VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING & TECHNOLOGY HYDERABAD
B.TECH. I YEAR
(EEE, ECE and EIE)

I SEMESTER **R18**

Course Code	Title of the Course	L	T	P/D	Contact Hours/ Week	Credits
18BS1MT01	Advanced Calculus	3	1	0	4	4
18BS1CH01	Engineering Chemistry	3	1	0	4	4
18HS1EN01	English	2	0	0	2	2
18ES1CS01	Programming through C	3	0	0	3	3
18BS2CH01	Engineering Chemistry Laboratory	0	0	3	3	1.5
18HS2EN01	English Language Communication Skills Laboratory	0	0	2	2	1
18ES2CS01	Programming through C Laboratory	0	0	4	4	2
18ES2ME01	Workshop Practices	1	0	3	4	2.5
Total		**12**	**2**	**12**	**26**	**20**
18MN6HS01	Induction Programme	**-**	**-**	**-**	**-**	**-**

II SEMESTER **R18**

Course Code	Title of the Course	L	T	P/D	Contact Hours/ Week	Credits
18BS1MT03	Linear Algebra, Ordinary Differential Equations and Laplace Transforms	3	1	0	4	4
18BS1PH02	Engineering Physics	3	1	0	4	4
18ES1EE01	Basics of Electrical Energy for Engineers	3	1	0	4	4
18ES3ME02	Engineering Drawing	1	0	4	5	3
18BS2PH02	Engineering Physics Laboratory	0	0	3	3	1.5
18ES2EE01	Basic Electrical Engineering Laboratory	0	0	3	3	1.5
18PW4EE01	Design Sensitization	0	0	2	2	1
Total		**10**	**3**	**12**	**25**	**19**

L – Lecture T – Tutorial P – Practical D – Drawing

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING & TECHNOLOGY

B.Tech. I Semester– Common to all branches	**L**	**T/P/D**	**C**
	3	**1**	**4**

(18BS1MT01) ADVANCED CALCULUS

COURSE PREREQUISITES: None

COURSE OBJECTIVES: To learn
- Geometrical Approach to the mean value theorems and their application to the mathematical problems.
- Concept of Sequence and Series
- Evaluation of improper integrals using Beta and Gamma functions
- Evaluation of multiple integrals and their applications
- Basic properties of vector point function and their applications to line, surface and volume integrals

COURSE OUTCOMES: Students will be able to
CO-1: Solve problems involving mean value theorems
CO-2: Analyze the nature of convergence of sequence and series
CO-3: Evaluate integrals using special functions and change of variables
CO-4: Evaluate double and triple integrals
CO-5: Transform line integral to surface and surface to volume integrals

UNIT-I: Calculus of Single and Several Real Variables
Mean value theorems – Rolle's Theorem, Lagrange's Mean value theorem Cauchy's Mean value theorem, Taylor's expansion and McLaurin's expansion of functions (without proofs). Partial differentiation, partial derivatives of first and second order in terms of partial derivatives, change of variables, Jacobian, Taylor's theorem of two variables (without proof). Maxima and Minima of two variables, Lagrange's method of undetermined multipliers.

UNIT-II: Sequences and Series
Sequence: Definition of a Sequence, limit; Convergent, Divergent and Oscillatory sequences. Series: Convergent, Divergent and Oscillatory Series; Series of positive terms; Comparison test, p-test, D-Alembert's ratio test; Raabe's test; Cauchy's Integral test; Cauchy's root test; logarithmic test. Alternating series: Leibnitz test; Alternating Convergent series: Absolute and Conditionally Convergence, Power series.

UNIT-III: Improper Integrals
Definition of Improper Integral: Beta and Gamma functions, Relation between the Beta and Gamma functions (without proof) and their applications, Standard forms of beta functions.

UNIT-IV: Multiple Integrals
Evaluation of Double Integrals (Cartesian and polar coordinates); change of order of integration (only Cartesian form); Evaluation of Triple Integrals: Change of variables

(Cartesian to polar) for double and (Cartesian to Spherical and Cylindrical polar coordinates) for triple integrals. Applications: Areas (by double integrals) and volumes (by double integrals and triple integrals).

UNIT-V: Vector Differential Calculus

Vector point functions and scalar point functions. Gradient, Divergence and Curl. Directional derivatives, Tangent plane and normal line. Vector Identities (without proofs). Scalar potential functions. Solenoidal and Irrotational vectors.

UNIT-VI: Vector Integral Calculus

Line, Surface and Volume Integrals. Theorems of Green, Gauss and Stokes (without proofs) and their applications.

TEXT BOOKS:

1. Advanced Engineering Mathematics-Erwin Kreyszig, 9th edition; Publisher: John Wiley
2. Higher Engineering Mathematics – B.V. Ramana; Publisher: Tata McGraw Hill, New Delhi,11th Reprint-2010

REFERENCES:

1. Calculus and Analytic Geometry - Thomas and Finney, 9th edition; Publisher: Pearson Education, 2002.
2. Higher Engineering Mathematics - B.S. Grewal, Publisher: Khanna, 36th Edition-2010.
3. Elementary Analysis: The Theory of Calculus - Kenneth Ross; Publisher: Springer.
4. Advanced Engineering Mathematics - Peter 'O' Neil, Publisher: Cengage Learning

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B.Tech. I Semester– Common to all branches	**L**	**T/P/D**	**C**
	3	**1**	**4**

(18BS1CH01) ENGINEERING CHEMISTRY

COURSE PREREQUISITES: None

COURSE OBJECTIVES:

- List out the importance of polymers, surfactants and lubricants in real world scenario.
- Outline the features of conventional and non-conventional sources of energy.
- Discuss the problems of corrosion on structures to interpret the need of alloys and describe the thermodynamic equilibrium of a system using phase rule.
- Emphasize the importance of nanomaterials, analytical techniques, environmental and green chemistry.

COURSE OUTCOMES: After the completion of the course, student will be able to:

CO-1: Identify & recognize the role of polymers, surfactants and lubricants in various fields.

CO-2: Rationalize ideas about alternate sources of energy so as to reduce load on fossil fuels.

CO-3: Summarise the effects of corrosion to indicate the use of alloys and predict the behaviour of a system under different variables.

CO-4: Familiarize with the role of nanomaterials, environmental & green chemistry and assess the use of analytical techniques.

UNIT-I: Polymers

Polymers-Definition, types of polymerization-addition, condensation and copolymerization, Properties of polymers- crystallinity, melting point and glass transition, viscoelasticity, solubility of polymers. Fabrication of polymers (compression, extrusion, blowing and thermoforming). Synthesis, properties and uses of PET, PTFE, PMMA, polycarbonate, Bakelite and urea formaldehyde. Conducting polymers-definition, classification and applications, Dendrimers-definition, features, applications. FRPs and their applications.

UNIT-II: Surfactants and Lubricants

Surfactants: Types of surfactants, cleaning mechanism, hydrophobic and hydrophilic interactions, micelles, reverse micelles and critical micelle concentration. Detergents and their role as cleaning agents.

Lubricants-Definition, types, mechanism of lubrication-thick film lubrication, thin film lubrication and extreme pressure lubrication. Additives and selection of lubricants. Properties-viscosity, cloud and pour point, flash and fire point, saponification number-definition and significance.

UNIT-III: Energy Science

Fuels: Definition, classification, characteristics of a good fuel. Coal-proximate & ultimate analysis-significance. Petroleum- refining, knocking, octane number, cetane number.

Cracking-definition, types of cracking, fluid-bed cracking. Limitations of fossil fuels. Alternative and non-conventional sources of energy – solar, wind, geothermal, nuclear and biomass (advantages and disadvantages).
Battery Technology: Features of batteries, Rechargeable batteries- lithium ion and Zn-air batteries. Fuel cells-methanol-oxygen fuel cell, Solar cells- principle and applications.

UNIT-IV: Alloys and Corrosion
Alloys: Purpose of making alloys, classification of alloys, ferrous alloys ex: Steel, non-ferrous alloys ex: Cu, Al, Pb (features and applications).
Phase rule, definition of terms in phase rule, advantages and limitations of phase rule, simple phase diagram -water system.
Corrosion: Introduction, causes and effects of corrosion, chemical and electrochemical corrosion and mechanism of corrosion. Types-differential aeration corrosion (Pitting and waterline corrosion), differential metal corrosion (Galvanic corrosion). Factors affecting corrosion-nature of metal (position, passivity, purity, areas of anode and cathode) & nature of environment (temperature, pH, humidity). Corrosion control methods-proper designing, cathodic protection, differences between galvanizing and tinning, paints-constituents and functions.

UNIT-V: Nanomaterials and Analytical Techniques
Nanomaterials: Definition, synthesis-top down and bottom up approaches. Properties and application of fullerenes, fullerols and carbon nanotubes. Applications of nanomaterials in electronics, catalysis, telecommunication and medicine.
Analytical Techniques: Working principle and applications of pH-metry, conductometry, colorimetry, chromatography (TLC), Scanning tunneling microscope and atomic force microscope. Sensors: Lab-on-a-chip- features and applications.

UNIT-VI: Environmental and Green Chemistry
Air, water and noise pollution: sources and effects, optimum levels of pollution. Solid waste management and e-waste: effects and management.
Green Chemistry- Definition, principles and applications of green chemistry. Self-healing materials-principle and applications.

TEXT BOOKS:

1. Engineering Chemistry, by P. C Jain and M. Jain, Dhanpat Rai Publications, New Delhi, 16th Edition.
2. Engineering Chemistry, by Prasanta Rath, B. Rama Devi, Ch. Venkata Ramana Reddy, Subhendu Chakroborty, Cengage Publications, Delhi- 2018.
3. A Textbook of Engineering Chemistry by Shashi Chawla, Dhanpat Rai Publications, New Delhi.

REFERENCES:

1. Engineering Chemistry, by S. S. Dara, S. Chand & Company Ltd, New Delhi.
2. Engineering Chemistry by O.G. Palanna, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
3. Engineering Chemistry by B. Sivasankar, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
4. Introduction to Nanoscience, by S. M. Lindsay.

5. Introduction to Environmental Science, by Y. Anjaneyulu, BS Publications, Hyderabad.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING & TECHNOLOGY

B.Tech. I Semester– Common to all branches	**L**	**T/P/D**	**C**
	2	**0**	**2**

(18HS1EN01) ENGLISH

COURSE PREREQUISITES: None

COURSE OBJECTIVES:

- Enhance their vocabulary through the use of affixes/stem and learn technical vocabulary in specialist fields.
- Read and comprehend different kinds of texts (tone, tenor, sound, sense, diction, etc.- sub-skills)
- Write clear, concise, and correct sentences and paragraphs to produce appropriate technical prose
- Recognize and practice use the rhetorical elements necessary for the successful practice of scientific and technical communication

COURSE OUTCOMES: On completion of the course, the student will be able to

CO-1: Use vocabulary effectively and contextually**.**

CO-2: Employ reading skills to comprehend different kinds of texts. (tone, tenor, sound, sense, diction, etc.- sub-skills)

CO-3: Apply principles of critical thinking, problem solving, for clarity, conciseness and accuracy of expression in academic and professional communication

CO-4: Demonstrate improved competence in Standard Written English, including grammar, sentence and paragraph structure, coherence, and use this knowledge to accurately communicate technical information.

CO-5: Employ the appropriate rhetorical patterns of discourse in technical and business contexts for scientific and technical communication

UNIT-I:

1.	Reading:	On the Conduct of Life by William Hazlitt
2.	Speaking & Listening:	Pronunciation, Stress, Intonation and Rhythm
3.	Grammar:	Prepositions
4.	Vocabulary:	Word Formation- I
5.	Writing:	Punctuation**,** Clauses and Sentences
6.	Life Skills:	Values and Ethics; 'If' by Rudyard Kipling

UNIT-II:

1.	Reading:	The Brook by Alfred Tennyson
2.	Speaking & Listening:	Introducing oneself and others, making announcements
3.	Grammar:	Articles
4.	Vocabulary:	Word Formation**-** II
5.	Writing:	Principles of Good Writing-Coherence, Cohesion
6.	Life Skills:	Self Improvement; How I Became a Public

Speaker by G.B. Shaw

UNIT-III:

1. Reading: The Death Trap by Saki
2. Speaking & Listening: Gaining attention, Interrupting Conversations
3. Grammar: Noun-Pronoun Agreement; Subject-Verb Agreement
4. Vocabulary: Word Formation**-** III
5. Writing: Transitional Devices & Paragraph Writing; Writing Process
6. Life Skills: Time Management; On Saving Time by Seneca

UNIT-IV:

1. Reading: Chindu Yellamma
2. Speaking & Listening: Making Requests and Responding to them; Extended Listening
3. Grammar: Misplaced Modifiers
4. Vocabulary: Synonyms and Antonyms
5. Writing: Writing a Summary
6. Life Skills: Innovation; Muhammad Yunus

UNIT-V:

1. Reading: Politics and the English Language by George Orwell
2. Speaking & Listening: Interview Skills; Making a Presentation
3. Grammar: Cliches; Redundancies
4. Vocabulary: Common Abbreviations
5. Writing: Cause and Effect Paragraphs
6. Life Skills: Motivation; The Dancer with a White Parasol by Ranjana Dave

UNIT-VI:

Organizational Patterns for writing

1. Patterns of Writing: Comparison and Contrast
2. Patterns of Writing : Classification Paragraph
3. Patterns of Writing: Problem-Solution Pattern of writing

TEXT BOOK:

1. Language and Life : A Skills Approach by Orient Black Swan

RECOMMENDED BOOKS:

1. Technical Communication, Meenakshi Raman & Sangeeta Sharma, Oxford University Press
2. Effective Communication Skills, Kulbushan Kumar, Khanna Publishing House, Delhi
3. Communication Skills, Pushplata, Sanjay Kumar, Oxford University Press
4. Longman Dictionary of Common Errors by N.D. Turton and J.B. Heaton

SUGGESTED READINGS:

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. On Writing Well. William Zinsser. Harper Resource Book. 2001
4. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
7. Rhetorical Grammar: Grammatical Choices, Rhetorical Effects (7th ed.), Martha Kolln & Loretta Gray. New York: Longman, 2012. ISBN-10: 0321846729; ISBN-13: 978-0321846723
8. Longman Dictionary of Common Errors.(Nigel D. Turton & J. B. Heaten)

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B.Tech. I Semester– Common to all branches	**L**	**T/P/D**	**C**
	3	**0**	**3**

(18ES1CS01) PROGRAMMING THROUGH C

COURSE PREREQUISITES: None

COURSE OBJECTIVES:

- **Relate** basics of programming language constructs and problem solving techniques
- **Classify** and implement derived data types
- **Analyze** and develop effective modular programming
- **Construct** mathematical problems and real time applications using C language

COURSE OUTCOMES: At the end of course, the student will learn

CO-1: To translate the algorithms to programs (in C language).

CO-2: To decompose a problem into functions and synthesize a complete program using divide and conquer approach.

CO-3: To use arrays, pointers and structures to formulate algorithms and programs.

CO-4: To apply programming to solve simple numerical method problems, namely root finding of function, differentiation for function and simple integration.

UNIT-I: Introduction to Programming

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.). Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flow chart / Pseudo code with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, syntax and logical errors in compilation, object and executable code .Arithmetic expressions and precedence

UNIT-II: Conditional Branching and Loops

Writing and evaluation of conditionals and consequent branching Iteration and loops Arrays (1-D, 2-D), Character arrays and Strings

UNIT-III: Basic Algorithms

Searching, basic sorting algorithms (bubble, insertion and selection), finding roots of equations, notion of order of complexity through example programs (no formal definition required)

UNIT-IV: Functions

(Including using built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference.

Recursion: Recursion, as a different way of solving programs. Example programs, such as finding factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT-V: Structures
Defining structures and array of structures.
Pointers: idea of pointers, defining pointers, use of pointers in self-referential structures, notation of linked list (no implementation), dynamic memory allocation.

UNIT-VI: File Handling
Basic concepts, text files and binary files, file input/output operations, random access of files, command line arguments.

TEXT BOOKS:
1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill.
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.

REFERENCES:
1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.

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B.Tech. I Semester– Common to all branches	**L**	**T/P/D**	**C**
	0	**3**	**1.5**

(18BS2CH01) ENGINEERING CHEMISTRY LABORATORY

COURSE PREREQUISITES: None

COURSE OBJECTIVES:

1. To practically learn the preparation of standard solutions and estimate hardness & chloride content so as to check its suitability for various purposes.
2. To determine the rate constant of a reaction and check the variation of concentrations with respect to time.
3. To measure properties like adsorption, absorption of light, conductance, viscosity, pH and surface tension.
4. To synthesize a polymer and to separate a mixture of organic compounds by Thin Layer Chromatographic (TLC) technique.

COURSE OUTCOMES: The students will gain skills

CO-1: To record the amount of hardness and chloride content in water and interpret the significance of its presence in water.

CO-2: To analyze the influence of variation of concentration with time on rate constant.

CO-3: To report and predict the significance of properties like absorption of light, adsorption, conductance, viscosity, pH and surface tension.

CO-4: To demonstrate the technique of Thin Layer Chromatographic (TLC) and preparation of a polymer.

1. Estimation of hardness of water by complexometric method using EDTA.
2. Determination of chloride content in the given sample water using Argentometric method.
3. Determination of the rate constant of hydrolysis of ester.
4. Verification of Freundlich/Langmuir isotherm for adsorption of acetic acid on charcoal.
5. Estimation of copper present in the given solution by colorimetric method.
6. Conductometric titration of Acid vs Base.
7. Determination of viscosity of sample oil by Redwood Viscometer-I.
8. Determination of pH of various sample solutions by pH meter.
9. Determination of R_f value of organic compounds in a mixture by Thin Layer Chromatography.
10. Determination of surface tension of a liquid by drop method using Stalagmometer.
11. Titration of Acid vs Base using pH metric method.
12. Synthesis of a Polymer-Bakelite/Nylon.

TEXT BOOKS:

1. Laboratory Manual on Engineering Chemistry by S.K. Bhasin and Sudha Rani; Dhanpat Rai Publications.
2. College Practical Chemistry V.K. Ahluwalia, Sunitha Dhingra, Adargh Gulati, University Press Pvt. Ltd.
3. Practical chemistry by Dr. O. P. Pandey, D.N. Bajpai, and Dr. S. Giri; S. Chand Publications.

REFERENCES:

1. Vogel's Text book of Quantitative Chemical Analysis by G.N. Jeffery, J. Bassett, J. Mendham and R.C. Denny, Longmann, ELBS.
2. Advanced Practical Physical Chemistry by J.D. Yadav, Goel Publishing House.
3. Practical Physical Chemistry by B.D. Khosla, R. Chand and Sons.

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B.Tech. I Semester– Common to all branches	**L**	**T/P/D**	**C**
	0	**2**	**1**

(18HS2EN01) ENGLISH LANGUAGE COMMUNICATION SKILLS LABORATORY

COURSE PREREQUISITES: None

COURSE OBJECTIVES:

- Provide ample practice in LSRW skills and train the students in oral presentations, public speaking, role play and situational dialogue.
- Provide practice in vocabulary usage, grammatical construction, structural patterns, and improve comprehension abilities in the students.
- Train students to use neutral accent through phonetic sounds, symbols, stress and intonation.
- Enable students to transfer information from verbal to graphic representation and vice versa.
- Equip the learners to learn basic vocabulary of 3000 words. (as identified in Oxford or Cambridge dictionary).

COURSE OUTCOMES: After going through this course, the student will be able to
CO-1: Comprehend spoken and written discourse.
CO-2: Speak fluently with neutral accent and exhibit interpersonal skills.
CO-3: Write accurately, coherently and lucidly making appropriate use of words depending on context.
CO-4: Introduce oneself to people and be able to speak extempore.
CO-5: Should have learnt the basic vocabulary of 3000 words. (as identified by oxford/Cambridge advanced learners dictionary).

UNIT-I:

1. Introduction of Self and others
2. Listening Comprehension-Listening for details
3. Reading Skills- Skimming and Scanning

UNIT-II:

1. Role play-
   i) Expressing likes and dislikes;
   ii) Agreeing and disagreeing
   iii) Making requests (Using modals for polite requests)
   iv) Accepting and declining requests
2. Listening and note taking
3. Reading Skills - Intensive Reading and Extensive Reading

UNIT-III:

1. Extempore Speech : JAM
2. Accuracy in listening- listening to discussion on specific issues

3. Pronunciation, Intonation, Stress and Rhythm

UNIT-IV:
1. Speaking Activity: Oral Presentation
2. Accuracy in listening- listening to discussion on specific issues
3. Reading Comprehension

UNIT-V:
1. Speaking Activity: Book/Film Review
2. Reading Comprehension-Contextual Vocabulary
3. Passive Voice-Constructing the impersonal passive

UNIT-VI:
1. Writing Skills: Information Transfer
2. Definition of a Technical Term
3. Description of a Mechanism/Process

SUGGESTED READINGS:

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.
4. Cambridge or Oxford Dictionary.
5. Fowler's Modern English Usage-Revised by R.W. Burchfield

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B.Tech. I Semester– Common to all branches	**L**	**T/P/D**	**C**
	0	**4**	**2**

(18ES2CS01) PROGRAMMING THROUGH C LABORATORY

COURSE PREREQUISITES: None

COURSE OBJECTIVES:

- **Gain** a working knowledge of C programming to write modular, efficient and readable C programs by Identifying the structural elements and layout of C source code.
- **Declare** and **manipulate** single and multi-dimensional arrays of the C data types and derived data types like structures, unions.
- **Use** functions from the portable C library and to describe the techniques for creating program modules using functions and recursive functions.
- **Manipulate** character strings in C programs. Utilize pointers to efficiently solve problems

COURSE OUTCOMES: At the end of course, students will be able to
CO-1: Use various data types for a specified problem
CO-2: Design, implement, debug a given problem using appropriate language constructs
CO-3: Implement programs using modular approach, file I/O
CO-4: Solve a given problem using C language.

[The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.]

Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment.

Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures.

Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems etc., sum of series.

Tutorial 5: 1D arrays: searching, sorting:
Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and strings
Lab 6: Matrix problems, string operations.

Tutorial 7: Functions, call by value:
Lab 7: Simple functions.
Tutorial 8 and 9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 8 and 9: Programming for solving Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls.
Lab 10: Recursive functions.

Tutorial 11: Pointers, structures and dynamic memory allocation.
Lab 11: Pointers and structures

Tutorial 12: File handling
Lab 12: File operations.

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B.Tech. I Semester– Common to all branches	**L**	**T/P/D**	**C**
	1	**3**	**2.5**

(18ES2ME01) WORKSHOP PRACTICES

COURSE PREREQUISITES: None

COURSE OBJECTIVES:

- To know the different popular manufacturing process.
- To gain a good basic working knowledge required for the production of various engineering products.
- To provide hands on experience about use of different engineering materials, tools, equipments and processes those are common in the engineering field.
- To identify and use marking out tools, hand tools, measuring equipment and to work to prescribed tolerances.

COURSE OUTCOMES: After completion of the course, the student is able to:
CO-1: Exposure to Various types of manufacturing Process.
CO-2: Fabricate/make components from wood, MS flat, GI Sheet etc. – hands on experience.
CO-3: Exposure to manufacturing of machine components like fasteners, holes & threaded holes etc.
CO-4: Produce small devices / products /appliances by assembling different components.

Lectures & Videos:
1. Manufacturing Methods - Casting, Forming, Machining, Joining, Advanced Manufacturing Methods
2. CNC Machining, Additive Manufacturing
3. Fitting Operations & Power Tools
4. Electrical & Electronics
5. Carpentry
6. Plastic Moulding, Glass Cutting
7. Metal Casting
8. Welding (Arc Welding & Gas Welding), Brazing
9. Power Tools
10. Printed Circuit Boards

I. Carpentry

i. Cross lap joint
ii. Mortise & tenon joint

II. Fitting

i. Square fitting
ii. L-Fitting

III. Welding

i. Butt joint by arc welding
ii. Lap joint by arc welding

IV. Smithy

i. Making of Rectangular Tray from sheet metal.
ii. Making of U shaped component by black smithy

V. Electrical & Electronics

i. Single lamp connection & Stair case connection
ii. Translation of any tested / designed and tested circuits on a PCB.

VI. Machine Shop

i. Step turning on lathe
ii. Drilling & threading

TEXT BOOKS:

1. Workshop Manual by P. Kannaiah and K.L. Narayana; Publisher: Scitech.
2. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., ―Elements of Workshop Technology‖, Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Printed Circuit Boards: Design, Fabrication, and Assembly by R. S. Khandpur (McGraw-Hill Electronic Engineering)

REFERENCES:

1. Kalpakjian S. And Steven S. Schmid, ―Manufacturing Engineering and Technology‖, 4th edition, Pearson Education India Edition, 2002.
2. Gowri P. Hariharan and A. Suresh Babu, Manufacturing Technology – I‖ Pearson Education, 2008.
3. Roy A. Lindberg, ―Processes and Materials of Manufacture‖, 4th edition, Prentice Hall India, 1998.
4. Rao P.N., ―Manufacturing Technology‖, Vol. I and Vol. II, Tata McGraw Hill House, 2017.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING & TECHNOLOGY

B.Tech. II Semester– Common to EEE, ECE & EIE	**L**	**T/P/D**	**C**
	3	**1**	**4**

(18BS1MT03) LINEAR ALGEBRA, ORDINARY DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS

COURSE PREREQUISITES: Matrices, Differentiation and Integration

COURSE OBJECTIVES: To learn

- Concept of Rank of the matrix and its application to consistency of system of linear equations
- Concept of Eigen Values and Eigen Vectors.
- The methods of solving first order differential equations and learn about its applications to basic engineering problems.
- The methods of solving higher order differential equations and learn about its applications to basic engineering problems.
- Laplace transforms of standard function.

COURSE OUTCOMES: Students will be able to

CO-1: Find the rank of a matrix and to analyze the solution of system of linear equations.
CO-2: Calculate Eigen values and Eigen vectors.
CO-3: Formulate and solve the problems of first and higher order differential equations.
CO-4: Apply knowledge of differential equations to real world problems.
CO-5: Use Laplace transform as tool to solve problems.

UNIT-I: Linear Algebra-Matrices

Rank of a matrix by Echelon form and Normal form, System of linear equations; Consistency of Homogeneous and Non-Homogeneous equations.
Real and Complex matrices: Symmetric; Hermitian; Skew-Symmetric; Skew-Hermitian; orthogonal matrices; Unitary Matrices.

UNIT-II: Linear Algebra-Eigen values and Eigen vectors

Eigen values and eigenvectors and their properties (without proof), Diagonalization of matrices; Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton Theorem. Eigen values and vectors of complex matrices.

UNIT-III: First Order and First-Degree ODE

Differential equations of first order and first degree - Exact differential equation, Linear and Bernoulli differential equation , Applications of differential equations of first order and first degree - Newton's law of cooling, Law of natural growth and decay, Orthogonal trajectories.

UNIT-IV: Higher Order ODE with constants Coefficients

Second order linear differential equations with constant coefficients: Solution of Homogenous non homogeneous differential equations, Non-Homogeneous terms of the type e , sin (ax), cos (ax), polynomials in x, e V(x), x V(x).

UNIT-V: Ordinary Differential Equations with Variable Coefficients

Method of variation of parameters; Equations reducible to linear ODE with constant Coefficients: Legendre's equation, Cauchy-Euler equation. Series solutions of second order Ordinary Differential Equations, Singular point, Regular singular point, Frobineous Method.

UNIT-VI: Laplace Transforms

Laplace transform, Existence condition, Laplace transform of Elementary functions, Properties of Laplace transforms (Without Proofs), Laplace transform of special functions (Unit step function, Dirac delta function and Periodic function). Inverse Laplace transform and its properties, Convolution theorem (without proof) ant its applications, Solving linear differential equations using Laplace transform.

TEXT BOOKS:

1. Linear Algebra: A modern introduction- D. Poole, 2nd edition; Brooks/Cole-2005
2. Advanced Engineering Mathematics-Erwin Kreyszig, 9th edition; Publisher: John Wiley-2006.
3. Higher Engineering Mathematics – B.V. Ramana; Publisher: Tata McGraw Hil, New Delhi, 11th Reprint-2010.

REFERENCES:

1. Higher Engineering Mathematics- B.S. Grewal, Khanna publishers, 36th Edition-2010.
2. Differential Equations- S.L. Ross, 3rd Edition, Wiley India-1984.
3. Advanced Engineering Mathematics - Peter 'O' Neil, publisher: Cengage Learning.
4. Advanced Engineering Mathematics - R.K. Jain and S.R.K. Iyengar; Narosa Publications.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING & TECHNOLOGY

B.Tech. II Semester– Common to EEE, ECE, CSE, EIE & IT	**L**	**T/P/D**	**C**
	3	**1**	**4**

(18BS1PH02) ENGINEERING PHYSICS

COURSE PREREQUISITES: None

COURSE OBJECTIVES:

- To comprehend various phenomena of light- Interference and Diffraction.
- To understand the basic principles, working of lasers and optical fibers.
- To learn and enhance the basic concepts in quantum physics required to deal with behavior of particle.
- To understand behavior of an electron in a periodic potential in crystal.
- To understand various types of semiconductors and semiconductor materials.

COURSE OUTCOMES: After completion of the course, the student is able to

CO-1: Realize the importance of Interference in thin films, Fraunhofer diffraction.
CO-2: Analyze the lasing action of various laser sources and optical fiber materials.
CO-3: Elucidate the behavior of a particle quantum mechanically
CO-4: Classify solids based on band gap**.**
CO-5: Perceive formation of PN junction and importance of semiconductor materials

UNIT-I: Wave Optics

Superposition Principle, Coherence, Interference of light by wave front splitting and amplitude splitting; Interference in thin films by reflection, Newton's rings experiment by reflection- Calculation of wavelength, Farunhofer diffraction from a single slit, Double slit diffraction, Diffraction grating (Qualitative), and a circular aperture.

UNIT-II: Lasers

Introduction, Characteristics of Lasers, Spontaneous And Stimulated Emission Of Radiation, Meta Stable State, Population Inversion, Lasing Action, Einstein's Coefficients And Relation Between Them, Ruby Laser, Helium-Neon Laser, Semiconductor Laser, Application of Lasers in Science, Engineering and Medicine, Propagation of LASER through Optical Fiber- Total Internal Reflection.

UNIT-III: Principles of Quantum Mechanics

Introduction to Quantum Mechanics ,Waves and particles, de Broglie hypothesis, Matter waves, Davisson and Germer experiment, Heisenberg's uncertainty principle, Schrodinger Time independent Wave Equation, Physical significance of wave function, Particle in one dimensional infinite potential box.

UNIT-IV: Band Theory of Solids

Free electron theory of metals (Drude and Lorentz theory), Electrical conductivity and Ohm's law, Bloch's theorem for particles in a periodic potential, Kronig-Penney model (Qualitative only), E-K diagram and origin of energy bands. Types of electronic materials: metals, semiconductors, and insulators, Effective mass of an electron.

UNIT-V: Semiconductors

Intrinsic semiconductors- Carrier concentration, dependence of Fermi level on carrier-concentration and temperature, Extrinsic Semiconductors (Qualitative), Continuity equation-Carrier generation and recombination, Carrier transport: diffusion and drift currents, Hall Effect, Hall Experiment, Measurement of Hall mobility, Resistivity, carrier density using Hall effect.

UNIT-VI: Engineered Semiconductor Materials

Direct and Indirect band gap semiconductors, Formation of p -n junction, Energy diagram of diode, V-I characteristics of p-n junction diode, Working principle of LED, Working principle and V-I characteristics of Solar Cell – Parameters (short circuit current and open circuit voltage) extraction from I-V characteristics.

TEXT BOOKS:

1. Physics Vol.2 by Halliday, Resnick and Krane ;John Wiley &Sons
2. Engineering Physics by R.K.Gaur and S.L.Gupta; Dhanpat Rai and Sons
3. Introduction to Semiconductor Materials and Devices by M.S Tyagi, Wiley India.

REFERENCES:

1. A Textbook of Engineering Physics, Dr.M.N. Avadhanulu and Dr P.G. Kshirsagar, S.Chand & Company Pvt. Ltd.
2. A. Ghatak, "Optics", McGraw Hill Education, 2012.
3. Introduction to Solid State Physics by Charles Kittel (Publishers: John Wiley & Sons)
4. Engineering Physics, B.K.Pandey and S. Chaturvedi, Cengage Learning.
5. Concepts of Modern Physics- Arthur Beiser, Mc-Graw Hill Inc.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING & TECHNOLOGY

B.Tech. II Semester– Common to EEE, ECE, CSE, EIE & IT	**L**	**T/P/D**	**C**
	3	**1**	**4**

(18ES1EE01) BASICS OF ELECTRICAL ENERGY FOR ENGINEERS

COURSE PREREQUISITES: None

COURSE OBJECTIVES:

- To understand the use of Electrical Energy in different engineering fields
- To analyze electrical circuits using different network theorems
- To know the working & construction of electrical machines, converters and electronic components
- To identify different LT electrical installation components and know the safety standards

COURSE OUTCOMES: Upon the completion of course, students are able to

CO-1: Appreciate the role of Electrical Energy in various engineering branches and to use different electronic components for system modelling

CO-2: Get familiarised with different electrical components and to find their suitability in the relevant fields of engineering

CO-3: Find the compatibility of Electrical Machines and Power Converters to different systems with required back ground knowledge

CO-4: Know about Low Voltage Electrical Installation components and the safety norms

UNIT-I: Introduction to Electrical Energy & DC Circuits

The role of Electrical Energy in modern life and various engineering branches, Overview of electrical energy generation, Transmission, Distribution and Utilization, basic review of electrical potential and current, Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff's current and voltage laws, series parallel connections, analysis of simple circuits with DC excitation, concept of linearity – Superposition theorem, time response of series RL and RC circuits.

UNIT-II: Steady state A.C. Circuits

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

UNIT-III: Transformers and DC Machines

Role of Transformers in the fields of engineering, Transformer principle, Ideal and Practical Transformers, Equivalent circuit, Regulation and Efficiency, Auto Transformer, Three phase transformer connections (star- delta connections).

Basic Construction of DC machine, DC generator principle, Emf equation, DC motor principle, back emf, Load characteristics and speed control of separately excited dc motor.

UNIT-IV: Alternating Current Machines

Three phase induction motor, types, principle, torque-Slip characteristics, power flow diagram, Single phase induction motor-principle-Double Field Revolving Theory, Working principle of Synchronous generator, Stepper motor- Applications.

UNIT-V: Power Converters

Basics of AC to DC, DC to AC and DC to DC power converters - their necessity and applications in engineering (block diagram approach), UPS block diagram,

Electrical Installations: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB and MCCB-Types of Wires and Cables - Earthing - Types of Batteries, charging and discharging- Electrical Characteristics for Batteries - Elementary calculations for energy consumption, electrical safety standards.

UNIT-VI: Amplifiers, Transducers and Data Acquisition

Ideal operational amplifier, commercial IC 741 operational amplifier. Remote control and monitoring - Transducers, different types of transducers for measuring or sensing strain, temperature, acceleration, and light, examples. A/D and D/A converters, Data Acquisition and Control.

TEXT BOOKS:

1. Basic Electrical Engineering - D.P. Kothari and I.J. Nagrath, 3rd edition 2010, Tata McGraw Hill.
2. Basic Electrical Engineering - D.C. Kulshreshtha, 2009, Tata McGraw Hill.
3. Dr. P. Ramana, Dr. M. Suryakalavathi, Dr.G.T. Chandra Sekhar "Basic Electrical Engineering", S. Chand Technical Publications

REFERENCES:

1. Electrical and Electronics Technology, E. Hughes, 10th Edition, Pearson, 2010
2. Electrical Engineering Fundamentals, Vincent Deltoro, Second Edition, Prentice Hall India, 1989
3. Electrical and Electronics Measurements and Instrumentation, A.K. Sawhney, Dhanpat Rai & Co.
4. Fundamentals of Electrical Engineering, L.S. Bobrow, Oxford University Press, 2011
5. Engineering circuit analysis by William Hayt and Jack E. Kemmerly, Mc Graw Hill Company, 6th Edition

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING & TECHNOLOGY

B.Tech. I Semester– Common to EEE, ECE, CSE, EIE & IT	**L**	**T/P/D**	**C**
	1	**4**	**3**

(18ES3ME02) ENGINEERING DRAWING

COURSE PREREQUISITES: None

COURSE OBJECTIVES:

- Know the conventions used in Engineering Drawing and comprehend the tools to be used in AutoCAD software
- Understand the importance of engineering scales and curves
- Learn to use the orthographic projections for points, lines, planes and solids in different positions
- Understand the development of sections and isometric projections
- Create simple solid models of various domain applications

COURSE OUTCOMES: At the end of the course, student will be able to

CO-1: Apply the concepts of engineering curves in construction using AutoCAD

CO-2: Solve the problem of projections of points, lines, planes and solids in different positions using AutoCAD

CO-3: Solve the problems of Projections of solids and its positions using AutoCAD

CO-4: Solve the problems on Isometric Projections and its conversions using AutoCAD

Introduction to AutoCAD Software:

The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line, The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.

UNIT-I: Engineering Curves

Construction of Ellipse, Parabola and Hyperbola – General and Special methods; Cycloidal curves- Epicycloids and Hypocycloids.

UNIT-II: Orthographic Projections

Projections of Points & Straight Lines

Principles of Orthographic Projections - Conventions

Projections of Points in all positions; Projections of lines inclined to both the planes

UNIT-III: Projections of Planes

Projections of Planes- Surface Inclined to both the Planes

UNIT-IV: Projections of Regular Solids

Projections of Regular Solids inclined to both the Planes – Prisms, Pyramids, Cylinder and Cone

UNIT-V: Isometric Projections
Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and Compound Solids;

UNIT-VI: Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions
Introduction to solid modelling: Creation of simple solid models relevant to the domain.

TEXT 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. Narayana, K.L. & P. Kannaiah (2008), Textbook on Engineering Drawing, Scitech Publishers

REFERENCES:

1. AutoCAD Software Theory and User Manuals

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING & TECHNOLOGY

B.Tech. II Semester– Common to EEE, ECE, CSE, EIE & IT	**L**	**T/P/D**	**C**
	0	**3**	**1.5**

(18BS2PH02) ENGINEERING PHYSICS LABORATORY

COURSE PREREQUISITES: None

COURSE OBJECTIVES:

- To practically learn interaction of light with matter through physical phenomena like interference, diffraction and dispersion.
- To understand the periodic motion and formation of standing waves and know the characteristics of the capacitors and resistors.
- To study semiconductor devices
- To experience resonance phenomena
- To compare the experimental results with the class room learning.

COURSE OUTCOMES: After completion of the course, the student is able to

CO-1: demonstrate the optical phenomena with formation of Newton Rings, pure spectrum through prism and to evaluate grating parameters.

CO-2: illustrate periodic motion by measuring rigidity modulus of a material and discharging of a capacitor.

CO-3: asses the various characteristics semiconductor devices

CO-4: realize tangent law of magnetism and resonance phenomenon in Melde's and Sonometer experiment.

CO-5: correlate the experimental results with the class room learning

1. **Spectrometer:** To determine the dispersive power of given prism using spectrometer
2. **Diffraction Grating:** To determine the wavelength of given laser and grating parameters
3. **Diffraction at Single Slit:** To determine the width of given wire.
4. **Newton's Rings Experiment:** To determine the radius of curvature of given plano convex lens
5. **RC Circuit:** To determine the time constant of RC circuit
6. **Optical fiber:** To determine Numerical aperture and Acceptance angle of a given optical fiber cable.
7. **Energy band gap of Semiconductor:** To determine Energy band gap of a semiconductor diode
8. **Light Emitting Diode:** To study the V-I characteristics of LED
9. **Solar Cell:** To study the V-I characteristics of Solar cell
10. **AC frequency by Sonometer**: To measure frequency of A.C mains
11. **Stewart Gee's experiment:** To verify Biot - Savart's law
12. **Melde's experiment:** To determine the frequency of electrical vibrator using resonance phenomenon

REFERENCES:

1. Engineering Physics laboratory Manual/Observation by Physics Faculty of VNRVJIET.

2. Laboratory Manual of Engineering Physics by Dr. Y. Aparna & Dr. K. Venkateswara Rao, VGS Publications.
3. Engineering Physics Practicals by Dr. B. Srinivasa Rao, Keshava Vamsi Krishna and K.S. Rudramamba by Laxmi Publications Pvt. Ltd (University Science Press), second edition

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING & TECHNOLOGY

B.Tech. II Semester– Common to EEE, ECE, CSE, EIE & IT	**L**	**T/P/D**	**C**
	0	**3**	**1.5**

(18ES2EE01) BASIC ELECTRICAL ENGINEERING LABORATORY

COURSE PREREQUISITES: None

COURSE OBJECTIVES:

- To understand the construction of electrical equipment
- To recognize different circuit reduction techniques using theorems
- To practice the techniques to control and assess electrical machines
- To know different electric safety measures

COURSE OUTCOMES: Upon the completion of course, students are able to

CO-1: Identify different parts of electrical equipment and appreciate their purpose
CO-2: Apply different network theorems to solve complex electrical circuits
CO-3: Realize the compatibility of electrical machines in different engineering fields
CO-4: Control different electrical machines and evaluate their performance

PART – A

1. Demonstration of Safety Precautions, Measuring instruments and Electrical Components.
2. Identification of Ratings of resistors using color codes and Electrical circuit bread board practice
3. Demonstration of Cut-out sections of Electrical Machines.
4. Demonstration of LT Switchgear Components.
5. Demonstration of various converters and UPS.
6. Demonstration and study of Step response using Automatic Data Acquisition.

PART – B

1. Verification of KVL & KCL.
2. Verification of Superposition Theorem.
3. Time Response of RC and RL circuits.
4. Analysis of series RL, RC and RLC circuits
5. Load test on 1- φ Transformer
6. Speed control of DC shunt Motor.
7. Torque Speed Characteristics of Separately Excited DC motor.
8. Brake test on 3- φ Induction Motor.
9. Control of Synchronous generator voltage through its field excitation.
10. Constant Voltage and Constant Current charging of Batteries.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING & TECHNOLOGY

B.Tech. II Semester– Common to EEE, ECE & EIE	**L**	**T/P/D**	**C**
	0	**2**	**1**

(18PW4EE01) DESIGN SENSITISATION

COURSE PREREQUISITES: None

COURSE OBJECTIVES:

- To create awareness of design among students of engineering
- To motivate students to think of design before implementing an engineering project
- To teach a systematic approach to identifying and defining a problem before brainstorming for a solution
- To instill a sense of significance towards applying creativity to product and service design

COURSE OUTCOMES: Upon completion of this course, the student shall be

CO-1: Learn to identify design principles from an engineering perspective

CO-2: Cultivate sensitivity towards design aspects in objects made by engineers and non-engineers, which are typically used in daily life

CO-3: Understand and create visual design elements to communicate more effectively

CO-4: Construct clear problem statements, understand the importance of validation, and design services creatively

CO-5: Develop fundamental team skills: working in teams and managing teams, strategizing tasks, and streamlining activities pertaining to a project

Students' Responsibilities:

1. Students will form teams of 3–5 members each, while working collaboratively throughout the semester.
2. Students will present and report the tasks to the class and to the concerned faculty members and design experts, using their oral and written communication skills as well as creativity and team skills.
3. Students must proactively engage in observing the objects and processes which are part of their daily life and society from a design perspective and discuss with peers to learn collaboratively.

MODULE-1: Design Overview and Motivation

History and Context of birth of Design; Design thinking: Introduction and Motivation; Various definitions and interpretations of design, Design Vocabulary; Design in Indian Context; Art and Design: Art in Design, Design beyond Art; Design in Creative Industries

MODULE-2: Design Sensitisation for Engineers

Design Engineering vs. Engineering Design, Examples of Engineering Design and Design Engineering in various engineering domains, Examples of design failures leading to bad products and services, Real-world examples of bad design that caused engineering and technological disasters, Domain-specific Engineering Design examples

MODULE-3: Design Thinking Foundations

The Design Double Diamond: Discover-Define-Develop-Deliver

User-centric design approaches: Importance of user-centricity for design, Empathisation, Empathy Maps, Data collection from users and for users, Data Validation

Responsible Innovation and Ethical Design: Ethics as foundation for design, Concern for environment and sustainability

MODULE-4: Communication Skills for Design, Culture and Art

Communication Media to express an idea: Visuals, Text, Voice and Audio, Infographics

General guidelines for a good Presentation: Target audience, slideshow templates, appropriate visual elements, presentation styles, guidelines

General guidelines for a good Report: Documentation classification, standards, styles, and templates

Modes of communication: Reports and documents, Presentation, poster, graphic, blog or website.

Understanding Art in Design: Need for creativity, Elements of Visual Design

Design Aesthetics: Influences and impressions of Colours, Shapes, Layouts, Patterns, and Fonts as Design Elements

MODULE-5: Applied Creativity and Design for Services

Methods to brainstorm solutions for user issues; Combining solutions to workable solution concepts; Identifying the user needs in a service-driven economy; Process Flows and Customer Experience considerations for designing and improving services; 5 Why's; Service Delivery Pathways

MODULE-6: Doing Design

Looking for a problem, Ideation and Rules of Ideation, Framing and stating the problem; Basic considerations of Prototyping/ Model Building, Basics of Testing and Validation, Incorporating feedback

TEXT BOOKS:

1. Daniel Ling, "Complete Design Thinking Guide for Successful Professionals", CreateSpace Independent Publishing, 2015 (ISBN: 978-1514202739)
2. Tim Brown, "Change by Design", Harper Business, 2012 (ISBN: 978-0062337382)
3. Jimmy Jain, "Design Thinking for Startups: A Handbook for Readers and Workbook for Practitioners", Notion Press, 2018 (ISBN: 978-1642495034)
4. Beverly Rudkin Ingle, "Design Thinking for Entrepreneurs and Small Businesses: Putting the Power of Design to Work", APress, 2013 (ISBN: 978-1430261810)

REFERENCES:

1. Donald A. Norman, "The Design of Everyday Things", *MIT Press*, 2013 (ISBN: 978-0262525671)
2. Bruno Munari, "Design As Art", *Penguin UK*, 2009 (ISBN: 978-0141035819)
3. Tom Kelly, Jonathan Littman, "The Art of Innovation", HarperCollins Business, 2002 (ISBN: 978-0007102938)
4. Thomas Lockwood, "Design Thinking: Integrating Innovation, Customer Experience, and Brand Value", *Allworth Press*, 2009 (ISBN: 978-158115