Courses of Study

B.Tech Robotics and Automation

Batch 2024 Onwards

1st Semester

Department of Mechanical Engineering

Islamic University of Science and Technology Kashmir

Table of Contents

Detailed Course Contents for 1st Semester

Total Credits = 18 *Total Hours Per Week = 26+2(S)*

Course Code	Course Title	L	T	P	S	Credits
MTH115C	Calculus for Engineers	3	1	0	0	4
CHM102C	Engineering Chemistry	3	0	2	0	4
PHY102C	Engineering Physics	3	0	2	0	4
ENG107F	Technical Communications	2	0	2	0	3
CIV101A	Introduction to Environmental Science and Engineering	2	0	0	1	0
MEC102C	Engineering Visualization	1	0	4	0	3
MEC104A	Engineering Perspectives	1	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.

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).

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).

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).

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.

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).

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.

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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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.

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.

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).

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
