Autumn 2020-21 (1st Semester)

S.No	Course Code	Course Name	No. of Credits
1	CH 101	Chemistry for Engineers: Fundamental concepts and Applications	8.0
2	MA 101	Calculus	8.0
3	ME 111	Engineering Graphics Lab	5.0
4	PH 101	Quantum Physics and Applications	6.0
5	BB 101	Essential Biology for Engineers *	6.0
		Total Number of Credits	**33.0**

Syllabus

Name of Academic Unit: Chemistry
Level: UG
Programme: B.Tech.

i	**Title of the course**	CH 101 Chemistry for Engineers: Fundamental concepts and Applications
ii	**Credit Structure (L-T-P-C)**	(3-1-0-8)
iii	**Type of Course**	Core course
iv	**Semester in which normally to be offered**	Autumn
v	**Whether Full or Half Semester Course**	Full
vi	**Pre-requisite(s), if any (For the students) – *specify course number(s)***	--
vii	**Course Content**	**Organic and Inorganic** **(Inorganic): a. Harness the power of periodic table** Periodic properties: trends in size, electron affinity, ionization potential and electronegativity • Role of chemical elements in water contamination • Hardness of water • Desalination of brackish and sea water • Role of silicon in semiconducting applications • metal atom (Cu, Au, Pt, Pd etc.) based nanoparticles **b. Coordination complexes** Transition metal chemistry: inorganic complexes, bonding theories, magnetism, bonding aspects and structural distortion **(Organic): a. M.O. theory and π-conjugated compounds** Molecular orbitals of common functional groups, Qualitative Huckel MOs of conjugated polyenes and benzene. Aromaticity. Configuration, molecular chirality and isomerism, Conformation of alkanes and cycloalkanes **b. Polymers** Types and classification of polymers • polymerization techniques • Structure-property relationships of polymers • Conducting polymers **Physical Chemistry:** **a. Quantum chemistry** Schrodinger equation, Origin of quantization, Born interpretation of wave function, Hydrogen atom: solution to ϕ-part, Atomic orbitals, many electron atoms and spin orbitals. Chemical bonding: MO theory: LCAO molecular orbitals, Structure, bonding and energy levels of diatomic molecules. Concept of sp, sp^2 and sp^3 hybridization; Bonding and shape of many atom molecules; Intermolecular Forces; Potential energy Surfaces-Rates of reactions; Steady state approximation and its applications;

		Concept of pre-equilibrium; Equilibrium and related thermodynamic quantities **b. Electrochemistry** Electrochemical cells and Galvanic cells • EMF of a cell • Single electrode potential • Nernst equation • Electrochemical series • Types of electrodes • Reference electrodes • Batteries • Modern batteries • Fuel cells • corrosion
viii	**Texts/References**	1. J. D. Lee, "Concise Inorganic chemistry" 5th Edition. Wiley India. Ed. 2. J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, "Inorganic Chemistry: Principles of structure and reactivity" 4th Edition, Person. 3. P. Atkins, J. de Paula, "physical chemistry" 5th Edition, Oxford. 4. J. Clayden, N. Greeves, S. Warren, "Organic chemistry" 2th Edition, Oxford. 5. George Odian, Principles of polymerization, 4th edition, Wiley student edition, Wiley India Pvt Ltd. 6. F. W. Billmeyer, Text book of Polymer Science, 3rd edition, Wiley student edition, Wiley India Pvt Ltd. 7. A. K. De, Environmental Chemistry, 8th edition, New Age International publishers. 8. B. K. Sharma, Environmental Chemistry, 16th edition, Krishna Prakashan Media Pvt Ltd. 9. A. R. West, Solid State Chemistry and Its Applications, Wiley student edition, Wiley India Pvt Ltd. 10. T. Pradeep, Nano: The essentials, McGraw-Hill Education publishers. 11. Geoffrey A Ozin and André Arsenault, Nanochemistry: A Chemical Approach to Nanomaterials, 2nd edition, RSC publishing.
ix	**Name(s) of Instructor(s)**	BLT, MRR
x	**Name(s) of other Departments/ Academic Units to whom the course is relevant**	NA
xi	**Is/Are there any course(s) in the same/ other academic unit(s) which is/ are equivalent to this course? If so, please give details.**	No
xii	**Justification/ Need for introducing the course**	This is an existing fundamental chemistry course in the institute which is now revamped by introducing pertaining engineering applications

Name of Academic Unit: Mathematics
Level: UG
Programme: B.Tech.

i	**Title of the course**	MA 101 Calculus
ii	**Credit Structure (L-T-P-C)**	(3-1-0-8)
iii	**Type of Course**	Core course
iv	**Semester in which normally to be offered**	Autumn
v	**Whether Full or Half Semester Course**	Full
vi	**Pre-requisite(s), if any (For the students) – specify course number(s)**	--
vii	**Course Content**	Review of limits, continuity, differentiability. Mean value theorem, Taylors Theorem, Maxima and Minima. Riemann integrals, Fundamental theorem of Calculus, Improper integrals, applications to area, volume. Convergence of sequences and series, power series. Partial Derivatives, gradient and directional derivatives, chain rule, maxima and minima, Lagrange multipliers. Double and Triple integration, Jacobians and change of variables formula. Parametrization of curves and surfaces, vector fields, line and surface integrals. Divergence and curl, Theorems of Green, Gauss, and Stokes.
viii	**Texts/References**	1. B.V. Limaye and S. Ghorpade, A Course in Calculus and Real Analysis, Springer UTM (2004) 2. B.V. Limaye and S. Ghorpade, A Course in Multivariable Calculus and Analysis, Springer UTM (2010) 3. James Stewart, Calculus (5th Edition), Thomson (2003). 4. T. M. Apostol, Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern (1980). 5. Marsden and Tromba, Vector calculus (First Indian Edition), Springer (2012)
ix	**Name(s) of Instructor(s)**	BVL
x	**Name(s) of other Departments/ Academic Units to whom the course is relevant**	NA
xi	**Is/Are there any course(s) in the same/ other academic unit(s) which is/ are equivalent to this course? If so, please give details.**	No
xii	**Justification/ Need for introducing the course**	This is a fundamental mathematics course which is essential for any branch of engineering

Name of Academic Unit: Physics
Level: UG
Programme: B.Tech.

i	**Title of the Course**	PH 101: Quantum Physics and Applications
ii	**Credit Structure (L-T-P-C)**	(2-1-0-6)
iii	**Type of Course**	Core course
iv	**Semester in which normally to be offered**	Autumn
v	**Whether Full or Half Semester Course**	Full
vi	**Pre-requisite(s), if any (For the students) – *specify course number(s)***	--
vii	**Course Content**	• Quantum nature of light: Photoelectric Effect and Compton Effect. • Stability of atoms and Bohr`s rules. • Wave particle duality: De Broglie wavelength, Group and Phase velocity, Uncertainty Principle, Double Slit Experiment. • Schrödinger Equation. • Physical interpretation of Wave Function, Elementary Idea of Operators, Eigen-value Problem. • Solution of Schrödinger equation for simple boundary value problems. • Reflection and Transmission Coefficients. Tunneling. • Particle in a three dimensional box, Degenerate states. • Exposure to Harmonic Oscillator and Hydrogen Atom without deriving the general solution. • Quantum Statistics: Maxwell Boltzmann, Bose Einstein and Fermi Dirac Statistics by detailed balance arguments. • Density of states. • Applications of B-E statistics: Lasers. Bose-Einstein Condensation. • Applications of F-D statistics: Free electron model of electrons in metals. Concept of Fermi Energy. • Elementary Ideas of Band Theory of Solids. • Exposure to Semiconductors, Superconductors, Quantum Communication and Quantum Computing.
viii	**Texts/References (separate sheet may be used, if necessary)**	1. Quantum Physics: R. Eisberg and R. Resnick, John Wiley 2002, 2nd Edition. 2. Introduction to Modern Physics: F. K. Richtmyer, E. H. Kennard and J.N. Cooper, Tata Mac Graw Hill 1976, 6th Edition. 3. Modern Physics: K. S. Krane, John Wiley 1998, 2nd Edition. 4. Introduction to Modern Physics: Mani and Mehta, East-West Press Pvt. Ltd. New Delhi 2000.

		5. Elements of Modern Physics: S. H. Patil, Tata McGraw Hill, 1984. 6. Concepts of Modern Physics, A Beiser, Tata McGraw Hill, 2009.
ix	**Name(s) of Instructor(s)**	RP
x	**Name(s) of other Departments/ Academic Units to whom the course is relevant**	NA
xi	**Is/Are there any course(s) in the same/ other academic unit(s) which is/ are equivalent to this course? If so, please give details.**	No
xii	**Justification/ Need for introducing the course**	This course develops the concepts of Quantum Mechanics such that the behavior of the physical universe can be understood from a fundamental point of view. It provides a basis for further study of quantum mechanics. It is necessary for students to undertake this course, as the course sheds light on topics like, the basic principles behind the working of semiconductor devices, superconductors, etc. It is important to note that, such devices occupy the central stage in current technological advancements. The course also deals with the basic concepts behind the most advanced techniques like quantum communication and quantum computation.

Name of Academic Unit: Mechanical Engineering
Level: UG
Programme: B.Tech.

i	**Title of the course**	ME 111 Engineering Graphics Lab
ii	**Credit Structure (L-T-P-C)**	(1-0-3-5)
iii	**Type of Course**	Core course
iv	**Semester in which normally to be offered**	Autumn
v	**Whether Full or Half Semester Course**	Full
vi	**Pre-requisite(s), if any (For the students) – *specify course number(s)***	--
vii	**Course Content**	**Engineering Graphics with mini-drafter**: Around half a semester and bit more with following topics to be covered. • Introduction to Engineering Graphics • Curves • Projections of Points • Projection of Lines • Projection of Planes • Projections on Auxiliary Planes • Projections of Solids • Sections of Solids • Intersections of Solids **Engineering Graphics with 2D Drafting Software**: 5 weekly computer laboratory sessions covering above using AutoCAD® as a drafting software, 5th session on Isometric Projections.
viii	**Texts/References**	1. N. D. Bhatt, revised and enlarged by V. M. Panchal and P. R. Ingle, Engineering Drawing, 53rd Edition, 2014, Charotar Publishers, Anand. 2. Warren J. Luzadder and Jon M. Duff, Fundamentals of Engineering Drawing, Prentice-Hall of India. 3. Gopalakrishna K. R., Engineering Drawing Vol. I & II Combined., Subhas Stores, 25th Edition, 2017. 4. Narayana. K. L., and Kannaiah, P. E., Text Book on Engineering Drawing, 2nd Edition, 2013, Scitech Publications, Chennai. 5. Venugopal K. and Prabhu Raja V., Engineering Drawing + AutoCAD, New Age International Publishers, 5th Edition, 2011.
ix	**Name(s) of Instructor(s)**	SS, TPG, DVP
x	**Name(s) of other Departments/ Academic Units to whom the course is relevant**	NA

xi	**Is/Are there any course(s) in the same/ other academic unit(s) which is/ are equivalent to this course? If so, please give details.**	No
xii	**Justification/ Need for introducing the course**	This is a fundamental course which is essential for appreciating the engineering drawings and compulsory for all B.Tech. majors.

Name of Academic Unit: Biosciences and Bioengineering
Level: UG
Programme: B.Tech.

i	**Title of the course**	BB 102: Essential biology for engineers
ii	**Credit Structure (L-T-P-C)**	(3-0-0-6)
iii	**Type of Course**	Core course
iv	**Semester in which normally to be offered**	Spring
v	**Whether Full or Half Semester Course**	Full
vi	**Pre-requisite(s), if any (For the students) – *specify course number(s)***	Nil
vii	**Course Content**	Quantitative views of modern biology. Importance of illustrations and building quantitative/qualitative models. Role of estimates. Cell size and shape. Temporal scales. Relative time in Biology. Key model systems – a glimpse. Management and transformation of energy in cells. Mathematical view – binding, gene expression and osmotic pressure as examples. Metabolism. Cell communication. Genetics. Eukaryotic genomes. Genetic basis of development. Evolution and diversity. Systems biology and illustrative examples of applications of Engineering in Biology.
viii	**Texts/References**	1 Miko, I. & Lejeune, L., eds. Essentials of Genetics. Cambridge, MA: NPG Education, 2009.O'Connor, C. M. & Adams, J. U. Essentials of Cell Biology. Cambridge, MA: NPG Education,2010. 2. Watson JD, Baker, TA, Bell SP, Gann A, Levin M, Losick R, Molecular Biology of the Gene, Pearson Education, 2004. 3. Dan E. Krane, Michael L. Raymer. Fundamental Concepts of Bioinformatics, Pearson Education India. 2003
ix	**Name(s) of Instructor(s)**	SS
x	**Name(s) of other Departments/ Academic Units to whom the course is relevant**	NA
xi	**Is/Are there any course(s) in the same/ other academic unit(s) which is/ are equivalent to this course? If so, please give details.**	No
xii	**Justification/ Need for introducing the**	To introduce students to modem biology with an

	course	emphasis on evolution of biology as a multi-disciplinary field, to make them aware of application of engineering principles in biology, and engineering robust solutions inspired by biological examples. Based on student's feedback, lab experiments are being added to the course. The addition of lab work will change the course structure to 3-0-1-7.

Proposed laboratory activities:

Before Mid Semester

Biosafety laboratory practices and biological waste disposal + Buffers in biology, buffering capacity and pKa

Observing cell surface and intracellular contents using phase contrast microscopy

DNA isolation, PCR, and visualization

Protein isolation and Visualization

After Mid-semester

DNA cloning and transformation

Bacterial growth kinetics

BLAST, BLAT, sequence identification

Gene expression analysis