B.Tech. in Mathematics and Computing

Course Structure

In *L-T-P-C*,

- L denotes the number of lecture classes per week,
- T denotes the number of tutorial classes per week,
- P denotes the number of practical classes per week, and
- C denotes the credits of the course.

The credits of a course are generally computed as follows:

$$C = (2 \times L) + (2 \times T) + (1 \times P)$$

For the courses that are graded with the letter grades PP-Passed and NP-Not Passed, the credits are assigned as 0 (zero) irrespective of their *L-T-P* and hence such courses will not be included in computing the Semester Performance Index (SPI) and the Cumulative Performance Index (CPI).

First Semester			
Component	Course Number	Course Title	*L-T-P-C*
Basic Engineering	CE101	Engineering Drawing	2-0-3-7
Basic Sciences	CH101	Chemistry	3-1-0-8
Basic Sciences	CH110	Chemistry Laboratory	0-0-3-3
Basic Engineering	EE101	Basic Electronics	3-1-0-8
Basic Sciences	MA101	Mathematics I	3-1-0-8
Basic Engg./ Sci.	ME110/ PH110	Workshop/ Physics Laboratory	0-0-3-3
Basic Sciences	PH101	Physics I	2-1-0-6
HSS	HS101	English Communication (only for required students)	2-0-2-0
		Total Credits	**43**

Second Semester			
Component	Course Number	Course Title	*L-T-P-C*
Basic Sciences	BT101	Introductory Biology	3-0-0-6
Basic Engineering	CS101	Introduction to Computing	3-0-0-6
Basic Engineering	CS110	Computing Laboratory	0-0-3-3
Basic Engineering	EE102	Basic Electronics Laboratory	0-0-3-3
Basic Sciences	MA102	Mathematics II	3-1-0-8
Basic Engg./Sci.	ME110/ PH110	Workshop/ Physics Laboratory	0-0-3-3
Basic Engineering	ME101	Engineering Mechanics	2-0-3-7
Basic Sciences	PH102	Physics II	2-1-0-6
Extra Acad. Act.	SA1xx	Students' Activity Course I	0-0-2-0
		Total Credits	**43**

Third Semester			
Component	Course Number	Course Title	*L-T-P-C*
Basic Sciences	MA201	Mathematics III	3-1-0-8
Major Discipline	MA221	Discrete Mathematics	3-0-0-6
Major Discipline	MA222	Elementary Number Theory and Algebra	3-0-0-6
Major Discipline	MA225	Probability Theory and Random Processess	3-1-0-8
Major Discipline	MA251	Data Structures	2-0-2-6
Major Discipline	CS221	Digital Design	3-0-0-6
HSS	HSxxx	Sustainable Development Goals	2-0-0-0
Extra Acad. Act.	SA2xx	Students' Activity Course II	0-0-2-0
		Total Credits	**40**
Minor Discipline		Minor Course I	3-0-0-6

Minor Discipline Courses are only for opted students.

Fourth Semester			
Component	Course Number	Course Title	*L-T-P-C*
HSS	HS1xx	First Level HSS Elective I	3-0-0-6
Major Discipline	MA224	Real Analysis	3-0-0-6
Major Discipline	MA252	Design and Analysis of Algorithm	3-0-0-6
Major Discipline	MA271	Financial Engineering I	3-0-0-6
Major Discipline	CS223	Computer Organization and Architecture	3-0-0-6
Major Discipline	CS245	Database Management Systems	3-0-0-6
Major Discipline	CS246	Database Management Systems Lab	0-0-4-4
Extra Acad. Act.	SA3xx	Students' Activity Course III	0-0-2-0
		Total Credits	**40**
Minor Discipline		Minor Course II	3-0-0-6

Fifth Semester			
Component	Course Number	Course Title	*L-T-P-C*
HSS	HS1xx	First Level HSS Elective II	3-0-0-6
Major Discipline	MA321	Optimization	3-0-0-6
Major Discipline	MA323	Monte Carlo Simulation	0-1-2-4
Major Discipline	MA372	Stochastic Calculus for Finance	3-0-0-6
Major Discipline	CS341	Computer Networks	3-0-0-6
Major Discipline	CS342	Computer Networks Lab	0-0-4-4
Major Discipline	CS343	Operating Systems	3-0-0-6
Major Discipline	CS344	Operating Systems Lab	0-0-4-4
Extra Acad. Act.	SA4xx	Students' Activity Course IV	0-0-2-0
		Total Credits	**42**
Minor Discipline		Minor Course III	3-0-0-6

Sixth Semester			
Component	Course Number	Course Title	*L-T-P-C*
Major Discipline	MA322	Scientific Computing	3-0-2-8
Major Discipline	MA324	Statistical Inference & Multivariate Analysis	3-0-0-6
Major Discipline	MA351	Theory of Computation	4-0-0-8
Major Discipline	MA373	Financial Engineering II	3-0-0-6
Major Discipline	MA374	Financial Engineering Laboratory	0-0-3-3
Major Discipline	MAxxx	Department Elective I	3-0-0-6
		Total Credits	**37**
Minor Discipline		Minor Course IV	3-0-0-6

Seventh Semester			
Component	Course Number	Course Title	*L-T-P-C*
HSS	HS2xx	Second Level HSS Elective I	3-0-0-6
Major Discipline	MA423	Matrix Computations	3-0-2-8
Major Discipline	MA473	Computational Finance	3-0-2-8
Major Discipline	MAxxx	Department Elective II	3-0-0-6
Major Discipline	MA498	Project I	0-0-6-6
		Total Credits	**34**
Minor Discipline		Minor Course V	3-0-0-6

Eighth Semester			
Component	Course Number	Course Title	*L-T-P-C*
HSS	HS2xx	Second Level HSS Elective I	3-0-0-6
Major Discipline	MAxxx	Department Elective III	3-0-0-6
Major Discipline	MAxxx	Department Elective IV	3-0-0-6
Open/ Any	XXxxx	Open Elective	3-0-0-6
Major Discipline	MA499	Project II	0-0-10-10
		Total Credits	**34**

Total Credits for the Programme is $43 + 43 + 40 + 40 + 42 + 37 + 34 + 34 =$ **313**.

In the curriculum of B.Tech. in Mathematics and Computing, the distribution of various components are as follows.

- Basic Sciences = 56 credits which is 17.89%,
- Basic Engineering = 38 credits which is 12.14%,
- Humanities and Social Sciences = 24 credits which is 7.67%,
- Open/ Any Discipline = 6 credits which is 1.92%,
- Major Discipline = 189 credits which is 60.38%. In this major discipline component,
  - Mathematics courses = 38 credits which is 12.14%,
  - Computing Courses = 20 credits which is 6.39%,
  - Computer Science and Engineering courses = 62 credits which is 19.81%,
  - Mathematical Finance courses = 29 credits which is 9.26%,
  - Elective courses = 24 credits which is 7.67%,
  - Project Courses = 16 credits which is 5.11%.

Syllabus/ Course Content

CE101 Engineering Drawing **2-0-3-7**
Prerequisite: Nil

Importance of engineering drawing; Conventions and standards: ISO; Orthographic projections: points, lines, planes and solids; Sections of solids; Isometric projections; Development of surfaces; Intersection of solids., Introduction to a Computer Aided Drafting software, basic commands of two dimensional drafting. Application of orthographic and isometric Projections in the software.

References:

1. N. D. Bhatt and V. M. Panchal, Engineering Drawing Plane and Solid Geometry, 53rd Edition Charator Publishing House, 2014.
2. K. Venugopal and V. Prabhu Raja, Engineering Drawing+ AutoCAD, 5 th Edition, New Age International, 2011.
3. D. A. Jolhe, Engineering Drawing with an Introduction to AutoCAD, McGraw Hill Education 2017.

4. T. E. French, C. J. Vierck and R. J. Foster, Graphic Science and Design, 4th Edition, McGraw Hill, 1984.

5. W. J. Luzadder and J. M. Duff, Fundamentals of Engineering Drawing, 11th Edition, PHI, 2012.

6. F. E. Giesecke, A. Mitchell, H. C. Spencer, I. L. Hill, R. O. Loving, J. T. Dygdon, J. E. Novak, Engineering Drawing 8th Edition, Person Prentice Hall, 2000.

CH101 Chemistry I **3-1-0-8**

Prerequisite: Nil

Structure and Bonding; Origin of quantum theory, postulates of quantum mechanics; Schrodinger wave equation: operators and observables, superposition theorem and expectation values, solutions for particle in a box, harmonic oscillator, rigid rotator, hydrogen atom; Valence Bond and Molecular Orbital Theories; Hydrogen Molecule; Hybridization; Molecular Symmetry; Electronic Spectroscopy and Lasers. Chemical Thermodynamics and Chemical Kinetics. Coordination compounds: ligand, stereochemistry, crystal field and molecular orbital theories; Bioinorganic chemistry and organometallic chemistry; Chemistry of materials. Stereochemistry of more than two stereo-centers, R&S and E&Z nomenclature, Conformation of cyclohexane and 1,2-disubstituted cyclohexane; Pericyclic reactions; Bioorganic chemistry: proteins, enzymes, carbohydrates, nucleic acids and lipids; Natural products: classification and origin of terpenoids, alkaloids and steroids. Macromolecules (polymers); Solid phase synthesis; Green chemical processes. Modern spectroscopic techniques in structural elucidation of organic compounds (UV-vis, IR, NMR).

Texts:

1. P. W. Atkins, Physical Chemistry, 5th edition, ELBS, 2009.

2. C. N. Banwell, and E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th edition, Tata McGraw-Hill, 2017.

3. F. A. Cotton, and G. Wilkinson, Advanced Inorganic Chemistry, 6th edition, Wiley, 1999.

4. D. J. Shriver, P. W. Atkins, and C. H. Langford, Inorganic Chemistry, 3rd edition, ELBS, 2008.

5. S. H. Pine, Organic Chemistry, 5th edition, McGraw-Hill, 2006.

References:

1. I. A. Levine, Physical Chemistry, 4th edition, McGraw-Hill.

2. I. A. Levine, Quantum Chemistry, EE edition, Prentice Hall.

3. G. M. Barrow, Introduction to Molecular Spectroscopy, International Edition, McGraw-Hill.

4. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry: Principle, structure and reactivity, 4th edition, Harper Collins.

5. L. G. Wade (Jr.), Organic Chemistry, Prentice Hall.

EE101 Basic Electronics **3-1-0-8**

Prerequisite: Nil

DC Analysis: Dependent and independent Voltage and current sources, Nodes, Paths, Loops and Branches, Nodal and Mesh Analysis, Superposition, Source Transformations, Thevenins and Nortons Theorems, Maximum Power Transfer. RL, RC and RLC Circuit. AC Circuit Analysis: Sinusoidal Forcing Function, Phasor Relationship for R, L and C, Impedance and Admittance, Phasor Diagrams. Instantaneous Power, Average Power, Complex Power, Apparent Power and Power Factor.

Logic Gates and Combinational Circuits: Number Systems and Binary Codes, Boolean Algebra and Logic Gates, De Morgans Theorems, Sum-of-Product and Product-of-Sum Forms, Algebraic Simplification, Karnaugh-Map Method, Combinational Logic Circuits, Binary Half and Full Adder, Parity Generator-Checker, Sequential Circuits, Storage Elements; NAND and NOR gate Latches, S-R Flip-Flop, J-K Flip-Flop, D Flip-Flop, T Flip-Flop, Counters.

Polyphase Circuits: Balanced Three-phase Systems (Star (Y) & Delta ()), Three-phase Power Measurement, Magnetic Circuit: Amperes circuital law, Application of Amperes circuital law in magnetic circuit, Reluctance and permeance, Analysis of Series magnetic circuit, Analysis of Series-parallel magnetic circuit, Flux linkage, self and mutual inductance. Frequency Response: Low pass and High pass RC and RL circuits, Series and Parallel Resonance, Quality factor.

Diodes: Semiconductor Diode, V-I characteristics of Diode, Half-Wave and Full-Wave Rectifier Circuits, Wave Shaping Circuits, Clippers and Clampers, Zener Diodes. Transistors: Bipolar Junction Transistor, MOSFET: Biasing, Small Signal model, Amplifiers. Operational Amplifiers: Ideal Op-Amp, Application of Op-Amp: Comparator, Inverting and non-Inverting Amplifiers, Differential and Integral Amplifier, Adder-Subtractor.

Texts/ References:

1. W. H. Hayt, J. E. Kemmerly, and S. M. Durbin, Engineering Circuit Analysis, 8th edition, McGraw-Hill, 2013.

2. R. J. Smith and R. C. Dorf, Circuits, Devices and Systems, 5th edition, John Wiley India, 2007.

3. R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, 11th edition, Pearson, 2012.

4. N. S. Widmer, G. L. Moss, and R. J. Tocci, Digital Systems, 12th edition. Pearson, 2017.

5. V. D. Toro, Electrical Engineering Fundamentals, 2nd edition. PHI, 2014.

MA101 Mathematics I **3-1-0-8**

Prerequisite: Nil

Singlevariable Calculus: Convergence of sequences and series of real numbers; Continuity of functions; Differentiability, Rolle's theorem, mean value theorem, Taylor's theorem; Power series; Riemann integration, fundamental theorem of calculus, improper integrals; Application to length, area, volume and surface area of revolution.

Multivariable Calculus: Vector functions of one variable - continuity and differentiability; Scalar valued functions of several variables, continuity, partial derivatives, directional derivatives, gradient, differentiability, chain rule; Tangent planes and normals, maxima and minima, Lagrange multiplier method; Repeated and multiple integrals with applications to volume, surface area; Change of variables; Vector fields, line and surface integrals; Green's, Gauss' and Stokes' theorems and their applications.

Texts:

1. G. B. Thomas, Jr. and R. L. Finney, Calculus and Analytic Geometry, 9th Edition, Pearson Education India, 1996.

References:

1. R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd edition, Wiley India, 2005.

2. S. R. Ghorpade and B. V. Limaye, An Introduction to Calculus and Real Analysis, Springer India, 2006.

3. T. M. Apostol, Calculus, Volume-II, 2nd edition, Wiley India, 2003.

4. J. E. Marsden, A. J. Tromba and A. Weinstein, Basic Multivariable Calculus, Springer India, 2002.

PH101 Physics I **2-1-0-6**
Prerequisite: Nil

Calculus of variation: Fermats principle, Principle of least action, Euler-Lagrange equations and its applications.

Lagrangian mechanics: Degrees of freedom, Constraints and constraint forces, Generalized coordinates, Lagrange's equations of motion, Generalized momentum, Ignorable coordinates, Symmetry and conservation laws, Lagrange multipliers and constraint forces.

Hamiltonian mechanics: Concept of phase space, Hamiltonian, Hamilton's equations of motion and applications.

Special Theory of Relativity: Postulates of STR. Galilean transformation. Lorentz transformation. Simultaneity. Length Contraction. Time dilation. Relativistic addition of velocities. Energy momentum relationships.

Quantum Mechanics: Two-slit experiment. De Broglie's hypothesis. Uncertainty Principle, wave function and wave packets, phase and group velocities. Schrdinger Equation. Probabilities and Normalization. Expectation values. Eigenvalues and eigenfunctions.

Applications in one dimension: Infinite potential well and energy quantization. Finite square well, potential steps and barriers - notion of tunnelling, Harmonic oscillator problem zero point energy, ground state wavefunction and the stationary states.

Texts:

1. R. Takwale and P. Puranik, Introduction to Classical Mechanics, 1st Edition, McGraw Hill Education, 2017.

2. John Taylor, Classical mechanics, University Science Books, 2005.

3. R. Eisberg and R. Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, 2nd Edition, John-Wiley, 2006.

References:

1. Patrick Hamill, A Students Guide to Lagrangians and Hamiltonians,Cambridge University Press, 1st edition, 2013.

2. M. R. Spiegel , Theoretical Mechanics, Tata McGraw Hill, 2008.

3. R. P. Feynman, R. B. Leighton, and M. Sands, The Feynman Lectures on Physics, Volume I, Narosa Publishing House, 1998.

4. R. Resnick, Introduction to Special Relativity, John Wiley, Singapore, 2000.

5. S. Gasiorowicz, Quantum Physics, John Wiley (Asia), 2000.

ME110 Workshop I **0-0-3-3**

Prerequisite: Nil

Familiarization with workshop practice, safety, health and environmental issues, demonstrations in machine, carpentry, fitting, welding and foundry shops. Introduction to different welding processes, demonstration of gas, TIG, MAG and submerged arc welding processes, simple exercises in shielded metal arc welding. Introduction to wood working, hand tools and machines, simple exercises in wood working including making of a simple pattern for foundry. Introduction to foundry shop, exercises in green sand molding and CO_2 molding, demonstration of shell molding; familiarization with melting and pouring practices. Introduction to bench work and fitting, simple exercises involving filing, sawing, drilling and tapping. Assembly of the models of CNC machines and exposure to part programming.

Practice on working with sheet-metal/ plastic/ glass/ composite.

Texts:

1. Department of Mechanical Engineering, IIT Guwahati, Workshop Practice Manual, Vidya Mandir, Guwahati, 2018.

References:

1. S. K. H. Choudhury, A. K. H. Choudhury and N. Roy, Elements of Workshop Technology, Volume I: Manufacturing Processes, Media Promotors, 2008.

2. H. Gerling, All About Machine Tools, 2nd Edition, New Age International, 2006.

3. W. A. J. Chapman, Workshop Technology, 4th Edition, Viva Books, 1998.

4. HMT, Mechatronics, McGraw Hill Education, New Delhi, 2017.

HS101 English Communication **2-0-2-0**

Only for students lagging language proficiency, Non-Credit Course, Grading: PP-Passed/ NP-Not Passed

Prerequisite: Nil

General proficiency in English and Communication skills.

Listening: What is listening, difference between listening and speaking, barriers to listening, effective listening strategies, comprehending social conversation, comprehending

narrations and academic lectures; Speaking: Understanding accent (intelligibility, Indian and non-Indian accents), nuances of fluency; understanding effective speaking strategies, using language in various situations such as - introducing oneself and others on formal and informal situations, asking for information and giving information, describing people, places and objects, narrating events, explaining processes and products, expressing opinions, arguing, giving instructions, taking part in conversation and group discussions understanding turn taking strategies, making short presentations.

Reading: Reading simple narratives and comprehending the gist, identifying topic sentences, identifying cohesive devices and their functions, comprehending texts of different genres and content matter.

Vocabulary: understanding different aspects of a word, learning various strategies to develop vocabulary, using a dictionary for developing vocabulary.

Grammar: Revising grammar already learnt - use of articles, quantifiers, punctuation, use of tenses, gerunds and infinitives, present participles, subject verb concord, adverbs, nouns, pronouns, prepositions, use of connectives, use of adjectives and adverbs, common errors.

Writing: Writing short paragraphs with the help of topic sentences, cohesive devices, writing narratives of minimum three paragraphs, developing information transfer skills, summarising and paraphrasing, note-taking, note- making, writing short reviews, writing short reports.

Texts:

1. John Eastwood, Oxford Practice Grammar. Oxford University Press, New Delhi, 1992.

2. O'Dell and McCarthy, English Vocabulary in Use. Cambridge University Press. New Delhi, 2002.

3. Jayashree Mohanraj, et al (Eds), Speak Well, First Edition, Orient Blackswan, 2012.

References:

1. Oxford Advanced Learners Dictionary of English, Ninth Edition, 2016.

2. Nitin Bhatnagar and Mamta Bhaatnagar, Communicative English for Engineers and Professionals, Pearson, 2010.

BT101 Introductory Biology **3-0-0-6**
Prerequisite: Nil

Evolution of life: Origin of Life; Darwin's concepts of evolution; Biodiversity.

Cell, the structural and functional unit of life: Three domains of life; cell types, cell organelles and structure; Basic biomolecules of cell.

Nutrients, bioenergetics and cell metabolism: Essential nutrients to sustain life; biological energy and laws of thermodynamics, basics of aerobic and anaerobic glycolysis and citric acid cycle.

Genes and chromosomes: DNA, DNA replication; Central dogma of molecular biology: Transcription and translation; Mendelian Genetics; Genetic engineering/Cloning and its applications.

Biological systems: Body systems required to sustain human physiology, special sense organs including hearing, taste, smell and visual receptors.

Texts:

1. J. L. Tymoczko, J. M. Berg and L. Stryer, Biochemistry, 8th Edition, W. H. Freeman & Co, 2015.

2. D. L. Nelson and M. M. Cox, Lehninger Principles of Biochemistry, 7th Edition, Macmillan Worth, 2017.

References:

1. N. Hopkins, J. W. Roberts, J. A. Steitz, J. Watson and A. M. Weiner, Molecular Biology of the Gene, 7th Edition, Benjamin Cummings, 1987.

2. C. R. Cantor and P. R. Schimmel, Biophysical Chemistry, Parts I, II and III, W.H. Freeman & Co., 1980.

3. C. C. Chatterjee, Human Physiology, Volumes 1 and 2, 11th Edition, Medical Allied Agency, 1987.

4. B. K. Hall, Evolution: Principles and Processes, 1st Edition, Jones & Bartlett, 2011.

CS101 Introduction to Computing **3-0-0-6**

Prerequisite: Nil

Introduction to Computers: the von Neumann architecture, low/high level language, compiler, interpreter, loader, linker, operating system, flowchart, programming environment.

Concepts of programming (using C): Data types, variables, operators, expressions, statements, control structures, functions, parameter passing, recursion, arrays and pointers,

records (structures), memory management, files.

Program development lifecycle. Algorithms, efficiency, correctness, implementation, verification, assertions, pre/post conditions, invariants, testing.

Fundamental data structures: arrays, stacks, queues, linked lists.

Searching and sorting.

Introduction to object oriented programming.

Texts:

1. A. Kelly and I. Pohl, A Book on C, 4th Edition, Pearson Education, 1999.

References:

1. Y. N. Patt and S. J. Patel, Introduction to Computing Systems: From Bits and Gates to C and Beyond, 2nd Edition, McGraw Hill, 2004.
2. B. Kernighan and D. Ritchie, The C Programming Language, 4th Edition, Prentice Hall of India, 1988.
3. M. A. Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson, 2002.
4. R. G. Dromey, How to Solve it by Computer, 1st Edition, Pearson Education, 2008.

CS110 Computing Laboratory **0-0-3-3**
Prerequisite: Nil

Programming Laboratory will be set in consonance with the material covered in CS101. This will include assignments in a programming language like C.

References:

1. B. Gottfried and J. Chhabra, Programming With C, Tata McGraw Hill, 2005.

EE102 Basic Electronics Laboratory **0-0-3-3**
Prerequisite: Nil

Experiments based on the syllabus of EE101 Course.

MA102 Mathematics II **3-1-0-8**
Prerequisite: Nil

Linear Algebra: Systems of linear equations, matrices, Gaussian elimination, echelon form, column space, null space, rank of a matrix, inverse and determinant; Vector spaces (over the field of real and complex numbers), subspaces, spanning set, linear independence, basis and dimension; Linear transformations, rank-nullity theorem, matrix of a linear transformation, change of basis and similarity; Eigenvalues and eigenvectors, algebraic and geometric multiplicity, diagonalization by similarity; Inner-product spaces, Gram-Schmidt process, orthonormal basis; Orthogonal, Hermitian and symmetric matrices, spectral theorem for real symmetric matrices.

Ordinary Differential Equations: First order differential equations exact differential equations, integrating factors, Bernoulli equations, existence and uniqueness theorem, applications; Higher-order linear differential equations solutions of homogeneous and nonhomogeneous equations, method of variation of parameters, operator method; Series solutions of linear differential equations, Legendre equation and Legendre polynomials, Bessel equation and Bessel functions of first and second kinds; Systems of first-order equations, phase plane, critical points, stability.

Texts:

1. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
2. S. L. Ross, Differential Equations, 3rd Edition, Wiley India, 1984.

References:

1. G. Strang, Linear Algebra and Its Applications, 4th Edition, Brooks/Cole India, 2006.
2. K. Hoffman and R. Kunze, Linear Algebra, 2nd Edition, Prentice Hall India, 2004.
3. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
4. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.

ME101 Engineering Mechanics **3-1-0-8**
Prerequisite: Nil

Equivalent Force Systems: concentrated and distributed force systems, simplest resultant (wrench), centre of pressure, centroid, and centre of gravity.

Equilibrium of Rigid Bodies: free body diagram, reactions, equations of equilibrium, static indeterminacy.

Analysis of Structures: analysis of trusses, method of joints and method of sections, analysis of frames and beams, shear force and bending moment, axial force and twisting

moment.

Friction: concept of friction, applications of friction to simple machines; rolling resistance.

Virtual Work: principle of virtual work and its application to machines.

Moment of Inertia: moments of inertia of simple and composite bodies, moments of inertia under transformation of axes, principle axes and principle moments of inertia, Mohrs circle.

Kinematics of Particles and Rigid Bodies: rectilinear motion, curvilinear motion, velocity and acceleration in cylindrical and path coordinate system, relative and constrained motion, rate of change of a vector in a rotating frame, three-dimensional motion of a particle relative to a rotating frame, rigid body kinematics.

Kinetics of Systems of Particles and Rigid Bodies: linear and angular momentum of a system of particles and a rigid body, kinetic energy of a system of particle and a rigid body, linear and angular momentum principles, Euler equation of motion.

Impact of Rigid Bodies: linear and angular impulse, impulse-momentum principle, work-energy principle, central and eccentric impacts.

References:

1. I. H. Shames, Engineering Mechanics: Statics and Dynamics, 4th Edition, PHI, 2002.

2. F. P. Beer, E. R. Johnston Jr., D. F. Mazurek, P. J. Cornwell, S. Sanghi, Vector Mechanics for Engineers Statics and Dynamics, 10th Edition, McGraw Hill, 2013.

3. J. L. Meriam, L. G. Kraige, Engineering Mechanics Statics, 7th Edition, John Willey, 2012.

PH102 Physics II **2-1-0-6**

Prerequisite: Nil

Electrostatics: Gauss's law and its applications, Divergence and Curl of Electrostatic fields,Electrostatic Potential, Boundary conditions, Work and Energy, Conductors, Capacitors, Laplace's equation, Method of images, Boundary value problems in Cartesian Coordinate Systems, Dielectrics, Polarization, Bound Charges, Electric displacement, Boundary conditions in dielectrics, Energy in dielectrics, Forces on dielectrics.

Magnetostatics: Lorentz force, Biot-Savart and Ampere's laws and their applications, Divergence and Curl of Magnetostatic fields, Magnetic vector Potential, Force and torque

on a magnetic dipole, Magnetic materials, Magnetization, Bound currents, Boundary conditions.

Electrodynamics: Ohm's law, Motional EMF, Faraday's law, Lenz's law, Self and Mutual inductance, Energy stored in magnetic field, Maxwell's equations, Continuity Equation, Poynting Theorem, Wave solution of Maxwell Equations.

Electromagnetic waves: Polarization, reflection and transmission at oblique incidences.

Texts:

1. D. J. Griffiths, Introduction to Electrodynamics, 3rd Edition, Prentice Hall of India, 2005.

References:

1. N. Eda, Engineering Electromagnetics, Springer, 2005.

2. M. N. O. Sadiku, Elements of Electromagnetics, Oxford, 2006.

3. R. P. Feynman, R. B. Leighton and M. Sands, The Feynman Lectures on Physics, Volume II, Narosa Publishing House, 1998.

4. I. S. Grant and W. R. Phillips, Electromagnetism, John Wiley, 1990.

PH110 Physics Laboratory **0-0-3-3**

Prerequisite: Nil

Experiments on general physics: Mechanics (compound pendulum etc.), Optics (single slit, Newton's ring etc.), Fluids (Jaeger's method etc.), and Electricity and Magnetism (Magnetic field, LCR circuit, etc.).

Texts:

1. Department of Physics, IIT Guwahati, Laboratory Manual with details about the experiments.

2. F. A. Jenkins and H. E. White, Fundamentals of Optics, Tata McGraw-Hill, 1981.

3. D. Halliday and R. Resnick, Fundamental of Physics, Wiley India Pvt. Limited, 2008.

4. D. J. Griffiths, Introduction to Electrodynamics, 3rd Edition, Prentice Hall of India, 2005.

MA201 Mathematics III 3-1-0-8

Prerequisite: Nil

Complex analysis: Complex numbers and elementary properties; Complex functions - limits, continuity and differentiation, Cauchy-Riemann equations, analytic and harmonic functions, elementary analytic functions, anti-derivatives and line (contour) integrals, Cauchy-Goursat theorem, Cauchy's integral formula, Morera's theorem, Liouville's theorem, Fundamental theorem of algebra and maximum modulus principle; Power series, Taylor series, zeros of analytic functions, singularities and Laurent series, Rouche's theorem and argument principle, residues, Cauchy's Residue theorem and applications, Mobius transformations and applications.

Partial differential equations: Fourier series, half-range Fourier series, Fourier transforms, finite sine and cosine transforms; First order partial differential equations, solutions of linear and quasilinear first order PDEs, method of characteristics; Classification of second-order PDEs, canonical form; Initial and boundary value problems involving wave equation and heat conduction equation, boundary value problems involving Laplace equation and solutions by method of separation of variables; Initial-boundary value problems in non-rectangular coordinates.

Laplace and inverse Laplace transforms, properties, convolutions; Solution of ODEs and PDEs by Laplace transform; Solution of PDEs by Fourier transform.

Texts:

1. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Edition, McGraw Hill, 2004.

2. I. N. Sneddon, Elements of Partial Differential Equations, McGraw Hill, 1957.

3. E. Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley, 2015.

References:

1. J. H. Mathews and R. W. Howell, Complex Analysis for Mathematics and Engineering, 3rd Edition, Narosa,1998.

2. S. J. Farlow, Partial Differential Equations for Scientists and Engineers, Dover Publications, 1993.

3. K. Sankara Rao, Introduction to Partial Differential Equations, 3rd Edition, Prentice Hall of India, 2011.

HS2xx Sustainable Development Goals **2-0-0-0**

Non-Credit Course, Grading: PP-Passed / NP-Not Passed

Prerequisite: Nil

From Millennium Development Goals to Sustainable Development Goals: scale, scope and interrelationship of SDGs, and Agenda 2030; Realizing the SDGs: 'degrowth', circular economy, inclusive society, sustainable cities, transport, digital revolution, innovation and infrastructure, goal based business models, sustainable designs, technology, renewable energy, sustainable production and consumption; Financing the SDGs: types of financing, new financing mechanisms and global funds; Implementing SDGs: governance and policy tools such as openness, participation, accountability, effectiveness and coherence; OECD's framework for policy coherence for sustainable development.

References:

1. Jeffrey D. Sachs, The age of sustainable development, Columbia University Press, 2015.

2. B. Gagnon, R. Leduc and L. Savard, Sustainable development in engineering: a review of principles and definition of a conceptual framework, Environmental Engineering Science 26(10) February 2008.

3. Simon Dalby, Susan Horton, Rianne Mahon and Diana Thomaz, Achieving the Sustainable Development Goals: Global Governance Challenges, Routledge, 2019.

4. Jennifer Elliott, An introduction to sustainable development, Routledge, 2012.

5. Paul J. H. Schoemaker and George S. Day, Innovating in uncertain markets: 10 lessons for green technologies, MIT Sloan Management Review, 52.4: 37-45, 2011.