CURRICULUM

BTech Computer Science and Engineering

Semesters I and II

Batch 2023 and Onwards

Department of Computer Science and Engineering

Islamic University of Science and Technology, Kashmir

Course Outline for 1st Semester

Total Credits = 18 *Total Hours Per Week* = 26

S.No	Course Code	Course Title	L	T	P	S	Hours Per Week	Credits
1	MTH115C	Calculus for Engineers	3	1	0	0	4	4
2	PHY102C	Engineering Physics	3	0	2	0	5	4
3	CHM102C	Engineering Chemistry	3	0	2	0	5	4
4	CIV101A	Introduction to Environmental Science and Engineering	2	0	0	1	2	0
5	MEC102C	Engineering Visualisation	1	0	4	0	5	3
6	ENG107F	Technical Communication	2	0	2	0	4	3
7	MEC104A	Engineering Perspectives	1	0	0	1	1	0

Course Outline for 2nd Semester

Total Credits = 20 *Total Hours Per Week* = 23

S.No	Course Code	Course Title	L	T	P	S	Hours Per Week	Credits
1	MTH155C	Linear Algebra and Differential Equations	3	1	0	0	4	4
2	CIV152C	Engineering Mechanics	3	0	0	0	3	3
3	ELE150C	Basic Electrical Engineering	3	0	2	0	5	4
4	CSE160F	Programming for Problem Solving	3	0	2	0	5	4
5	ECE151C	Basic Electronic Devices	3	0	0	0	3	3
6	MEC152C	Product Realisation through Manufacturing	0	0	2	1	2	2
7	SS01A	Ethics and Social Responsibilities	1	0	0	0	1	0

MTH115C Calculus For Engineers 3-1-0-0

Course Objectives: The objective of this course is to provide introduction to important topics of applied mathematics, namely Single and Multivariable Calculus and Vector Calculus etc. The course would provide the relevant background and foundations necessary to understand the higher engineering mathematics courses.

Course Outcomes: At the end of this course, a student will be able to:

1. Apply single variable differentiation and integration to solve applied problems in engineering and find the maxima and minima of functions.
2. Understanding sequences and various techniques to discuss convergence or divergence of infinite series.
3. Evaluate partial derivatives, limits, total differentials, Jacobians, Taylor series and optimization problems involving several variables with or without constraints.
4. Evaluate multiple integrals in finding the volumes of different solids.
5. Evaluation of some complicated integrals by making use of differential under integral sign method.

Module I

Differential Calculus: Review of limit, indeterminate forms and L'Hospital's rule. Continuity and differentiability. Mean value theorems and applications, Taylor's theorem, maxima, and minima.

Module II

Real Sequences and Series: Sequences and series, limsup, liminf, convergence of sequences and series of real numbers, absolute and conditional convergence.

Module III

Integral Calculus: Riemann integral, fundamental theorem of integral calculus, applications of definite integrals, improper integrals, beta and gamma functions.

Module IV

Advanced Calculus: Functions of several variables, limit and continuity, partial derivatives and differentiability, chain rule, homogeneous functions and Euler's Theorem. Taylor's theorem, maxima and minima and the method of Lagrange's multipliers.

Module V

Applications Of Integral Calculus: Double and triple integration, Jacobian and change of variables formula. Parameterization of curves and surfaces. Differential under the sign of integration both with constant and variable limits and applications.

Pre-requisites: NA

Text Books:

1. J. Bird, Higher Engineering Mathematics, , 6th Edition, Elsevier Limited, 2017.
2. J. Stewart,Calculus: Early Transcendentals , 8th Edition, Cengage Learning, 2017.

Reference Books:

1. K. A. Stroud and Dexter J. Booth, Engineering Mathematics,7th Edition, Palgrave Macmillan, 2013.

Online Resources:

1. Basic Calculus for Engineers, Scientists and Economists by Prof. Joydeep Dutta (IIT Kanpur) NPTEL Course (https://nptel.ac.in/courses/111104085).

PHY102C Engineering Physics 3-0-2-0

Course Objectives: This course will enable students to understand the basics of the latest advancements in Physics viz., Quantum Mechanics, Nanotechnology, Lasers, Electromagnetic Theory and Fiber Optics.

Course Outcomes: At the end of this course, a student will be able to:

1. Explain the dual nature of radiation and matter.
2. Apply Schrodinger's equations to solve finite and infinite potential problems.
3. Apply quantum ideas at the nano-scale and for understanding the operation and working principle of optoelectronic devices.
4. Analyze Maxwell's equations in differential and integral form.
5. Classify the optical fibre for different engineering applications.

Module I

Vector Calculus: Vector Analysis, Transformation of vectors under rotation, Gradient of scalar field, divergence and curl of vector field in Cartesian and Spherical coordinate systems, line, surface & volume integrals, Gauss's divergence theorem, Stoke's theorem.

Module II

Quantum Mechanics: Need for quantum theory, Plank's radiation law, Compton effect, Heisenberg's uncertainty Principle, de-Broglie hypothesis, basic postulates of quantum mechanics, Schrödinger Equation (Time dependent and Independent), wave function and its interpretation, Application of Schrödinger theory to particle in 1D box, superposition principle, Step potential (Qualitative only) and concept of tunnelling.

Module III

Electromagnetic Theory-I: Electric field of continuous charge distribution, Divergence and curl of electric field, Gauss's law (integral and differential form), Electric potential and its relation with electric field, Biot-Savart law, Divergence and curl of magnetic field, Magnetic vector potential.

Module IV

Electromagnetic Theory-II: Faraday's laws, Ampere's law, Maxwell's modification of Ampere's law, Maxwell Equations in media and vacuum, Continuity equation, EM Wave Equation (Derivation) and boundary conditions, plane wave solutions.

Module V

Fibre Optics: Fiber Optics: optical fiber, Structure and types of optical fibers, Total internal reflection, Light propagation through fibers, Acceptance angle, Numerical Aperture, Brewster's angle, Attenuation, Applications of fiber optics in communication and endoscopy.

List of Experiments

Mechanics

1. To determine the value of Acceleration due to gravity (g) by using Bar Pendulum,
2. To determine the Young's Modulus of elasticity of rectangular Steel Bar by Bending of Beam Method.
3. Determination of Modulus of rigidity of wire by Maxwell's Needle
4. To determine the moment of Inertia of a Flywheel

Electromagnetism

1. To determine the value of e/m of an Electron by Thomson Method
2. To determine the frequency of AC by Melde's Method

Quantum Mechanics

1. To determine Planck's constant.
2. To verify Stefan's Law by Electrical method.

Solid State Physics and Electronics

1. To study the Hall Effect:
    i. Determination of Hall Voltage and RH.
    ii. Determination of mobility of charge carriers and carrier concentration in a Semiconductor.
2. To determine the energy band gap of a semiconductor sample by Four Probe method

Optics

1. To determine the refractive index of Crown Glass Prism.
2. To determine the Wavelength of Prominent lines of Mercury Light by Plane Diffraction Grating.
3. To study the slit diffraction pattern and determine the wavelength of laser light.

Pre-requisites: NA

Text Books:

1. D. J. Griffith, Introduction to Electrodynamics, 2014, 4th Edition, Pearson.
2. D. Neamen, Semiconductor Physics and Devices: Basic Principles, McGraw Hill
3. A. Beiser, Concepts of Modern Physics, 2013, Sixth Edition, Tata McGraw Hill.
4. W. Silfvast, Laser Fundamentals, 2008, Cambridge University Press.
5. I. Prakash, A textbook of practical physics Vol 1 & 2, Kitab Mahal, 1987.
6. C. L. Arora, B.Sc. Practical Physics, S. Chand pub.

Reference Books:

1. B. D. Duggal, C. L. Chhabra D. K. Mynbaev and L. L .Scheiner, Fiber Optic Communication Technology, 2011, Pearson
2. R. A. Serway, C. J. Mosses and C. A. Moyer Modern Physics, 2010, 3rd Indian Edition Cengage learning.
3. J. R. Taylor, C D. Zafiratos and M.A. Dubson, Modern Physics for Scientists and Engineers, 2011, PHI Learning Private Ltd.
4. The Feynman Lectures on Physics Vol 1-3.
5. P. R. Sasi Kumar, Practical Physics, PHI.
6. Lab. Manuals.

Online Resources:

1. Engineering Physics II by Prof. D. K. Ghosh (IIT Bombay), NPTEL Course (https://nptel.ac.in/courses/122101002).
2. Electromagnetic Theory by Prof. D. K. Ghosh (IIT Bombay), NPTEL Course (https://nptel.ac.in/courses/115101005).

CHM102C Engineering Chemistry 3-0-2-0

Course Objectives: The objective of this course is to impart technological aspects of applied chemistry and lay the foundation for practical application of chemistry in engineering applications.

Course Outcomes: At the end of this course, a student will be able to:

1. Evaluate the causes of metallic corrosion and apply the methods for corrosion protection of metals.
2. Evaluate the electrochemical energy storage systems such as lithium batteries, fuel cells and design for usage in electrical and electronic applications.
3. Analyse the properties of different polymers and distinguish the polymers which can be degraded and demonstrate their usefulness.
4. Explain the chemistry and classification of lubricants.
5. Explain the significance of modern automated instruments for performing multiple simultaneous sampling and testing.

Module I

Chemical Thermodynamics: Introduction and Importance of Thermodynamics, Introduction to different laws of Thermodynamics, Qualitative difference between First and Second Laws of thermodynamics, Work done in Isothermal and Adiabatic Conditions, Heat capacities, Relation between Cp and Cv, Carnot engine, Entropy, Helmholtz free energy (A) and Gibbs free energy (G), Relation between A and G. Thermodynamic Criteria for Reversible and Irreversible processes

Module II

Electro-Chemistry and Corrosion: Introduction of electrochemistry and corrosion: a correlation, Difference between metal and electrolytic conductance with the basic applicable terminology, Electrochemical cells, Batteries, Fuel Cells, Lithium ion batteries---General characteristics, electrode materials and electrolytes. Electrochemical theory of Corrosion and Dry Corrosion, mechanisms involved in different types of corrosion, Factors affecting Corrosion, Electrochemical series versus Galvanic series, Corrosion protection - cathodic protection – sacrificial anodic and impressed current protection methods.

Module III

Nanotechnology and Polymers: Introduction to nanomaterials and polymers with special emphasis on the applications in material science, Properties at Nanoscale: Optical, Electrical, and Magnetic. General Methods of Preparation of Nanomaterials viz Top Down (Ball Milling, Lithography), Bottom-up Methods (Sol-Gel, Solution Based Method) and microbial synthesis. Basic terms used in polymer science, Preparation, Properties and Engineering applications of some Important Polymers, Polythene, Polyvinyl Chloride, Polystyrene, Teflon, Phenol Formaldehyde resin.

Module IV

Lubricants: Introduction, Function of Lubricants, Mechanism of Lubrication, Classification of Lubricants (Liquid, Semisolid, Solid), Properties of Lubricants (Flash Point and Fire Point, Viscosity, Aniline Point Acid value).

Module V

Instrumental Techniques: Introduction, Advantages and Disadvantages of Instrumental and Non-Instrumental Methods, Electromagnetic Radiation, Electromagnetic Spectrum, Light Absorption (Beers-Lambert Law), UV-Vis. spectroscopy, Types of Transitions, Chromophores, Auxo-chromes and Applications; Infrared Spectroscopy, Modes of vibration, IR bands corresponding to different functional groups and Applications. Introduction to Thermal Methods of Analysis: Thermo

gravimetric analysis (TGA), Principle, Instrumentation, Applications of TGA in analysis of engineering materials.

List of Experiments:

1. Basic Introduction on Solution Preparation, Concentration terms, Handling of Glassware, Chemicals.
2. Determination of strength of NaOH solution by standardisation of sodium hydroxide using Oxalic acid.
3. To determine the acid value of a given mineral oil or vegetable oil.
4. To determine the moisture content of a given sample of coal.
5. To determine the Degree of dissociation of a weak acid by Conductometry.
6. Determination of the strength and pKa value of the weak acid by titration with an alkali.
7. To determine the Aniline point of the given sample of a Lubricating oil.
8. Synthesis of phenol formaldehyde resin.
9. To determine the temporary and permanent hardness of a sample of water by complexometric titration.
10. To determine the Alkalinity of the given sample of water.
11. Determination of the ion exchange capacity of cation exchange resin.
12. Construction and working of an Zn-Cu electrochemical cell.
13. Determination of viscosity-average molecular weight of different natural/ synthetic polymers.
14. Analysis of Iron in carbon steel by potentiometry.
15. Determination of level of TDS in water.
16. Demonstration Experiments:
    i. Determination of pH of different concentrations of acid and bases by pH meter.
    ii. Spectrophotometer (concentration determination, wavelength maximum).

Pre-requisites: NA

Text Books:

1. P .C. Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai & Sons, New Delhi.
2. L. A. Munro, Chemistry in Engineering, 1964, Prentice Hall, New York.
3. J. Kuriacose, R. Rajaram, Chemistry in Engineering and Technology Volumes I & II, , 2001, TMH publishing company Limited, New Delhi.
4. R. M. E. Diamant, Applied Chemistry for Engineers, 3rd Revised Edition, Pitman Publishing.
5. P. C. Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai & Sons, New Delhi.
6. L. A. Munro, Chemistry in Engineering, 1964, Prentice Hall, New York.

Reference Books:

1. T. Minami, M. Tatsumisago, M.Wakihara, C. Iwakura, S. Kohijiya, Solid state ionics for batteries, Springer Publication, 2009.
2. S. Dhameja, Electric Vehicle Battery Systems, Newnes publication, 2001.
3. P. Sharma and Pathania, Principles of Physical Chemistry –2017, 4th Edition, Vishal Publishing Co.
4. N. Perez, Electrochemistry and Corrosion Science, 2nd Edition, 2016, Springer.
5. T. Minami, M. Tatsumisago, M. Wakihara, C. Iwakura and S. Kohijiya, Solid state ionics for batteries, Springer Publication, 2009.
6. S. Dhameja, Electric Vehicle Battery Systems, Newnes publication, 2001.

Online Resources:

1. Engineering Chemistry I NPTEL Course (IIT Bombay) (https://archive.nptel.ac.in/courses/122/101/122101001/).
2. Tribology NPTEL Course (IIT Delhi) (https://nptel.ac.in/courses/112102014).

CIV101A Introduction to Environmental Science and Engineering 2-0-0-1

Course Objectives: This course will enable students to understand the basic principles of environmental engineering and to introduce the fundamental concepts of environmental pollution and its sources. The course shall also enable the students to understand the policies vis a vis environmental issues and ethics and will impart the concept of sustainability.

Course Outcomes: At the end of this course, a student will be able to:

1. Explain the principles of environmental sciences and engineering.
2. Identify the issues related to environmental pollution.
3. Explain the concept of sustainable development goals (SDG).
4. Discuss contemporary issues related to the environment.

Module I

Introduction: History of Environmental Science and Engineering, Biography of Renowned Environmental Scientists and Professionals.

Module II

Resources and Pollutions: Natural Resources; Renewable and Nonrenewable Energy Sources; Introduction to Environmental Pollution; Evolution of Pollution Control Strategies and Environmental Infrastructure.

Module III

Environmental Policies and Ethics: Major Environmental Episodes; Evolution of Environmental Acts and Policies; Environmental Ethics.

Module IV

Sustainability: Sustainability Concepts; Recent Research and Future Prospects in the field of Environment.

Module V

From Theory to Practice: Invited Talks from Environment Experts; Recorded Videos and Reference Study Material, Tours to different sites and facilities.

Pre-requisites: NA

Text Books:

1. W. P. Cunningham and M. A. Cunningham , Principles of Environmental Science, Tata McGraw-Hill Publishing Company, New Delhi, 2002.

Reference Books:

1. A. R. W. Jackson and J. M. Jackson, Environmental Sciences: The Environment and Human Impact, Longman Publishers, 1996.
2. G. M. Masters, Introduction to Environmental Engineering and Science, Prentice Hall, New Delhi, 2008.
3. A. Rosencranz, S. Divan and M. L. Noble, Environmental Law and Policy in India: Cases, Materials and Statutes, Tripathi Pvt. Ltd, Bombay, 1992.
4. S. R. Asolekar and R. Gopichandran, Preventive Environmental Management – An Indian Perspective Foundation Books Pvt. Ltd., New Delhi (the Indian association of Cambridge University Press, UK), 2005.

Online Resources:

1. Introduction to Environmental Engineering by Dr. V. C. Srivastava (IIT Roorkee), NPTEL Course (https://nptel.ac.in/courses/103107084).

MEC102C Engineering Visualisation 1-0-4-0

Course Objectives: This course will enable students to understand the importance of basic concepts and principles of Engineering Drawing (components, sections, views, and graphical representation) and enrich them with the knowledge of dimensioning, conventions and standards related to working drawings in order to become professionally efficient. The students will develop an ability to read and interpret engineering drawings created by others.

Course Outcomes: At the end of this course, a student will be able to:

1. Explain the significance of engineering drawing.
2. Implement the engineering graphics standards for a given drawing.
3. Construct a 3D (Isometric Projection) from a given set of 2D drawings, vice versa.
4. Use Computer aided tools (CAD Software) for better visualisation.
5. Draw various 2D drawings using conventional and CAD tools.

Module I

Introduction to Conventional Drawing: Importance of Engineering Drawing, Drawing instruments and materials, B.I.S. and ISO Conventions, Dimensioning & Tolerances, First angle and third angle projection method. Projection of points in different quadrants.

Module II

Projection of Lines and Planes: Orthographic Projection of Straight Line parallel to one plane and inclined to the other plane–Straight Line inclined to both the planes–True Length and inclination of lines with reference planes–Traces of line–Projection of Planes, projection of planes with its inclination with two reference planes, concept of auxiliary plane method for projection of planes.

Module III

Projection of Solids and Sections of Solids: Classifications of Solids, Projections of right and regular solids, Section plane perpendicular to one plane and parallel to other, Section plane inclined to one plane and perpendicular to other plane.

Module IV

Isometric Projections: Principles of Isometric projection, Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

Module V

Introduction to CAD: Introduction to Computer Aided Drafting (CAD), Reasons for implementing CAD, Applications of CAD, Benefits/limitations of CAD, Hardware of CAD system, Types of CAD software, the Menu System, Toolbars, Standard, Object Properties, Dialog boxes and windows, Shortcut menus, Different commands used in CAD.

1. Exercise on CAD software for projection of lines with reference to different planes
2. Exercise on CAD software for projection of planes with its inclination with two reference planes.
3. Exercise on CAD software for projection of solids with reference to different planes.
4. Exercise on CAD software for Section plane perpendicular to one plane and parallel to other.
5. Exercise on CAD software for Section plane inclined to one plane and perpendicular to another plane.

Pre-requisites: NA

Text Books:

1. N. D. Bhatt, V. M. Panchal and P. R. Ingle, Engineering Drawing, Charota Publishing House, 2014.

Reference Books:

1. B. Agrawal and C. M. Agrawal, Engineering Graphics, TMH Publication, 2012.
2. K. L. Narayana, and P Kannaiah, Text book on Engineering Drawing, Scitech Publishers, 2008.

Online Resources:

1. Engineering Graphics and Design by Prof. Naresh Varma Dalta, Prof. S. R. Kale (IIT Delhi), NPTEL Course (https://archive.nptel.ac.in/courses/112/102/112102304/).
2. Engineering Drawing by Prof. P. S. Robi (IIT Guwahati), NPTEL Course (https://nptel.ac.in/courses/112103019).

ENG107F Technical Communication 2-0-2-0

Course Objectives: This course will enable students to have written and spoken communications skills. The students will have communicative competence through listening and speaking activities in the classroom and language lab. They will acquire proficiency levels in LSRW skills on par with the requirements for placement interviews of high-end companies / competitive exams. They shall be able to evaluate complex arguments and to speak and write on general and technical topics.

Course Outcomes: At the end of this course, a student will be able to:

1. Improve listening skills so as to understand complex business communication in a variety of global English accents.
2. Enrich vocabulary through proper pronunciation and improve speaking skills in academic and social contexts.
3. Interpret texts, diagrams and improve both reading and writing skills which would help him/her in his/her academic as well as professional career.
4. Interpret topics from different perspectives; analyze complex concepts and present them in speech and writing
5. Write clearly and coherently on academic and general topics.

Module I

Fundamentals of verbal, non-verbal Communication: Verbal communication: Role and purpose of communication. Forms of communication. Barriers to effective communication. Non-verbal Communication: Relevance and effective use. Para language: Importance, Elements, Interpretation. Kinesis, Proxemics, Haptics, Chronemics, Occulesics. Cross-cultural non-verbal communication. Global accents.

Module II

Effective Reading, Comprehension and listening skills: Process and types of reading. Reading tactics and strategies. Skimming, Scanning, Intensive reading, Extensive reading. Reading Comprehension. Process and Types of Listening. Effective Listening: Principles and Barriers. Paraphrasing/Summarizing. Activities to enhance listening (Listening to News, Motivational speeches in global English accents). Activity: Note-making and Interpretive exercises.

Module III

Art of Public Speaking: Impromptu, Importance of Non-verbal Communication, Technical Talks, Dynamics of Professional Presentations – Individual & Group. Speaking: Socializing Skills - Introducing Oneself, SWOT analysis, Speeches: Types of speeches like extempore /monologues etc. Group discussion on: Factual, controversial and abstract issues.

Module IV

Writing Skill: Structure of documents, importance of tabs, indents and line spacing, Précis, Report writing, Letter writing (formal, informal), Notices, Summary writing, Parts of a Research paper, Abstract writing, how to avoid plagiarism, Resume Preparation/CV– writing your comprehensive CV including professional achievements in your life, SOP writing, how to write a review, review of Ted-talks: globally famous personalities, motivational speakers – sports celebrities, entrepreneurs. Activity: Classroom discussion and note-making.

Module V

Presentation Skills: Structure of presentations, Persuasive and Content-Specific Presentations Activity: Technical Presentations, Use of visual communication to inform, engage, inspire and persuade your audience, Usage of colors, fonts, pictures and videos to increase the impact of presentation. Use of data through compelling charts and graphs that narrate a story/theme.

Pre-requisites: NA

Text Books:

1. S. Kumar and L. Pushp, English Language and Communication Skills for Engineers, India, Oxford University Press, 2018
2. I. Bhattacharya, An Approach to Communication Skills, Dhanpat Rai Publications Pvt Ltd.
3. O. Clive and C. Latham-Koenig, New English File: Advanced Students Book. Paperback. Oxford University Press, UK, 2017.
4. A. Rizvi, Effective Technical Communication. McGraw-Hill India, 2017.

Reference Books:

1. P. Seargeant and B. Greenwell, From Language to Creative Writing, Bloomsbury Academic, 2013.
2. S. Brown and D. Smith, Active Listening, 3rd Edition, UK: Cambridge University Press, 2011.
3. M. Swan, Practical English Usage (Practical English Usage), 4th edition, UK: Oxford University Press, 2017.
4. W. Peter, Teaching and Developing Reading Skills: Cambridge Handbooks for Language teachers, UK: Cambridge University Press, 2018.
5. E. H. Glendinning and B. Holmstrom, Study Reading, 2nd Edition, UK: Cambridge University Press, 2012.

Online Resources:

1. http://www.eco-ction.org/dt/thinking.html (Leopold, Aldo. "Thinking like a Mountain")
2. https://www.esl-lab.com/
3. http://www.bbc.co.uk/learningenglish/
4. https://learningenglish.voanews.com/a/using-voa-learning-english-to-improve-listeningskills/3815547.html

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MEC104A Engineering Perspectives 1-0-0-1

Course Objectives: This course will enable students to get exposed to engineering solutions in terms of sustainability, economic, environmental, and social considerations. The course will also highlight the socio-technical and interdisciplinary nature of engineering.

Course Outcomes: At the end of this course, a student will be able to:

1. Explain the significance of research and development in engineering and its enormous impact on our day to day lives.
2. Develop an interest in stem subjects via DIY exercises and experiential learning workshops.

Outline of the Course:

Introduction to Engineering, Exposing students to "Engineering" as a profession that creates wealth for nations, and as a vehicle for economic growth, Exposing students to successful research cases, products and innovations which have reached people/industry/society.

Thought provoking lectures by successful industrialists, entrepreneurs, designers and alumni like Aerospace, Mechatronics, Additive manufacturing, Engineering Material, Software's, Microprocessors, AI/ML, Design, Global warming, Disaster management, Sustainability, SDG etc.

Social Component:

Do It Yourself (DIY) projects in teams: Select from ideas and make quick prototypes (mock-ups) using available material.

1. Visit to at least one local industry
2. Visit to Design Innovation Centre, IUST
3. Visit to one laboratory from each engineering department.
4. Experiential learning workshops: e.g., Simple assemblies, 3D printing, Reverse Engineering etc.

Evaluation: Based on attendance/viva voce/DIY projects/etc.

Textbooks: NA

Reference Books: NA

Online Resources: NA

MTH155C Linear Algebra and Differential Equations 3-1-0-0

Course Objectives: This course will enable students to understand the elementary notions of Fourier series, which is vital in practical harmonic analysis. The students will be exposed to the concept of eigenvalues and eigenvectors of matrices and the transform techniques to solve linear systems that arise in sciences and engineering. The course will also enrich the skills in solving initial and boundary value problems.

Course Outcomes: At the end of this course, a student will be able to:

1. Explain and apply the concept of vector spaces, subspaces, bases, dimension, and their properties.
2. Relate matrices and linear transformations, compute Eigenvalues and Eigenvectors of linear transformations.
3. Identify and apply the nature, formation, geometry, and solution of differential equations.
4. Apply the techniques to solve differential equations including series solution.
5. Employ the tools of Fourier series to find harmonics of periodic functions from the tabulated values.

Module I

Vector Spaces: Vector spaces over Q, R and C, subspaces, linear independence, linear span of a set of vectors, basis, and dimension of a vector space, sum and direct sum. Systems of linear (homogeneous and non-homogeneous) equations, matrices and Gauss elimination, elementary row operations, row space, column space, null space, and rank of a matrix.

Module II

Linear Mapping and Matrices: Linear transformation, rank-nullity theorem and its applications, matrix representation of a linear transformation, change of basis and similarity. Eigenvalues and eigenvectors, characteristic and minimal polynomials, Cayley-Hamilton theorem (without proof) and applications.

Module III

Ordinary Differential Equations I: Review of first order differential equations, Picard's theorem, linear dependence and Wronskian. Dimensionality of space of solutions, linear ODE with constant coefficients of second and higher order, Cauchy-Euler equations.

Module IV

Differential Equations II: Simultaneous differential equations. System of linear differential equations with constant coefficients, fundamental matrix, matrix methods.

Module V

Power Series and Fourier Analysis: Power Series and its convergence, power series method, Fourier series - Euler's formulae - Dirichlet's conditions - Change of interval - Half range series – RMS value – Parseval's identity – Computation of harmonics.

Pre-requisites: None

Text Books:

1. E. Kreyszig, Advanced Engineering Mathematics, 10th Edition, 2015, John Wiley, India.
2. M. D. Greenberg, Advanced Engineering Mathematics, 2nd Edition, 2006 Pearson.

Reference Books:

1. B. S. Grewal, Higher Engineering Mathematics, 43rd Edition, 2015 Khanna Publishers, India,

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Online Resources:

1. Ordinary Differential Equations and Applications by A. K. Nandakumaran, P. S. Datti & Raju K. George, (IISc Bangalore), NPTEL Course (https://www.digimat.in/nptel/courses/video/111108081/L01.html).
2. Linear Algebra by Dr. K.C. Sivakumar, Department of Mathematics (IIT Madras), NPTEL Course (https://nptel.ac.in/courses/111106051).

CIV152C Engineering Mechanics 3-0-0-0

Course Objectives: This course will enable students to have the knowledge of fundamental laws and basic concepts of rigid body mechanics to solve problems of bodies under rest or in motion. The students will also be able to apply conditions of static equilibrium to analyze physical systems and compute the properties of areas and bodies.

Course Outcomes: At the end of this course, a student will be able to:

1. Compute the resultant system of forces in plane and space acting on bodies.
2. Predict the support-reactions and the internal forces of the members of various trusses and Frames.
3. Apply transfer theorems to determine properties of various sections.
4. Analyse equilibrium of connected bodies virtual work method.
5. Apply the laws of dynamics to real life problems.

Module I

Statics: Fundamental concepts and laws of mechanics. Equilibrium of bodies: Free-body diagrams, conditions of equilibrium, torque due to a force, statical determinacy. Force systems: principle of moments, resultant of forces, couple systems, equilibrium of rigid bodies, Support reactions.

Module II

Properties of plane surfaces: Centroid of simple figures from first principle, centroid of composite sections; Area moment of Inertia, Moment of Inertia of plane sections from first principles, theorems of moment of inertia, moment of inertia of standard sections and composite sections.

Module III

Concept of stress and strain: Conditions of equilibrium, compatibility and stress strain relations. Stress- strain diagrams, Modulus of elasticity, Poisson's ratio, Bulk modulus, Modulus of rigidity. Shear force and bending moment in beams; Structural analysis**:** Forces in members of a truss by method of joints and method of sections and principle of virtual work.

Module IV

Centre of Gravity and Moment of Inertia: Centre of gravity and its implications; Mass moment of inertia, Moment of inertia of Cylinder, Cone, Sphere, etc.

Module V

Fundamentals of Dynamics: Kinematics and Kinetics of particles in rectilinear and curvilinear motion; Kinematics and Kinetics of Rigid bodies, types of motion, instantaneous centre of rotation in plane motion, D'Alembert's principle and its applications in plane motion and connected bodies, Work Energy principle, Impulse-Momentum principle.

Pre-requisites: N/A

Text Books:

1. F. Beer, E. Johnston, D. Mazurek, P. Cornwell and B. Self. Vector Mechanics for Engineers: Statics and Dynamics, 10th Edition, McGraw-Companies, Inc., New York, 2013
2. Hibbeler, R.C., Engineering Mechanics: Statics and Dynamics, Prentice Hall(2012).

Reference Books:

1. R.C. Hibbeler and A. Gupta, Engineering Mechanics: Statics and Dynamics (11th Edition), Pearson Education Inc., Prentice Hall, 2010.
2. J. L. Meriam and L. G., Kraige Engineering Mechanics, Volume I - Statics, Volume II - Dynamics, 7th Edition, John Wiley & Sons, New York, 2012.

Online Resources:

1. Engineering Mechanics by Prof. K. Rames (IIT Madras), NPTEL Course (https://archive.nptel.ac.in/courses/112/106/112106286/).

ELE150C Basic Electrical Engineering 3-0-2-0

Course Objectives: The objective of the course is to explain the fundamentals of AC and DC circuits and operative principle of transformer and electric machines with background of magnetic circuits. The course will also expose students to the working principle of electrical installation and protection equipment.

Course Outcomes: At the end of this course, a student will be able to:

1. Define the basic terminology/definitions of electrical engineering.
2. Solve the basic DC and AC electric circuits.
3. Apply the knowledge of theorems/laws to analyze the DC and AC electric networks.
4. Explain the working principles of magnetic circuits, transformers and electrical machines.
5. Design and implement the common electrical installation and protective equipment for a particular application.

Module I

DC Circuits analysis: Electrical circuit elements (R, L and C), voltage and current sources, Ohm's law, Kirchhoff's current and voltage laws, analysis of simple circuits with dc excitation, Mesh analysis and Nodal analysis, Superposition, Thevenin and Norton Theorems.

Module II

AC Circuit analysis and three phase circuits: Representation of sinusoidal waveforms, peak 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). Three phase balanced circuits, voltage and current relations in star and delta connections.

Module III

Magnetism and Transformer operation: Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Module IV

Electrical Machines: Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, concept of slip, construction and working principle of a separately excited DC motor, construction and working of a synchronous generator..

Module V

Electrical Installations and types of batteries: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries.

List of Experiments

1. Connection of Ammeters, voltmeters, Wattmeter and Multimeter in DC and AC circuits and selection of their ranges, Use of LCRQ meter.
2. Introduction to CRO, Discussion on front panel buttons and their uses.
3. To study the color coding of Resistors (4-band, 5-Band schemes), familiarization with Capacitors (Ceramic and Electrolytic, DC, AC), value calculation of ceramic caps and Inductors and their measurement using LCRQ meter.
4. Introduction to Breadboard and verify the KVL and KCL using discrete components on Breadboard.
5. To verify the Superposition theorem.

6. To measure single phase power by Wattmeter method.
7. Determination of voltage, current, power and power factor of series RLC circuit.
8. Demonstration of cut-out sections of machines: dc machine, three phase induction machine, single-phase induction machine and synchronous machine.
9. Demonstration of various commonly used electrical equipment such as fuses, MCB, Types of Wires and Types of Batteries etc.
10. Study of Light emitting diodes (common cathode/common anode), Monochromic, RGB and their Voltage current relationships.
11. Study of VI characteristics of PN junctions.
12. Study of BJT as a switch to drive a load (e.g LED, small DC Motor etc.)

Pre-requisites: NA

Text Books:

1. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering, Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, Basic Electrical Engineering, McGraw Hill, 2009.
3. V. D. Toro, Electrical Engineering Fundamentals, Prentice Hall India, 1989.
4. L. Nashelsky and R Boylestad, Electronic Devices and Circuit Theory: Pearson New International Edition.

Reference Books:

1. E. Hughes, Electrical and Electronics Technology, Pearson, 2010.
2. C. K. Alexender, Mathew N. O. Sadiku, Fundamentals of Electric circuits, McGraw Hill,
3. J. E. Kemmerly William H. Hayt, Engineering Circuit Analysis,McGraw Hill, 2012.
4. L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
5. A. Chakrabarti, Circuit Theory, Dhanpat Rai Publications, 6th Edition, 2006.
6. V. N. Mittal and Arvind Mittal, Basic Electrical Engineering, McGraw Hill.

Online Resources:

1. Basic Electrical Technology by Prof. N.K. De, Prof. G. D. Roy, Prof. T. K. Bhattacharya (IIT Kharagpur), NPTEL Course (https://nptel.ac.in/courses/108105053).

CSE160F Programming for Problem Solving 3-0-2-0

Course Objectives: The objective of this course is to introduce the concept of problem-solving strategies for simple problems with the fundamental syntax and semantics of the C language. The course will also enable students to use various data types and control structures in C programming.

Course Outcomes: At the end of this course, a student will be able to:

1. Design and implement algorithms and flowchart for simple problems.
2. Use syntax and semantics in C programming.
3. Define and describe C programming concepts like data types, control structures.
4. Use modular approach for problem solving using functions
5. Store and retrieve data from complex data types and files.

Module I

Introduction to Problem Solving: Introduction to problem solving, flowcharts, algorithms, the compilation process, features of C language, structure of C program, data types, constants and variables. arithmetic, relational and logical operators, type conversion, increment and decrement operators, bitwise operator, assignment operator and expressions, conditional expressions, precedence and associativity, I/O functions, basic C program examples.

Module II

Control Structures and Arrays: Introduction to conditional branching. iterative loops, arranging things: arrays, 2-D arrays, character arrays and strings.

Module III

Functions: Functions and parameters passing by value, recursion as a different way of solving problems, macros.

Module IV

Pointers: Idea of pointers, defining pointers, pointer and function argument (call by reference), pointer and array, pointer to functions, pointer to pointer, pointer to multi-dimensional array.

Module V

Structures and File Handling: Structures: defining structures and array of structures. unions, Storage classes: scope and extent, storage classes in a single source file: auto, extern, static & register. Use of pointers in self-referential structures, command line arguments, File handling.

List of Experiments

1. Familiarisation with the programming environment
2. Simple computational problems using arithmetic expressions
3. Problems involving conditional branching.
4. Iterative problems
5. 1D Array manipulation
6. Matrix problems,
7. String operations
8. Simple functions
9. Passing values in functions
10. Recursive functions
11. Pointers
12. Pointer and array

13. Pointer and function
14. structures
15. File operations

Pre-requisites: None

Text Books:

1. B. W. Kernighan and D. M. Ritchie, The C Programming Language, Prentice Hall of India.
2. B. Gottfried, Schaum's Outline of Programming with C, McGraw Hill Education India.

Reference Books:

1. A. Shaw, Learn C the hard way: Practical exercises on the computational subjects you keep avoiding (like C), Addison-Wesley Professional.
2. V. D. I. Peter, Expert C programming: deep C secrets. Prentice Hall Professional.

Online Resources:

1. Introduction to Programming in C NPTEL Course (IIT Kanpur) (https://archive.nptel.ac.in/courses/106/104/106104128/).
2. Online Compiler: (https://www.onlinegdb.com).

ECE151C Basic Electronic Devices 3-0-0-0

Course Objectives: The objective of this course is to provide the student with the fundamental skills to understand the basics of semiconductor electronics and components like diode, LED, transistor, FET etc.

Course Outcomes: At the end of this course, a student will be able to:

1. Define the concepts of the depletion region and minority carrier injection.
2. Explain how a diode works and the applications of diodes.
3. Explain the operation of the Zener diode and its applications.
4. Explain the formation of several devices by joining two different Semi-Conductor materials.
5. Explain the Construction and working of unipolar electronic devices.

Module I

Fundamentals of Semiconductor: Introduction to band theory in solids, Conduction and Valence band, concept of forbidden energy, Germanium and Silicon as semiconductors, Doping in Semiconductors(S.Cs), Types of doping, Conduction in Si and Ge (Extrinsic & Intrinsic), Majority and minority charge carriers in S.Cs, Concept of Energy Levels, Excitation and de-excitation and energy release phenomenon, Luminescence. carrier transport by drift and diffusion, carrier generation and recombination, Poisson and Continuity equation.

Module II

Semiconductor Junctions: Introduction to PN semiconductor junctions, construction, Band diagrams of PN junctions, Depletion region, Barrier potential, P-N junction under zero, Forward and reverse bias, built-in potential barrier, electric field and space charge width, junction capacitance, charge flow in a P-N junction, current-voltage relationship, minority carrier distribution, junction breakdown mechanisms, application of P-N junctions.

Module III

Special Semiconductor Junctions: Zener diode constructions and VI characteristics, LEDs Voltage and current relationships in LEDS, Seven segment display, Introduction to Solar Cell, VI characteristics of solar cell. metal-semiconductor junctions, ohmic contacts, Laser diode, photodiode, PIN diode.

Module IV

Bipolar Junction Devices: Bipolar Junction transistor, Construction, principle of operation, modes of operation, C.B,C.E,C.C configurations of BJT. Static IV characteristics in active and saturation modes, minority carrier distribution, emitter efficiency, Transistor action, BJT as a switch, BJT as current controlled current source, current gain, amplification due to BJT (C.B).

Module V

Unipolar Junction Devices: UJT, Construction and principle of operation. Field effect Transistors, JFET construction and working, p-channel/n-channel FET, VI characteristics. Introduction to MOSFET construction and working, MOSFET as a switch.

Pre-requisites: NA

Text Books:

1. D. Neamen, Semiconductor Physics And Devices: Basic Principles, McGraw Hill Education India.
2. A. P. Malvino, D. J. Bates and P. E. Hoppe, Electronic Principles, McGraw Hills, 9th Edition.

Reference Books:

1. E. D. Gates, Introduction to Electronics, Delmar, Cengage Learning 6th Edition.
2. L. Nashelsky and R. Boylestad, Electronic Devices and Circuit Theory, Pearson New International Edition.

Online Resources:

1. Basic Electronics by Prof. M. B. Patil, Department of Electrical and Electronics Engineering, (IIT Bombay), NPTEL Course (https://nptel.ac.in/Courses/108101091).

MEC152C Product Realisation through Manufacturing 0-0-2-1

Course Objectives: The objective of the course is to expose students to the role of manufacturing processes in product realisation by endeavouring hands-on activities by undertaking manufacturing exercises and assembly activity in teams.

Course Outcomes: At the end of this course, a student will be able to:

1. Explain and select manufacturing processes for a particular product realisation task
2. Safely use various tools, instruments and machines for a particular product realisation task
3. Practise various trades including fitting, carpentry, machining and welding.
4. Apply skills acquired from C01, C02, and C03 in order to fabricate a prototype with societal applications.

Module I

Overview of Manufacturing Methods and Tools:

Manufacturing as a backbone of a developed economy, Subtractive manufacturing, conventional, CNC, additive manufacturing, forging and forging tools, metal casting, plastic moulding, glass cutting.

Module II

Introduction to workshop practices: Safety precautions, introduction of various shops trades used in engineering and technology viz., machining trade, sheet metal and spray-painting section, fitting and bench work section, welding section, smithy and forging section, carpentry and pattern making section, automobile section, electrical and electronics section, plastic moulding section etc.

Module III

Practicals in machine shop:

1. Demonstration of basic operations on the lathe machine, such as drilling, facing, turning, taper turning, step turning, knurling, chamfering etc.
2. Demonstration of basic measuring instruments.
3. To manufacture a job on the centre lathe as per given drawing
4. To perform additional operations such as grooving, drilling, knurling.
5. To manufacture a job on the CNC lathe and CNC milling trainers as per the given drawing

Module IV

Practicals in fitting shop and carpentry shop:

1. Demonstration of all basic hand tools/ measuring tools and equipment.
2. Demonstration of simple operations such as marking, punching, filing, sawing, scrapping, and drilling.
3. Demonstration and practice of different carpentry operations like planning, sawing and chiselling and joints.
4. Demonstration of pattern making tools and materials
5. To prepare a half lap cross joint.

Module V

Practicals in welding shop:

1. Demonstration of all basic tools and personal protective equipment.
2. To make a single-V butt joint of mild steel 80×50×8 mm.
3. To make a lap joint of mild steel 85×35×6 mm.

Social Component Module:

Fabrication of a prototype: This module includes fabrication of a prototype using the skills, knowledge and the tools and machines available in the workshop. The prototype should be developed by a team of students which has relevance to some societal problems. The developed prototype shall be submitted by the students at the end of the semester for evaluation.

Pre-requisites: NA

Text Books:

1. S. K. H Choudhury, Elements of Workshop Technology, Media promoters and publishers private limited, Mumbai.
2. P. N. Rao, Manufacturing Technology, Vol. I and Vol. II, Tata McGraw Hill House, 2017.

Reference Books:

1. S. Kalpakjian and S. S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.
2. P. Gowri, Hariharan and A. S. Babu, Manufacturing Technology – I, Pearson Education, 2008.
3. R. A. Lindberg, Processes and Materials of Manufacture, 4th edition, Prentice Hall India, 1998.

Online Resources: NA

SS01A Ethics and Social Responsibilities 1-0-0-0

Course Objectives: This course aims to foster a holistic understanding of ethics by introducing students to diverse worldviews, ethical theories, and practical applications. Through philosophical and scientific perspectives, students will develop a nuanced appreciation for ethical dilemmas. They will gain proficiency in major ethical theories and learn to apply them effectively in personal, social, and professional contexts, particularly in the field of engineering. The course will also emphasise the ethical responsibilities of engineers in addressing global issues and emerging technologies, equipping students with critical analytical skills for making ethically sound decisions in an ever-evolving ethical landscape.

Course Outcomes: Upon completing this course, students will have developed a well-rounded ethical perspective by examining philosophical and scientific worldviews. They will have attained a solid grasp of major ethical theories and the ability to adeptly apply them in personal, social, and professional situations. Additionally, students will be equipped to understand and address the ethical responsibilities inherent in engineering, particularly in the context of global challenges and emerging technologies, enabling them to make sound ethical decisions in diverse, real-world scenarios.

Module I

Worldview: An Introduction, Philosophical Perspective, Scientific Perspective, Science and Scientism

Module-II

Applied Ethics, Meaning and Introduction of Ethics, Overview of Key Ethical Theories (Utilitarianism, Deontology, Virtue Ethics, etc.), Personal & Social Ethics, Professional Ethics

Module-III

Ethical Considerations in Engineering, The Role of Engineers in Society, Environmental Ethics and Sustainable Engineering, Engineering and Global Issues (e.g., Climate Change, Resource Depletion), Ethical Considerations in Emerging Technologies (e.g., AI, Biotechnology)

Evaluation: Presentation cum Viva Voce

Suggested Readings:

1. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
2. India Wins Freedom - Maulana Abdul Kalam Azad.
3. Wings of Fire: Autobiography, A. P. J. Abdul Kalam.
4. Theology, and Ethics, Ted Peters, Science, London: Taylor and Francis, 2017.
5. The Alchemy of Happiness, Al-Ghazali. Translated by Claud Field.