Relevant Course Descriptions

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Academic Pattern

The 2020 Engineering Physics curriculum at IIT Hyderabad requires me to complete 130 IITH credits over the course of 4 years. Hence, one year of studies is equivalent to completing 32.5 IITH credits.
ECTS credits for course Y = 60 x (credits for course Y at home university) / (Number of credits equivalent to one year of full-time studies)
Following the above conversion formula : **1 IITH credit = 1.85 ECTS credit**
The highest possible grade point is 10 and the least passing grade point is 4. The Cumulative Grade Point Average (CGPA) is a weighted average of the grade points with courses' credits as the weights.

Index

1 Semester - I

1.1 EP1118 Maths for Physics

Contents :
Vector Algebra, Matrices and determinants, Vector calculus (gradient, divergence, curl and related theorems), Line, surface and volume integrals, Curvilinear coordinates (spherical and cylindrical polar, Jacobian, grad, divergence, curl, Laplacian)
IITH credits - 2
ECTS credits - 3.7

1.2 EP1128 Basic Electric Circuits

Contents :
Mesh and node analysis, Thevenin, Norton and other network theorems, two port Networks, Sinusoidal Steady state analysis of R-L-C circuits, Filters, Transient Circuit analysis through Laplace transform techniques.
IITH credits - 2
ECTS credits - 3.7

1.3 ID1063 Introduction to Programming

Contents :
Introduction to C and C++ programming. Problem solving and algorithms. Input and output operations, decision control structure, loop control structure, arrays, strings, etc. pointers, arrays, structures, functions, file operations. Lab is also included in this course.
IITH credits - 3
ECTS credits - 5.55

1.4 MA1110 Calculus-I

Contents :
Sequences and Series: Limit of a sequence, monotone and Cauchy sequences and properties of convergent sequences, examples. Infinite series, positive series, tests for convergence and divergence, integral test, alternating series, Leibnitz test. Differential Calculus: Continuity and differentiability of a function of single variable, statement of Rolle's Theorem, Lagrange's mean value theorem and applications.
IITH credits - 1
ECTS credits - 1.85

1.5 MA1220 Calculus-II

Contents :
Integral Calculus: Definite Integrals as a limit of sums, Applications of integration to area, volume, surface area, Improper integrals. Functions of several variables: Continuity and differentiability, mixed partial derivatives, local maxima and minima for function of two variables, Lagrange multipliers.
IITH credits - 1
ECTS credits - 1.85

2 Semester - II

2.1 EP1031 Physics Lab

Contents :
Determination of young's modulus of wood using a strain gauge. Determination of rigidity modulus of a wire using torsional pendulum. Verification of stefan's law and planck's constant. Study of the principle of superposition using a cathode ray oscilloscope(CRO). Determination of refractive index of the material of the prism using a spectrometer. Determination of the radius of curvature of a plano-convex lens using newton's rings method. Determination of the wavelength of a laser by studying the diffraction from a scale. Study of the field along the axis of a coil and the earth's magnetic feild. Determination of energy gap of a semiconductor. Study of the characteristics of zener diode and bipolar junction transistor(BJT).
IITH credits - 2
ECTS credits - 3.7

2.2 EP1208 Electricity and Magnetism

Contents :
Coulomb's law, Electric field, Divergence and curl of electrostatic fields, electric potential, work and energy in electrostatics, conductors, Special techniques to solve Laplace's equations, Method of images, separation of variables and Multiple expansion, Polarization, Field of a polarized object, Electric displacement and linear dielectrics. Lorentz force law, Biot-Savart Law, Divergence and curl of B, magnetic vector potential, magnetization, field of a magnetized object, linear and nonlinear media
IITH credits - 2
ECTS credits - 3.7

2.3 ID1054 Digital Fabrication

Contents :
Complete process chain for design and subsequent realization of concepts making use of 3D modelling and additive manufacturing (3D printing) processes: Familiarization with 3D solid modelling for creation of engineering and freeform geometries; 3D Scanning using CMM and laser scanners. 3D Printing concepts for conversion of CAD model into real part: slicing, effect of part orientation. Project involving ideation, design and final fabrication using 3D printing.
IITH credits - 2
ECTS credits - 3.7

2.4 MA1140 Elementary Linear Algebra

Contents :
Vector spaces, Subspaces, basis and dimension, linear transformations, representation of transformations by Matrices, linear functionals, transpose of linear transformations, canonical forms. Linear functionals and adjoints, Bilinear forms, symmetric bilinear forms, skew symmetric bilinear forms.
IITH credits - 1
ECTS credits - 1.85

2.5 MA1150 Differential Equations

Contents :
Ordinary Differential Equations: First order linear equations, Bernoulli's equations, Exact equations and integrating factor, Second order and Higher order linear differential equations with constant coefficients.
IITH credits - 1
ECTS credits - 1.85

3 Semester - III

3.1 EP2100 Classical Mechanics

Contents :
Mechanics of particles and systme of particles. Constraints. D'Alembert's principle and lagranges' equations. velocity-dependent potentials and the dissipation function. Simple Applications of the Lagrangian Formulation. Hamilton's principle. Calculus of variations. Extending Hamilton's principle to nonholonomic systems. Conservation theroems and symmetry properties. Energy function and conservation of energy. Central force problem. The Kepler problem. Three body problem. Euler angles. Euler's Theorem on the motion of a rigid body. Finite and infinitesimal rotations.
IITH credits - 3
ECTS credits - 5.55

3.2 ID2230 Data Structures and Applications

Contents :
Abstract data types, Big-Oh notation, Basic data types - Stacks, Queues, Trees. More data types. Dictionaries. Binary search trees, Balanced search trees, Hash tables; Heaps, Priority queues, Graphs. Algorithmic Design Paradigms, Divide and Conquer, Analysis for Divide and Conquer, Sorting, Greedy Algorithms. Dynamic Programming, Graph Algorithms (DFS, BFS, Topological Sort, Single Source Shortest Path, Spanning Trees, All Pair Shortest Path, Matching, Max Flow).
IITH credits - 3
ECTS credits - 5.55

3.3 MA2110 Probability

Contents :
Sample space and events, definitions of probability, properties of probability, conditional probability. Random variables: distribution functions, discrete and continuous random variables, moments of random variables, conditional expectation, Chebyshev inequality, functions of random variables. Special Distributions: Bernoulli, Binomial, Geometric, Pascal, Poisson, Exponential, Uniform, Normal distributions, Limit Theorems: Law of large numbers.
IITH credits - 2
ECTS credits - 3.7

4 Semester - IV

4.1 EP2200 Thermodynamics

Contents :
Kinetic theory of Gases, Maxwell-Boltzmann Distribution, molecular distribution, mean free path and collisions, transport and thermal diffusion, viscosity, thermal conductivity. Thermodynamic systems, First law of Thermodynamics, Second law of Thermodynamics, Clausius theorem, thermodynamics and statistical definition of Entropy, Gibbs paradox, Entropy and probability, internal energy and heat capacity equations and their applications.
IITH credits - 3
ECTS credits - 5.55

4.2 EP2228 Fluid dynamics

Contents :
Introduction - scope and relevance; Method of analysis - system vs control volumes - differential vs integral approach, Units and dimensions; Fluid properties - continuum, density, viscosity, surface tension, velocity, pressure, temperature; Fluid Statics - Hydrostatics, Fluid forces on planes and curved surfaces, submerged and floating bodies, Buoyancy and stability, Atmosphere as a fluid; Fluid Concepts - Streamlines, streaklines, pathlines, viscous vs inviscid flows, laminar vs turbulent flows, compressible vs incompressible flows; Engineering bernoulli equation; Control Volume analysis: Basic laws - Mass conservation law, thermodynamic laws, Newton's laws, Angular-Momentum principle; Buckingham Pi-theorem; Similitude and modeling - scaling effects; Flows in a pipes and channels - friction factor, flow measurement devices - Venturi meter, Orifice meter. Differential analysis to fluid flow: Conservation of Mass - Coordinate systems, Kinematics - Translation, Rotation, Deformation, derivation of Governing

equations of fluid flows - continuity, Euler equations, Potential flows - Bernoulli equation and applications to external aerodynamics, Navier-Stokes equations, Non-dimensional analysis; Exact solutions of Navier-Stokes equations; Internal flows; External flows - Prandtl's Boundary layer theory - flow over a flat plate, concept of similarity; Approximate methods - von Karman Integral analysis; (Thwaites method); Flow separation; Brief introduction to turbulence - characteristics of turbulence, drag crisis.
IITH credits - 2
ECTS credits - 3.7

4.3 EP3208 Advanced Mathematical Physics

Contents :
Infinite sequences and series - convergence and divergence, conditional and absolute convergence, ratio test for convergence, Special functions (Euler beta and gamma, Heaviside Step function, Dirac Delta function, Kronecker delta, Bessel equation and function, Legendre equation and function, Spherical harmonics, Green function, hermite, Laguerre, Chebyshev), Probability and Statistics (Various distributions e.g. Gaussian, Poisson, Binomial, Error analysis), Fourier Series and transforms, Laplace series and transforms, Ordinary differential equations, Partial differential equations: First order, second order, separation of variables, Laplace and Poisson equations, Wave equations.
IITH credits - 2
ECTS credits - 3.7

4.4 EP3227 Nonlinear Dynamics

Contents :
Nonliner methods and chaos, stability, logistic map, Nonlinear differential equations, application to physics and engineering, one dimensional system, bifurcations
IITH credits - 1
ECTS credits - 1.85

4.5 EP4210 Computational Physics

Contents :
Interpolation; Least square and spline approximation; numerical differentiation and integration; Numerical methods for matrices; Extremes of a function; Non-linear equations and roots of polynomials; Numerical methods for ordinary differential equations; Numerical solution of Sturn-Liouville and Schrodinger equation; Discrete and fast Fourier transforms; Molecular dynamics and Monte Carlo simulations; Numerical methods for partial differential equations; Applications of numerical methods in Physics
IITH credits - 3
ECTS credits - 5.55

4.6 MA2140 Statistics

Contents :
Fundamentals of Data: Collection, Summarization, and Visualization; Sampling and Sampling Distributions, Central Limit Theorem; Methods of Estimation, Unbiased estimators; Confidence Interval Estimation: Z-interval, t-interval; Hypothesis Testing, Types of Errors, Rejection Region Approach and p-value Approach.
IITH credits - 1
ECTS credits - 1.85

5 Semester - V

5.1 EE3900 Linear Systems and Signal Processing

Contents :
Introduction: The communication process, Sources of information, Communication channels, Baseband and pass band signals, Representation of signals and systems, The modulation process, Information theory and coding, Analog versus digital communications Representation of signals and systems: Notation of energy and power, Dirac delta function, Continuous-time LTI systems and their properties, The Fourier transform and its properties, Transmission of signals through linear systems, Filters, Hilbert transform, Pre-envelope, Canonical representation of band-pass signals, Phase and group delay. Modulation: Amplitude modulation, Double sideband-suppressed carrier modulation, Single sideband modulation, VSB, Frequency modulation, Phase- locked loop. Review of LTI systems and their properties, Convolution sum, Sampling of continuous-time signals, Discrete-time Fourier transform (DTFT) and its properties, Sampling in frequency domain, Discrete Fourier transform (DFT) and its properties, Z-transform and its inverse, region of convergence, pole-zero locations and frequency response, stability analysis, implementation of discrete-time systems, design of FIR filters and IIR filters, linear phase filters, group delay, response of first and second order filters, Computational issues in DFT, FFT algorithm
IITH credits - 3
ECTS credits - 5.55

5.2 EP3051 Physics Lab (EP)

Contents :
Determination of elastic constants by cornu's method. Study of dielectric constant of material. Electron charge to mass ratio. Faraday effect. Study of hall effect. Study of magnetic hysteresis. Millikan's oil drop experiment. Determination of magnetic mass susceptibility of a liquid by quincke's method. Ultrasonic interferometer. Young's modulus of a wooden beam by method of flexure.
IITH credits - 2
ECTS credits - 3.7

5.3 EP3105 Project-1

Contents :
Modelling and simulation of thermo and fluid dynamic processes inside Compression Ignition Engines using MATLAB and python to predict real time performance.
IITH credits - 3
ECTS credits - 5.55

6 Semester - VI

6.1 EP3205 Project-2

Contents :
Deriving a complete set of equations of motion of multiple rigid bodies that comprise a motorbike using Lagrangian mechanics. Predicting the trajectory and behaviour of the motorbike from a few input parameters.
IITH credits - 3
ECTS credits - 5.55

6.2 EP4130 Data Science Analysis

Contents :
Measurement, analysis; Probability distributions; Parameter Estimation; Hypothesis testing; Model Comparison; Confidence Intervals; Bayesian Analysis; Markov Chain Monte Carlo techniques; Dimensionality Reduction; Time-series analysis
IITH credits - 3
ECTS credits - 5.55

7 Semester - VII

7.1 ME5120 Dynamics and Vibration

Contents :
Particle and system of particle dynamics. State space representation. Approaches for describing systems in various coordinate systems and accounting for relative motion between systems. Analytical Dynamics. Principle of Virtual Work. D'Alembert's principle. Extended Hamilton's principle. Introduction to vibration. Vibration parameters. Lumped-element model. Response of single degree of freedom systems. Damping/Quality Factor. Responses for harmonic and non-harmonic excitations. Describing and solving two degrees of freedom systems for string, rod and shaft like systems.
IITH credits - 3
ECTS credits - 5.55

8 Semester - VIII (Ongoing)

8.1 ME2220 Kinematics and Dynamics of Machinery

Contents :
Brief introduction to Mechanical Engineering, Machinery, Machines, and Mechanisms. Basic kinematic concepts: links, kinematic pairs, kinematic chains, degree of freedom, Kutzbach criterion, Grübler's equation, and kinematic inversions; Introduction to Geogebra and Matlab. Introduction to four-bar mechanisms; Grashof's linkages; Kinematic analysis of mechanisms, loop-closure equations, implementation in Matlab/python; Analysis in Simscape. Graphical analysis of mechanisms; Instantaneous center of rotation, Kennedy's theorem; Velocity and acceleration diagrams. Four-bar synthesis, Freudenstein's equations; Path generation; Motion Generation; Function generation; Graphical synthesis. Cams: terminology, classification, analytical and graphical synthesis of translating flat-face, translating roller and

oscillating roller follower cams; Fundamental law of gearing, involute profile; Gears: terminology, classification, interference and undercutting, minimum number of teeth, contact ratio; Gear trains: simple, compound and epicyclic. Introduction; dynamics of rigid bodies in plane motion; dynamic force analysis of machines; flywheels, balancing of rotors and in-line internal combustion engines; chain and belt drive.
IITH credits - 3
ECTS credits - 5.55

8.2 ME5610 Fracture Mechanics

Contents :
Modes of loading, Classification as LEFM and EPFM, Crack growth and fracture mechanisms, Energy release rate, Crack branching, Equivalence between SIF and G, Various methods for evaluating Stress Intensity Factors, Modeling plastic zone at the crack-tip.
IITH credits - 3
ECTS credits - 5.55

9 Validation

Certified by Prof. Kirit Makwana, Faculty Advisor for BTech Engineering Physics batch of 2020-24.

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