

SHRI VENKATESHWARA UNIVERSITY



Syllabus

B.TECH
Mechanical Engineering
IInd SEMESTER
(Four Years Degree Programme)

(w.e.f. 2019-20)

SCHOOL OF ENGINEERING & TECHNOLOGY

SEMESTER- II

Sl No.	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	P S	TE	P E		
1	BSC- 201	Chemistry-I	3	1	0	20	10	30		70		100	4
	BSC- 202	Mathematics –II	3	1	0	20	10	30		70		100	4
3	ESC-203	Programming for Problem Solving	3	0	0	20	10	30		70		100	3
4	ESC-204	Workshop	1	0	4				25		25	50	3
5	ESC-205	Basic Electronics	2	0	0	20	10	30		70		100	2
6	BSC- 211	Chemistry-I Lab	0	0	4				25		25	50	2
7	ESC-213	Programming for Problem Solving Lab	0	0	4				25		25	50	2
8	ESC-215	Basic Electronics Lab	0	0	2				25		25	50	1
												600	21

Chemistry-I

<i>Course code</i>	BSC-201				
<i>Category</i>	Basic Science Course				
<i>Course title</i>	Chemistry-I				
<i>Scheme and Credits</i>	L	T	P	Credits	Semester –II
	3	1	0	4	
<i>Pre-requisites (if any)</i>					

(Concepts in chemistry for engineering) [L: 3; T: 1; P: 0 (4 credits)]

Detailed contents

(i) Atomic and molecular structure (12 lectures)

Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

(ii) Spectroscopic techniques and applications (12 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H₃, H₂F and HCN and trajectories on these surfaces.

(iii) Use of free energy in chemical equilibria (10 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications.

Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

(iv) Stereochemistry (4 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

(v) **Organic reactions and synthesis of a drug molecule (4 lectures)**

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Suggested Text Books

- (i) University chemistry, by B. H. Mahan
- (ii) Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
- (iii) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
- (iv) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
- (v) Physical Chemistry, by P. W. Atkins
- (vi) Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition <http://bcs.whfreeman.com/vollhardtschore5e/default.asp>

Course Outcomes

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications.

Quantum theory is more than 100 years old and to understand phenomena at nanometer levels, one has to base the description of all chemical processes at molecular levels. The course will enable the student to:

- Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- Rationalise bulk properties and processes using thermodynamic considerations.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
- Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
- List major chemical reactions that are used in the synthesis of molecules.

BSC- 211	Chemistry-I Lab
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Choice of 10-12 experiments from the following:

- Determination of surface tension and viscosity
- Thin layer chromatography
- Ion exchange column for removal of hardness of water
- Determination of chloride content of water
- Colligative properties using freezing point depression
- Determination of the rate constant of a reaction
- Determination of cell constant and conductance of solutions
- Potentiometry - determination of redox potentials and emfs
- Synthesis of a polymer/drug
- Saponification/acid value of an oil
- Chemical analysis of a salt
- Lattice structures and packing of spheres
- Models of potential energy surfaces
- Chemical oscillations- Iodine clock reaction
- Determination of the partition coefficient of a substance between two immiscible liquids

- Adsorption of acetic acid by charcoal
- Use of the capillary viscosimeters to demonstrate the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg

Laboratory Outcomes

- The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:
- Estimate rate constants of reactions from concentration of reactants/products as a function of time
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
- Synthesize a small drug molecule and analyse a salt sample

Mathematics -2 (Calculus, Ordinary Differential Equations and Complex Variable)

Course code	BSC-202				
Category	Basic Science Course				
Course title	Mathematics -II (Calculus, Ordinary Differential Equations and Complex Variable)				
Scheme and Credits	L	T	P	Credits	Semester-II
	3	1	0	4	
Pre-requisites (if any)	-				

Calculus, Ordinary Differential Equations and Complex Variable

Detailed contents:

UNIT 1: Multivariable Calculus (Integration): (10 lectures)

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

UNIT 2: First order ordinary differential equations: (6 lectures)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

UNIT 3: Ordinary differential equations of higher orders: (8 lectures)

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

UNIT 4: Complex Variable – Differentiation: (8 lectures)

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

UNIT 5: Complex Variable – Integration: (8 lectures)

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Suggested Text/Reference Books

- (i) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
- (ii) Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
- (iii) W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
- (iv) S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
- (v) E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
- (vi) E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
- (vii) J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.
- (viii) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
- (ix) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

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 effective mathematical tools for the solutions of differential equations that model physical processes.
- The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

Course code	ESC-203				
Category	Engineering Science Course				
Course title	Programming for Problem Solving				
Scheme and Credits	L	T	P	Credits	Semester – II
	3	0	0	3	[The lab component should have one hour of tutorial followed or preceded by laboratory assignments.]
Pre-requisites (if any)	-				

Detailed contents

Unit 1: Introduction to Programming (4 lectures)

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: Flowchart/Pseudocode 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-

Unit 2: Basic Algorithms (20 lectures)

Arithmetic expressions and Precedence Conditional

Branching and Loops

Writing and evaluation of conditionals and consequent branching

Iteration and loops

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 3: Function and Recursion (10 lectures)

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sor

or Merge sort.

Unit 4: Arrays (6 lectures) and Structure (4

lectures) Arrays (1-D, 2-D), Character arrays and

Strings Structures, Defining structures and Array of

Structures Unit 5: Pointers (4 lectures)

Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation), File handling (only if time is available, otherwise should be done as part of the

Lab)

Suggested Text Books

- (i) Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
- (ii) E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

Suggested Reference Books

- (i) Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course Outcomes

The student will learn

- To formulate simple algorithms for arithmetic and logical problems.
- To translate the algorithms to programs (in C language).
- To test and execute the programs and correct syntax and logical errors.
- To implement conditional branching, iteration and recursion.
- To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
- To use arrays, pointers and structures to formulate algorithms and programs.
- To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.
- To apply programming to solve simple numerical method problems, namely root finding of function, differentiation of function and simple integration.

[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 e.g., 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 &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

Laboratory Outcomes

- To formulate the algorithms for simple problems
- To translate given algorithms to a working and correct program
- To be able to correct syntax errors as reported by the compilers
- To be able to identify and correct logical errors encountered at run time
- To be able to write iterative as well as recursive programs
- To be able to represent data in arrays, strings and structures and manipulate them through a program
- To be able to declare pointers of different types and use them in defining self-referential structures.
- To be able to create, read and write to and from simple text files.

Course code	ESC-204				
Category	Engineering Science Courses				
Course title	Workshop/Manufacturing Practices				
Scheme and Credits	L	T	P	Credits	Semester-II
	1	0	4	3	
Pre-requisites (if any)	-				

1.

Detail ed conten ts

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods(3 lectures)
2. CNC machining, Additive manufacturing (**1 lecture**)
3. Fitting operations & power tools (**1 lecture**)
4. Electrical &Electronics (**1 lecture**)
5. Carpentry (**1 lecture**)
6. Plastic moulding, glass cutting (**1 lecture**)
7. Metal casting (**1 lecture**)
8. Welding (arc welding & gas welding), brazing (**1 lecture**)

Suggested Text/Reference Books:

- (i) 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.

- (ii) Kalpakjian S. And Steven S. Schmid, “Manufacturing Engineering and Technology”, 4th edition, Pearson Education India Edition, 2002.
- (iii) Gowri P. Hariharan and A. Suresh Babu,”Manufacturing Technology – I” Pearson Education, 2008.
- (iv) Roy A. Lindberg, “Processes and Materials of Manufacture”, 4th edition, Prentice
- (v) Hall India, 1998.
- (vi) Rao P.N., “Manufacturing Technology”, Vol. I and Vol. II, Tata McGrawHill House, 2017.

Course Outcomes

Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

(ii) Workshop Practice:(60 hours) [L : 0; T:0 ; P : 4 (2 credits)]

1. Machine shop (10 hours)
2. Fitting shop (8 hours)
3. Carpentry (6 hours)
4. Electrical & Electronics(8 hours)
5. Welding shop (8 hours (Arc welding 4 hrs + gas welding 4 hrs)
6. Casting (8 hours)
7. Smithy (6 hours)
8. Plastic moulding& Glass Cutting (6 hours)

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Laboratory Outcomes

- Upon completion of this laboratory course, students will be able to fabricate components with their own hands.
- They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
- By assembling different components, they will be able to produce small devices of their interest.
- observation of the no-load current waveform on an oscilloscope (non- sinusoidal wave- shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics).
Loading of a transformer: measurement of primary and secondary voltages and currents power.
- Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
- Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winding - slip ring arrangement) and single-phase induction machine.
- Torque Speed Characteristic of separately excited dc motor.
- Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super-synchronous speed.
 - Synchronous Machine operating as a generator: stand-alone operation with a load. Control of

voltage through field excitation.

- Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

Laboratory Outcomes

- Get an exposure to common electrical components and their ratings.
 - Make electrical connections by wires of appropriate ratings.
 - Understand the usage of common electrical measuring instruments.
 - Understand the basic characteristics of transformers and electrical machines.
 - Get an exposure to the working of power electronic converters.
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Basic Electronics

ESC-205	Basic Electronics	1L:0T:2P	2 credits
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The objective of this Course is to provide the students with an introductory and broad treatment of the field of *Electronics Engineering to facilitate better understanding of the devices, instruments and sensors used in Civil Engineering applications*. Lab should be taken concurrently. This course emphasizes more on the laboratory/practical use of the knowledge gained from the courselectures.

What Will I Learn?

- a) Know broadly the concepts and functionalities of the electronic devices, tools and instruments
- b) Understand use, general specifications and deployabilities of the electronic devices, and assemblies
- c) Confidence in handling and usage of electronic devices, tools and instruments in engineering applications

Proposed Syllabus

Module1: *Diodes and Applications* covering, Semiconductor Diode - Ideal versus Practical, Resistance Levels, Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Opto-Electronic Devices – LEDs, Photo Diode and Applications; Silicon Controlled Rectifier (SCR) – Operation, Construction, Characteristics, Ratings, Applications;

Module 2: *Transistor Characteristics* covering, Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Voltage Divider Bias Configuration; Field Effect Transistor (FET) – Construction, Characteristics of Junction FET, Depletion and Enhancement type Metal Oxide Semiconductor (MOS) FETs, Introduction to CMOS circuits;

Module 3: *Transistor Amplifiers and Oscillators* covering, Classification, Small Signal Amplifiers

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Basic Features, Common Emitter Amplifier, Coupling and Bypass Capacitors, Distortion, AC Equivalent Circuit; Feedback Amplifiers – Principle, Advantages of Negative Feedback, Topologies, Current Series and Voltage Series Feedback Amplifiers; Oscillators – Classification, RC Phase Shift, Wien Bridge, High Frequency LC and Non-Sinusoidal type Oscillators;

Module 4: *Operational Amplifiers and Applications* covering, Introduction to Op-Amp, Differential Amplifier Configurations, CMRR, PSRR, Slew Rate; Block Diagram, Pin Configuration of 741 Op- Amp, Characteristics of Ideal OpAmp, Concept of Virtual Ground;

ESC-215	Basic Electronics
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Module 1: Laboratory Sessions covering, Identification, Specifications, Testing of R, L, C Components (Colour Codes), Potentiometers, Switches (SPDT, DPDT and DIP), Bread Boards and Printed Circuit Boards (PCBs); Identification, Specifications, Testing of Active Devices – Diodes, BJTs, JFETs, MOSFETs, Power Transistors, SCRs and LEDs;

Module 2: Study and Operation of Digital Multi Meter, Function / Signal Generator, Regulated Power Supply (RPS), Cathode Ray Oscilloscopes; Amplitude, Phase and Frequency of Sinusoidal Signals using Lissajous Patterns on CRO; (CRO);

Module 3: Experimental Verification of PN Junction Diode Characteristics in A) Forward Bias B) Reverse Bias, Zener Diode Characteristics and Zener Diode as Voltage Regulator, Input and Output Characteristics of BJT in Common Emitter (CE) Configuration, Drain and Transfer Characteristics of JFET in Common Source (CS) Configuration;

Module 4: Study of Half Wave and Full Wave Rectification, Regulation with Filters, Gain and Bandwidth of BJT Common Emitter (CE) Amplifier, Gain and Bandwidth of JFET Common Source (CS) Amplifier, Gain and Bandwidth of BJT Current Series and Voltage Series Feedback Amplifiers, Oscillation Frequency of BJT based RC Phase Shift, Hartley and Colpitts Oscillators; Module 5: Op-Amp Applications – Adder, Subtractor, Voltage Follower and Comparator; Op-Amp Applications – Differentiator and Integrator, Square Wave and Triangular Wave Generation, Applications of 555 Timer – Astable and Monostable Multivibrators;

Module 5: Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR Integrated Circuits (ICs); Truth Tables and Functionality of Flip-Flops – SR, JK and D Flip-Flop ICs; Serial-In-Serial-Out and Serial-In-Parallel-Out Shift operations using 4-bit/8-bit Shift Register ICs; Functionality of Up-Down / Decade Counter ICs; (15 Sessions)

Text/Reference Books:

1. David. A. Bell (2003), *Laboratory Manual for Electronic Devices and Circuits*, Prentice Hall, India
2. Santiram Kal (2002), *Basic Electronics- Devices, Circuits and IT Fundamentals*, Prentice Hall, India
3. Thomas L. Floyd and R. P. Jain (2009), *Digital Fundamentals* by Pearson Education,
4. Paul B. Zbar, A.P. Malvino and M.A. Miller (2009), *Basic Electronics – A Text-Lab. Manual*, TMH
5. R.T. Paynter (2009), *Introductory Electronic Devices & Circuits, Conventional Flow Version*, Pearson