended statements or an author's bias.
iv. Students will be able to refine their communication skills on the basis of their learning to read critically and gather a huge amount of comprehensible input.
v. Students will be able to read analytically and think critically at a higher level and demonstrate the ability to transfer critical thinking skills to the interpretation and analysis of ideas encountered in academic reading.
vi. Students will be able to demonstrate their ability to collect, organize and evaluate relevant evidence necessary to make decisions, solve problems and/or develop convincing, supported and well-founded conclusions on issues related to them.

vii. Identify the common types of support in arguments, their relevance or irrelevance, common argument flaws, opposing points of views, and refutations.

Detail Syllabus

Module-I: The Importance of Reading and Its Principles

- The importance of developing Critical Reading skills
- Strategies of Critical Reading: Previewing, Annotating, Summarizing, Analysing, Re-reading and Responding

Tavantrishaa Vaijnathi

- The importance of Textual Analysis
- To understand the relation between reading and a text: Passive or Interactive
- Understanding the following sub-skills of reading:
    - Understanding the main idea and supporting details
    - Reading between the lines: inferential reading
    - Understanding the writer's point of view
    - Making Predictions
    - Guessing the meanings of unfamiliar words
    - Skimming and scanning
    - Note-making
    - Linking Critical Reading to effective communication both general and business

Module-II: Critical Reading and Communication

- Analysing Literature: Introduction to the language of literary texts
- Facilitating Critical Thinking through literature
- Using Literature to develop sensitivity to life's values
- Style in Literary Texts
- Connecting various usages and expressions to speech and written communication
- Communication and the use of Language and expressions

Module-III: Texts for Critical Reading

I. *Spoken English and Broken English* by G.B. Shaw
II. *Notes on the English Character* by E. M. Forster
III. *The Fly* by Katherine Mansfield
IV. *A Snake in the Grass* by R.K. Narayan
V. *Lajwanti* by Rajinder Singh Bedi
VI. *The Night Train at Deoli* by Ruskin Bond
VII. *Stigma, Shame and Silence* by Kalpana Jain
VIII. *The Dog of Titwal* by Saadat Hasan Manto
IX. *A Gandhian in Garhwal: Chandi Prasad Bhatt* by Ramachandra Guha
X. *Two Friends* by Guy De Maupassant
XI. *The Generation Gap* by Benjamin Spock
XII. *The Money Box* by Robert Lynd
XIII. *Mass Production* by G.C. Thornley
XIV. *India's Contribution to World Unity* by Arnold Toynbee
XV. *Film Making* by Satyajit Ray
XVI. *The Secret of Work* by Swami Vivekananda

Reading List

1. *Critical Reading Critical Thinking: Focusing on Contemporary Issues*by Richard Pirozzi,Gretchen Starks-Martin and Julie Dziewisz
2. *Critical Reading: English for Academic Purposes* by Tania Pattison
3. *Interpretation and overinterpretation* by Umberto Eco
4. *The Reading of Theoretical Texts. A Critique of Criticism in the Social Sciences* by P. Ekegren

Tarunshree Pujari

Hatapally

ENGINEERING CHEMISTRY

Course Objective:

Chemistry has an important role to play in achieving a sustainable civilization on earth. Each engineer will use directly/indirectly several objects/ materials/equipments in various filed. A sound knowledge in chemistry helps them to understand the properties as well as how to handle them to get the best service.

Module-1

Structure and Bonding: (8 Lectures)

Black-body radiation, photoelectric effect, Bohr's theory of hydrogen atom and de Broglie waves (Pre-Quantum theory). The Schrödinger equation and its variants, time dependent and time independent forms. MO Theory - LCAO-MO, bonding and anti-bonding orbital, bond order, magnetism; electronic structure of diatomic molecules.

Phase Rule: (5 Lectures)

Explanation of terms, One and Two Component System: H2O, S and Cd-Bi, Fe-C System

Module-2

Reaction Kinetics: (8 Lectures)

Order and molecularity of reactions, Zero order, first order and second order reactions. Integrated Rate equations, Theories of Reaction rates: collision theory, Transition – state theory, Dependence of temperature on reaction rates. Arrhenius theory, Homogeneous & Heterogeneous catalysis (a general idea)

Fuels & Combustion: (6 Lectures)

Classification of fuel, Calorific value: types and its determination by Bomb calorimeter, Dulong's Formula, Analysis of Coal, Proximate and Ultimate analysis, Flue gas analysis, Significance, Carbonization of Coal, Combustion calculations.

Module -3

Thermodynamics and Chemical Equilibrium: (6 Lectures)

Heat, work and energy, reversible and irreversible processes, work done in an isothermal reversible expansion of ideal gas, measurement of enthalpy and Heat Capacity: thermo chemical calculation.

2nd law of thermodynamics, Entropy, The free energy Concepts: application to gases. Gibbs Helmholtz equation: free energy change and criterion of spontaneity of chemical reactions and chemical equilibrium.

Module-4

Introduction to polymers (7 Lectures)

Polymeric materials: Historical development of polymers, classification and nomenclature of polymers: Homo polymers, copolymers, block copolymers, Polymer structures: Linear, branched and cross-linked polymers, tacticity, properties & applications of some commodity and engineering polymers.

Suggested Text Books:

1. Principles of Physical Chemistry by Puri, Sharma and Pathania by Vishal Publishing &CO (4th Edition)
2. Physical Chemistry by P.W. Atkins, by Oxford university (5th / 6th Edition)
3. Theory & Practicals of Engineering chemistry by Shashi Chawla by Danpat Rai &Co (3rd Edition)
4. Physical chemistry, A molecular approach by McQqarrie Simon by University Science Books (2nd Edition)
5. Engineering Chemistry by Jain and Jain (15th Edition).
6. Physical Chemistry-Thomas Engel, Philip Reid by Pearson Education (2nd Edition)
7. Physical Chemistry by G.M. Barrow, Tata McGraw Hill, (6th Edition)
8. Polymer Science and Technology by Joel R Fried, Pearson (3rd Edition)

Hatapathy

Course outcome:

By the end of this course, students will be able to

- Develop a sense of history of scientific thinking, knowledge of why/why not existence of compounds/molecules
- Diagnose chemical reaction, rate of progress and control over it
- Explain how and why about feasibility of a process
- Identify certain physical and chemical properties of various materials they come across
- Analyze the handling and service limit of different materials
- Development of sound knowledge on synthesis, properties and application of some commonly used polymers in daily life.

Chemistry Laboratory Syllabus

(Any ten experiments may be done)

1. Determination of amount of sodium hydroxide and sodium carbonate in a mixture.
2. Determination of total hardness of water by EDTA method.
3. Estimation of calcium in limestone.
4. Determination of percentage of available chlorine in a sample of bleaching powder.
5. Preparation of buffer solution and determination of pH of a buffer solution.
6. Standardization of KMnO4 using sodium oxalate.
7. Determination of Ferrous iron in Mohr's salt by potassium permanganate.
8. Determination of rate constant of acid catalyzed hydrolysis reaction.
9. Determination of concentration of a colored substance by spectrophotometer.
10. Determination of dissolved Oxygen in a sample of water.
11. Determination of Viscosity of lubricating oil by Red wood viscometer.
12. Determination of Flash point of given oil by Pensky Marten's flash point approach.
13. Polymerization of resorcinol and formaldehyde in an acidic medium takes place.
14. Dyeing of cotton silk and wool using malachite green.
15. Determination calorific value of a solid fuel by bomb calorimeter.
16. Glyptal Resin Plastic (Thermoset Polymer)"