

## College of Engineering Pune

List of the links available on <https://www.coep.org.in/> for the **vision and mission, PEO, PE, PSO, and SYLLABS** for of all the UG and PG Programmes offered in College of Engineering Pune.

Sr. No.	Department	Weblink
1	Department of Civil Engineering	<a href="https://www.coep.org.in/departments/civil/vision_and_mission">https://www.coep.org.in/departments/civil/vision_and_mission</a> <a href="https://www.coep.org.in/departments/civil/peo_and_po">https://www.coep.org.in/departments/civil/peo_and_po</a> <a href="https://www.coep.org.in/departments/civil/curriculum">https://www.coep.org.in/departments/civil/curriculum</a>
2	Department of Computer & IT	<a href="https://www.coep.org.in/departments/computerit/visionmission">https://www.coep.org.in/departments/computerit/visionmission</a> <a href="https://www.coep.org.in/departments/computerit/peospos">https://www.coep.org.in/departments/computerit/peospos</a> <a href="https://www.coep.org.in/departments/computerit/curriculum">https://www.coep.org.in/departments/computerit/curriculum</a>
3	Department of Electrical Engineering	<a href="https://www.coep.org.in/departments/electrical/vision">https://www.coep.org.in/departments/electrical/vision</a> <a href="https://www.coep.org.in/content/peosposandpos">https://www.coep.org.in/content/peosposandpos</a> <a href="https://www.coep.org.in/departments/electrical/syllabus">https://www.coep.org.in/departments/electrical/syllabus</a>
4	Department of Electronics and Telecommunication Engineering	<a href="https://www.coep.org.in/departments/entc/visionandmission">https://www.coep.org.in/departments/entc/visionandmission</a> <a href="https://www.coep.org.in/departments/entc/peosandpos">https://www.coep.org.in/departments/entc/peosandpos</a> <a href="https://www.coep.org.in/departments/entc/curriculum">https://www.coep.org.in/departments/entc/curriculum</a>
5	Department of Instrumentation and Control Engineering	<a href="https://www.coep.org.in/departments/instru/vision">https://www.coep.org.in/departments/instru/vision</a> <a href="https://www.coep.org.in/departments/instru/ugpo">https://www.coep.org.in/departments/instru/ugpo</a> <a href="https://www.coep.org.in/departments/instru/syllabus">https://www.coep.org.in/departments/instru/syllabus</a>
6	Department of Manufacturing Engineering and Industrial Management	<a href="https://www.coep.org.in/departments/production/visionandmission">https://www.coep.org.in/departments/production/visionandmission</a> <a href="https://www.coep.org.in/departments/production/peo">https://www.coep.org.in/departments/production/peo</a> <a href="https://www.coep.org.in/departments/production/syllabus">https://www.coep.org.in/departments/production/syllabus</a>
7	Department of Mechanical Engineering	<a href="https://www.coep.org.in/departments/mechanical/vision">https://www.coep.org.in/departments/mechanical/vision</a> <a href="https://www.coep.org.in/departments/mechanical/peos">https://www.coep.org.in/departments/mechanical/peos</a> <a href="https://www.coep.org.in/departments/mechanical/curriculum">https://www.coep.org.in/departments/mechanical/curriculum</a>
8	Department of Metallurgy and Materials Science	<a href="https://www.coep.org.in/content/visionandmission0">https://www.coep.org.in/content/visionandmission0</a> <a href="https://www.coep.org.in/content/peosposandpos0">https://www.coep.org.in/content/peosposandpos0</a> <a href="https://www.coep.org.in/departments/metallurgy/syllabus">https://www.coep.org.in/departments/metallurgy/syllabus</a>

9	Department of Planning	<a href="https://www.coep.org.in/content/visionandmission1">https://www.coep.org.in/content/visionandmission1</a> <a href="https://www.coep.org.in/content/peosandpos">https://www.coep.org.in/content/peosandpos</a> <a href="https://www.coep.org.in/content/syllabus">https://www.coep.org.in/content/syllabus</a>
10	Department of Applied Science	<a href="https://www.coep.org.in/departments/appsci/peo">https://www.coep.org.in/departments/appsci/peo</a> <a href="https://www.coep.org.in/departments/appliedscience/link2">https://www.coep.org.in/departments/appliedscience/link2</a>

## CO of all Departments

### Civil Engineering Courses

#### 1 Ordinary Differential Equations and Multivariate Calculus

Course outcomes:

1. Know and recall core knowledge of the syllabus. (To measure this outcome, questions may be of the type- define, identify, state, match, list, name etc.)
2. Understand basic concepts. (To measure this outcome, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.)
3. Analyze the problem and apply the appropriate concept. (To measure this outcome, questions will be based on applications of core concepts)
4. Give reasoning. (To measure this outcome, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc.)
5. Apply core concepts to new situations. (To measure this outcome, some questions will be based on self-study topics and also comprehension of unseen passages.)

#### 2 Biology for Engineers

Course outcomes:

1. understand basic biological principles and organizational structure of living systems at molecular level
2. comprehend basic biological principles and organizational structure of living systems at cellular level
3. know Energy transformations and information processing in biological systems
4. appreciate biological process with engineering perspective
5. impart knowledge about the common corridors of biology and engineering and biologically inspired technologies

### **3 INTERNET OF THINGS AND APPLICATIONS**

Course outcomes:

1. Understand the concepts of Internet of Things
2. Analyze basic communication protocols
3. Implement basic IoT applications using IoT platforms
4. Design IoT applications in diverse domain and analyze their performance

### **4 INDUSTRIAL PSYCHOLOGY**

Course outcomes:

1. Determine the psychological factors that influence individual differences at work and appraise the role of research. [PEO3][PO8, PO12]
2. Explain the concepts of motivation and job satisfaction at work and utilize the elements of organizational culture for enhancing group/team behavior. [PEO3][PO9, PO11, PO12]
3. Evaluate the relevance & functioning of leadership & diversity in workforce and acknowledge the multicultural factors influencing workplace behavior. [PEO3][PO9, PO11, PO12]
4. Illustrate the process of recruitment & selection and Experiment with the information required to sustain employability. [PEO3][PO9, PO10, PO11]
5. Interpret the nuances of Human Factors in Engineering and analyze its role in their disciplines. [PEO3][PO8, PO9, PO11]
6. Measure the behavioral findings from self-lead projects and Propose corrective actions to improve quality of workplace behavior. [PEO3][PO8, PO9, PO11]

### **5 Environmental Pollution**

Course outcomes:

1. Identify local and global effects of pollution and suggest control measures
2. Identify atmospheric stability conditions and relate them to transport of air pollutants & design stack under given conditions
3. Collect data and analyze the problem of noise, odor pollution & solid waste management
4. Understand importance & preparation stages of Environmental Impact Assessment
5. Determine the flow diagram of water and waste water treatment process and decide domestic wastewater treatment processes.

### **6 Applied Finite Element Analysis**

Course outcomes:

1. Solve Ordinary differential equations using Finite Element Method.
2. Solve simple Engineering problems using Finite Element Analysis.

3. Use the commercial Finite Element software to build Finite Element models and solve a selected range of engineering problems

### **7 Numerical Methods in Structural Engineering**

Course outcomes:

1. to mathematically model and analyze physical system
2. to solve structural engineering problems using numerical methods
3. to write the code for a mathematical problem

### **8 Advanced Analysis of Structures**

Course outcomes:

1. Analyze indeterminate structures using Flexibility method.
2. Develop member stiffness matrices for Framed structures.
3. Develop computer program for Plane Frame structure.
4. Analyze Framed structures using computer program.

## **Computer Engineering Courses**

### **1 Parallel Computer Architecture and Programming**

Course outcomes:

1. Justify the need of high performance provided by parallel computer architecture.
2. Demonstrate quantitative design principles of parallel computing systems.
3. Measure and analyze performance through different benchmarks.
4. Comprehend and differentiate various computer architectures.
5. Understand the building blocks of cluster setup.

### **2 Cryptography and Network Security**

Course outcomes:

1. Explain the concepts related to applied cryptography, including plaintext, ciphertext, symmetric cryptography, asymmetric cryptography, and digital signatures
2. Apply concepts of finite mathematics and number theory.
3. Demonstrate the understanding of common network vulnerabilities and attacks, defence mechanisms against network attacks, and cryptographic protection mechanisms.
4. Detect possible threats to different defence mechanisms and different ways to protect against these threats.

### **3 Compiler Construction**

Course outcomes:

1. Demonstrate the understanding of different phases of compilation.
2. Demonstrate the ability to generate and code lexical and syntax analyzer.
3. Analyze and differentiate different parsing techniques and syntax directed translation schemes and choose the optimal parsing technique.
4. Apply different intermediate code generation and code optimization techniques for various statements.

#### **4 Database Management Systems**

Course outcomes:

1. Construct Entity-Relationship Model for given applications and Relational Model for the same.
2. Design and write SQL queries for given problems
3. Normalization to database design
4. Describe, compare, and solve analytical problems based on storage mechanisms, and transactions

#### **5 Introduction to Algorithms**

Course outcomes:

1. Determine different time complexities of a given algorithm
2. Develop algorithms using various design techniques for a given problem.
3. Determine a design technique and design an algorithm using that technique for a given problem.

#### **6 Internet Technologies**

Course outcomes:

1. Describe, draw diagrams, solve analytical problems based on, structure of computer networks.
2. Describe, solve analytical problems based on, networking protocols
3. Create WWW pages to serve as front-end for Internet applications
4. Demonstrate the ability to write server side and client side programs.

### **Electrical Engineering Courses**

#### **1 Ordinary Differential Equations and Multivariate Calculus**

Course outcomes:

1. Know and recall core knowledge of the syllabus. (To measure this outcome, questions may be of the type- define, identify, state, match, list, name etc.)
2. Understand basic concepts. (To measure this outcome, questions may be of the type explain, describe, illustrate, evaluate, give examples, compute etc.)
3. Analyze the problem and apply the appropriate concept. ( To measure this outcome, questions will be based on applications of core concepts)

## **2 Linear Algebra and Univariate Calculus**

Course outcomes:

- 1 Know and recall core knowledge of the syllabus. ( To measure this outcome, questions may be of the type- define, identify, state, match, list, name etc.)
2. Understand basic concepts. ( To measure this outcome, questions may be of the type explain, describe, illustrate, evaluate, give examples, compute etc.)
3. Analyze the problem and apply the appropriate concept. ( To measure this outcome, questions will be based on applications of core concepts)

## **3 Probability Theory and Statistical Inference Teaching Scheme:**

Course outcomes:

- 1 Know and recall the core knowledge of the syllabus. (To measure this outcome, questions may be of the type- define, identify, state, match, list, name etc.)
2. Understand the concept. (To measure this outcome, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.)
3. Analyze the problem and apply the appropriate concept. ( To measure this outcome, questions will be based on applications of core concepts)
4. Give reasoning. (To measure this outcome, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc.)
5. Apply core concepts to new situations. (To measure this outcome, some questions will be based on self-study topics and also comprehension of unseen passages.)

## **1 Constitution of India**

Course outcomes:

1. Student will be able to understand how India has come up with a Constitution which is the combination of the positive aspects of other Constitutions.
2. Student will be able to understand the interpretation of the Preamble.
3. Student will be able to understand the basics of governance of our nation.
4. It helps in understanding the different aspects covered under the different important Articles. 5. Student will be able to understand the basic law and its interpretation. Understand the important amendments which took place and their effects.
6. Student will be able to understand our Union and State Executive better.
7. Student will be able to understand the basic that along with enjoying the rights one needs to fulfill one's duties.
8. Student will be able to understand and Gain confidence on our Constitution by knowing it better.

## **2 Control System**

Course outcomes:

1. Realize role of control in various industrial applications.
2. Understand various control components
3. Use tools root locus and bode plot to analyze the system.
4. Develop sequential control using contactors and relays and PLC

### **3 Electrical Machine Design**

- 1 Select proper commercial materials, their properties and selection criteria, IS standards used in electrical machine design.
2. Design commercial transformers and induction motors as per specifications.
3. Apply computer aided optimization techniques for design of electrical machines
4. Design and analyze electrical machines using finite element based software.

### **4 Mathematical Modeling of Electric Machines**

- 1 Analyze electromechanical devices and machines
2. Use reference frame theory to study and analyze the behavior of induction and synchronous machines
3. Calculate the machine inductances for use in machine analysis
4. Model the electrical machine from the terminal junction with transmission systems

### **5 Embedded Systems**

- 1 Discuss the embedded system concepts and architecture of embedded systems
2. Deploy low end applications using low and high level languages on microcontroller platform.
3. Test and debug peripherals in embedded system.
4. Identify, design and implement applications on embedded platform.

## **ENTC Engineering Courses**

### **1 Ordinary Differential Equations and Multivariate Calculus**

- Know and recall core knowledge of the syllabus. (To measure this outcome, questions may be of the type- define, identify, state, match, list, name etc.)
- Understand basic concepts. (To measure this outcome, questions may be of the type explain, describe, illustrate, evaluate, give examples, compute etc.)
- Analyze the problem and apply the appropriate concept. (To measure this outcome, questions will be based on applications of core concepts)
- Give reasoning. (To measure this outcome, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc.)
- Apply core concepts to new situations. (To measure this outcome, some questions will be based on self-study topics and also comprehension of unseen passages.)

## **2 Professional Laws, Ethics, Values and Harmony**

- Grasp the meaning of the concept – Law
- Get an overview of the laws relating to Engineers
- Apprehend the importance of being a law-abiding person
- Self-explore by using different techniques to live in harmony at various level
- Analyze themselves and understand their position with respect to the moral and ethical character needed for a successful and satisfactory work life

## **3 Probability and Statistics for Engineers**

- 1 Demonstrate number of methods of summarizing and visualizing data sets, evaluate probabilities of events.
2. Make use of concepts of random variables and associated probability distributions to solve problems, illustrate the central limit theorem.
3. Test for basic statistical inference (t-test, z-test, F-test,  $\chi^2$  –test, confidence interval, non-parametric tests).
4. Explain basic principles of regression analysis and perform the same.
5. Demonstrate use of R software for all the above.

## **4 Entrepreneurship Principles and Process**

- 1 Discover, develop, and assess different types of Entrepreneurial ventures and opportunities
2. Learn about opportunity and risk analysis.
3. Use the strategies for valuing your own company, and how venture capitalist and angel investors use valuations in negotiating milestones, influence, and control.
4. Pick correct marketing mix and how to position the company in the market by using analytical tools
5. Learn how to sale themselves and the product/service and to handle objections

## **5 Broadband Communication**

- Compare cellular (mobile) communication systems from 2G to 4G and their impact on the society.
- Visualize the architecture of satellite systems as a means of broadband communication and also the Indian scenario in the satellite area.
- State key features and operating principles of Wi-Fi and Wi-MAX systems.
- State key features of optical fiber communication and its advantages, and appreciate the revolution brought by the systems such as FTTH

## **6 Microwave and Optical Communication**

- To understand and visualize the different modes of microwave and light wave propagation.
- To compare merits and demerits of various microwave and optical sources and detectors.

- To contribute in the areas of microwave and optical communication link design.
- To implement simple microwave and optical communication system and will be in a position to understand the developments in the technology of advanced communication

### **7 Probability, Graph and Field Theory**

- 1 Grasp and apply Graph theory for engineering problem solving and CAD tools developments
2. Culminate operations in groups, rings and field theory towards applications in digital electronic systems.
3. Characterize random variables and its functions with probability distributions and cumulative distributions

### **8 Programming Languages for Embedded Software**

- 1 Write an embedded C application of moderate complexity.
2. Develop and analyze algorithms in C++.
3. Differentiate interpreted languages from compiled languages.
4. Acquire programming skills in core Python
5. Develop applications using scripting languages such as Python.

## **INSTRUMENTATION AND CONTROL Engineering Courses**

### **1 Industrial Automation**

- 1 Gained knowledge of Industrial Automation basics [PEO5][PO-i]
2. Selection of control components for given application [PEO2][PO-c]
3. Understanding of contemporary / emerging technology for various applications [PEO2][PO-j]

### **2 Digital Control**

- 1 Understanding the basic principles of Microcontroller based design and development [PEO2][PO-m]
2. To encourage the students to have a better understanding on state-of-the-art interfacing technologies, their potential applications and their market views [PEO2][PO-m] 11
3. Ability to undertake problem identification, formulation and selection of appropriate Microcontrollers [PEO1][PO-e]
4. To test whether students can apply their knowledge of fundamentals of Microcontrollers, programming and interfacing technology to solve and design simple engineering problems [PEO1][PO-a]

### **3 Probability and Statistics for Engineers**

- Learn a number of methods of summarizing and visualizing data sets, compute probabilities of events.

- Use the concepts of random variables and associated probability distributions, understand the meaning of central limit theorem.
- Perform basic statistical inference (t-test, z-test, F-test,  $\chi^2$  –test, confidence interval)
- Perform basic regression analysis.
- Demonstrate use of R software for statistical analysis.

#### **4 Entrepreneurship Principles and Process**

- Discover, develop, and assess different types of Entrepreneurial ventures and opportunities.
- Learn about opportunity and risk analysis
- Use the strategies for valuing your own company, and how venture capital is tangled investors use valuations in negotiating milestones, influence and control
- Pick correct marketing mix and how to position the company in the market by using analytical tools
- Learn how to sell themselves and the product/service and to handle objections
- Know how organizations operate, their process matrices, start new ventures, write winning business plans

#### **5 Ordinary Differential Equations and Multivariate Calculus**

- 1 Identify first order ordinary differential equations, Laplace transform formulae, and define functions of several variables. [PEO1][PO1]
2. Understand basic concepts of higher order ordinary differential equations, level curves and level surfaces. [PEO2][PO2]
3. Solve linear differential equations using different methods, find Laplace transforms of functions using properties and theorems, and evaluate directional derivatives and extreme values. [PEO2][PO3]
4. Prove theorems, solve ordinary differential equations using Laplace transforms, identify orthogonal trajectories, optimize functions subject to given constraints. [PEO5][PO3]
5. Apply concepts of ordinary differential equations and multivariate calculus to various applications including real life problems.[PEO2][PO4]

#### **6 Linear Algebra and Univariate Calculus**

- 1 Know matrices, linear equations, and determinants, recall basic vector algebra, differentiability of functions of single variable, and mean value theorems.[PEO1][PO1]
2. Understand basic concepts such as vector spaces, linear dependence / independence of vectors, basis. [PEO2][PO2]
3. Analyze and calculate Eigen values, Eigen vectors, rank nullity of a matrix, sketch function graphs, evaluate improper integrals, calculate integrals using special techniques, apply various tests of convergence. [PEO2][PO4]
4. Prove theorems; evaluate length / area / volume using single integrals. [PEO5][PO3]

5. Apply concepts of linear algebra and Univariate calculus to various applications including real life problems. [PEO2][PO6]

## **7 Statistics**

- 1 Understand the basic concepts of statistics for engineering. [PEO1][PO1]
2. Appreciate the use and importance of statistics in Engineering. [PEO1] [PO4]
3. Apply the techniques learnt in the course for problem solving and analysis. [PEO1] [PO3]
4. Apply knowledge of statistics to solve engineering problems. [PEO4] [PO4]

## **8 Anatomy and Physiology for Engineers**

- 1 Able to describe human body structure[PEO1] [PO3]
2. Understand working of different physiological systems of human body[PEO1] [PO3]
3. Ability to explain the functioning of the human body system[PEO1] [PO3]
4. Understand biological control and feedback mechanism[PEO1] [PO3]
5. Able to apply knowledge of human anatomy and physiology to solve different biomedical research problems[PEO3] [PO1]

## **MATHEMATICS Engineering Courses**

### **1 Linear Algebra**

- 1 define matrices, linear equations, and determinants, recall basic vector algebra.
2. understand basic concepts such as vector spaces, linear dependence / independence of vectors, basis and linear maps.
3. analyze and calculate eigen values, eigen vectors, rank nullity of a matrix / linear map.
4. prove theorems, apply Gram-Schmidt process on inner product spaces, diagonalize special matrices
5. apply concepts of linear algebra to various applications including real life problems

### **2 Univariate Calculus**

- 1 list continuity / differentiability conditions for functions of single variable, state mean value theorems, know sequence and series.
2. understand basic concepts of Riemann sums, fundamental theorem of calculus, convergence of sequence and series.
3. sketch function graphs, evaluate improper integrals, calculate integrals using special techniques, apply various tests of convergence.
4. prove theorems, evaluate length / area / volume using single integrals, find Fourier series expansions.
5. apply concepts of univariate calculus to various applications including real life problems.

### **3 Ordinary Differential Equations and Multivariate Calculus**

- 1 identify first order ordinary differential equations, tell Laplace transform formulae, define functions of several variables.
2. understand basic concepts of higher order ordinary differential equations, level curves and level surfaces.
3. solve linear differential equations using different methods, find Laplace transforms of functions using properties and theorems, evaluate directional derivatives and extreme values.
4. prove theorems, solve ordinary differential equations using Laplace transforms, identify orthogonal trajectories, optimize functions subject to given constraints.
5. apply concepts of ordinary differential equations and multivariate calculus to various applications including real life problems.

#### **4 Vector Calculus and Partial Differential Equations**

- 1 know and recall double / triple integrals, vector differentiation, vector integration, partial differential equations.
2. understand basic concepts of co-ordinate systems, iterated integrals, gradient, divergence and curl.
3. evaluate multiple integrals, find area / mass / volume using multiple integrals, evaluate line integrals and surface integrals.
4. prove theorems, apply Green's / Stoke's / Divergence theorem to different type of problems, model one dimensional heat / wave equations, solve partial differential equations.
5. apply concepts of vector calculus and partial differential equations to various applications including real life problems

#### **5 Probability and Statistics for Engineers**

- 1 demonstrate number of methods of summarizing and visualizing data sets, evaluate probabilities of events.
2. make use of concepts of random variables and associated probability distributions to solve problems, illustrate the central limit theorem.
3. test for basic statistical inference (t-test, z-test, F-test,  $\chi^2$  -test, confidence interval, non parametric tests).
4. explain basic principles of regression analysis and perform the same.
5. demonstrate use of R software for all the above.

#### **6 Numerical Methods with C / C++**

- 1 remember basics of numerical methods.
2. understand basic concepts of numerical differentiation and integration, interpolation.
3. find numerical solutions to ordinary differential equations, algebraic and transcendental equations.
4. Compare numerical solutions obtained by analytical methods with solutions obtained by C++ programs.
5. write C++ program and run it in the laboratory for the given data

## **7 Applied Statistics**

1. determine probability and conditional probability of simple events, define random variables
2. explain standard discrete and continuous distributions, statistical inference, types of estimation and hypothesis.
3. calculate probabilities, apply tests of hypothesis for various population parameters.
4. perform one way, two way analysis of variance, apply principles of design of experiments.
5. check for verifiability in a process using statistical quality control techniques, apply probability theory and statistical inference to problems in Engineering and real life situations.

## **8 Fundamentals of Mathematics**

1. understand and apply basic concepts of linear algebra and matrix theory.
2. define various concepts in multivariable calculus and solve problems.
3. apply various techniques of optimization.
4. use probability theory in problem solving.
5. understand support vector machines and error minimization.

## **MECHANICAL Engineering Courses**

### **1 ORDINARY DIFFERENTIAL EQUATIONS AND MULTIVARIATE CALCULUS**

- Know and recall core knowledge of the syllabus. (To measure this outcome, questions may be of the type- define, identify, state, match, list, name etc.)
- Understand basic concepts. (To measure this outcome, questions may be of the type explain, describe, illustrate, evaluate, give examples, compute etc.)
- Analyze the problem and apply the appropriate concept. (To measure this outcome, questions will be based on applications of core concepts)
- Give reasoning. (To measure this outcome, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, proving implications or corollaries of theorems, etc.)
- Apply core concepts to new situations. (To measure this outcome, some questions will be based on self-study topics and also comprehension of unseen passages.)

### **2 LINEAR ALGEBRA AND UNIVARIATE CALCULUS**

- Understand basic concepts. (To measure this outcome, questions may be of the type explain, describe, illustrate, evaluate, give examples, compute etc.)
- Analyze the problem and apply the appropriate concept. (To measure this outcome, questions will be based on applications of core concepts)

- Give reasoning. (To measure this outcome, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, proving implications or corollaries of theorems, etc.)

- Apply core concepts to new situations. (To measure this outcome, some questions will be based on self-study topics and also comprehension of unseen passages.)

### **3 Probability and Statistics for Engineers**

- Demonstrate number of methods of summarizing and visualizing data sets, evaluate probabilities of events.

- Make use of concepts of random variables and associated probability distributions to solve problems, illustrate the central limit theorem.

- Test for basic statistical inference (t-test, z-test, F-test,  $\chi^2$  –test, confidence interval, non parametric tests).

- Explain basic principles of regression analysis and perform the same.

- Demonstrate use of R software for all the above.

### **4 Data Analytics**

- Examine and compare various datasets and features.

- Analyze the business issues that analytics can address and resolve.

- Apply the basic concepts and algorithms of data analytics.

- Interpret, analyse, and validate data using popular data analytics tools

### **5 Computer Aided Design /Computer Aided Manufacturing**

- 1 Recall the fundamentals of CAD/CAM

2. Compare and Represent 2-D and 3-D entities

3. Apply transform techniques on 2-D and 3-D entities

4. Examine CNC program for production of components

5. Express the principles and methods of Rapid Prototyping

### **6 Refrigeration and Air Conditioning**

1. Interpret the working of Vapour Compression refrigeration system

2. Design the Vapour Compression refrigeration system for various applications.

3. Develop the knowledge of HVAC for multi-pressure systems.

4. Illustrate and apply the Psychrometry for air conditioning applications.

5. Design the duct for various air conditioning systems.

### **7 Mathematical Methods in Engineering**

1. Identify and solve engineering problems by applying the knowledge of differential equations.

2. Apply statistical techniques for analysis.
3. Develop and analyze mathematical models of engineering systems.

## **8 Advanced Thermodynamics**

- 1 Apply the 1st Law for steady and transient systems.
2. Apply the 2nd Law for cyclic systems
3. Analyze multi-components systems.
4. Analyze exergy, availability, and irreversibility in closed and open thermodynamic systems
5. Apply mass, energy, entropy, and availability balance equations for closed and open thermodynamic systems
6. Derive and apply thermodynamic relations between the measurable and non-measurable properties.
7. Determine adiabatic flame temperature
8. Appreciate importance of non-equilibrium thermodynamics

## **METALLURGY Engineering Courses**

### **1 Ordinary Differential Equations and Multivariate Calculus**

1. identify first order ordinary differential equations, tell Laplace transform formulae, define functions of several variables.
2. understand basic concepts of higher order ordinary differential equations, level curves and level surfaces.
3. solve linear differential equations using different methods, find Laplace transforms of functions using properties and theorems, evaluate directional derivatives and extreme values.
4. prove theorems, solve ordinary differential equations using Laplace transforms, identify orthogonal trajectories, optimize functions subject to given constraints.
5. apply concepts of ordinary differential equations and multivariate calculus to various applications including real life problems.

### **2 Linear Algebra and Univariate Calculus**

- 1 know matrices, linear equations, and determinants, recall basic vector algebra, differentiability of functions of single variable, and mean value theorems.
2. understand basic concepts such as vector spaces, linear dependence / independence of vectors, basis.
3. analyse and calculate eigen values, eigen vectors, rank nullity of a matrix, sketch function graphs, evaluate improper integrals, calculate integrals using special techniques, apply various tests of convergence.
4. prove theorems, evaluate length / area / volume using single integrals.

5. apply concepts of linear algebra and univariate calculus to various applications including real life problems.

### **3 Environmental Studies**

1. Comprehend Sustainable Development Goals for present generation
2. Appreciate environmental resources, functioning of an ecosystem, significance of biodiversity and environmental challenges
3. Analyze the current status of environment with respect to precautionary mechanisms and control measures
4. Appreciate the role of an engineer for better tomorrow

### **4 Internet of Things and Applications**

- 1 Understand the concepts of Internet of Things.
2. Analyze basic communication protocols.
3. Implement basic IoT applications using IoT platforms.
4. Design IoT applications in diverse domain and analyze their performance.

### **5 Corrosion and Surface Protection**

Course Outcomes: At the end of course students will be able to

1. apply fundamental knowledge and concepts in corrosion
2. solve numerical and problems on corrosion
3. select, test materials and apply corrosion prevention methods

### **6 Materials Joining**

Course Outcomes: At the end of course students will be able to

1. identify, formulate, and solve engineering problems related to welding
2. use the techniques, skills, and modern engineering tools necessary for materials joining
3. select and design welding materials, processes and inspection techniques based on application, fabrication and service conditions.
4. identify the defects in welded joints and perform the failures analysis and report in professional manner

### **7 Heat and Mass Transfer**

1. Understand and apply constitutive laws as to applied to fluid flow, heat and mass transfer.
2. Develop empirical equations using the knowledge of dimensionless analysis approach for modeling certain physical phenomena.
3. Analyze and quantify the kinetics of the processes.
4. Determine the concentration profile and mass conduction equation analogous to heat conduction equation.
5. Develop and design energy efficient systems.

6. Perform shell balances for heat, momentum and mass transfer to obtain differential equation describing the velocity, temperature and concentration gradient.
7. Use to Navier-Stoke equation for solving fluid problems.

### **8 Concepts in Materials Science**

1. Understand basics of the structure- properties relationship.
2. Understand importance of phase diagrams in micro structure design.
3. Analyze, interpret and solve scientific materials data/ problems.
4. Apply principles of heat treatments of steels.

## **PHYSICS Courses**

### **4 Optics and Modern Physics**

Student will be able to:

- Analyze the intensity variation of light due to interference, diffraction and polarization.
- They will be able to implement these phenomena to design advanced optical instruments.
- Understand the principle, construction and working of lasers in order to implement Laser Technology in engineering field.
- Understand fundamentals of quantum mechanics and apply to one dimensional motion of particles.
- Understand the principle, production and transmission of ultrasonic waves and understand the working of various instruments based on ultrasonic.

### **2 Semiconductor Physics and Electrodynamics**

Student will be able to understand:

- Understand the band theory of solids and the carrier concentration in solids..
- The charge distribution and charge transfer process in semiconductors
- The intrinsic and extrinsic conductivity to design semiconductor devices.
- The fundamentals of electromagnetism.
- Understand the electric polarization and identify the dielectrics for device study.
- Understand the electrodynamics and use Maxwell's equations for solving problems

### **3 Solid State Physics and Statistical Thermodynamics**

Students are expected to understand

- Different types of structure of solids and its characterization by x-ray technique.
- Band structure of solids, categorization of solids based on band structure, ideas about Fermi level positions in semiconductors.
- Foundation of statistical mechanics, basic concepts and various terms and formulations.

- The connection between statistics and thermodynamics, understanding thermodynamics by statistical point of view and its techniques.
- Thermal properties of solids, specifically, specific heat and some models for specific heat calculation.
- Origin of magnetism, various types of magnetic materials and its use in modern technology.

#### **4 Foundation of Physics**

Students will be able to

- Understand classical and wave mechanics to implement for the problems.
- Understand of the laws of thermodynamics to implement in various thermodynamic systems and processes.
- Understand the basic principles of Electromagnetism and formulate it to solve the engineering problems.
- Aware of limits of classical physics and will be able to use it in the appropriate field in order to solve the problems.

### MANUFACTURING AND INDUSTRIAL MANAGEMENT **Engineering Courses**

#### **1 Ordinary Differential Equations and Multivariate Calculus**

Course Outcomes: At the end of this course students will be able to:

- Identify first order ordinary differential equations, tell Laplace transform formulae and define functions of several variables.
- Understand basic concepts of higher order ordinary differential equations, level curves and level surfaces.
- Solve linear differential equations using different methods, find Laplace transforms of functions using properties and theorems, evaluate directional derivatives and extreme values.
- Prove theorems, solve ordinary differential equations using Laplace transforms, identify orthogonal trajectories and optimize functions subject to given constraints.
- Apply concepts of ordinary differential eq

#### **2 Biology for Engineers**

- Understand basic biological principles and organizational structure of living systems at molecular level.
- Comprehend basic biological principles and organizational structure of living systems at cellular level.
- Know Energy transformations and information processing in biological systems.
- Appreciate biological process with engineering perspective.
- Impart knowledge about the common corridors of biology and engineering and biologically inspired technologies.

### **3 Metrology and Quality Control**

- Interpret the manufacturing drawings and perform inspection.
- Understand the salient concept and principles required to develop the ability of using different types of measuring instrument
- Select appropriate measurement techniques for geometric features. Carryout data collection and use statistical tools for analysis.
- Identify and analyze the cause for variation and recommend suitable corrective actions
- Design an acceptance sampling plan for inspection and carry out process capability studies.
- Plot and use of quality control charts.
- Develop an ability of problem solving and decision making. Suggest measures to improve the quality of product and reduce cost.

### **4 ENGINEERING MATHEMATICS IV**

- Acquire the knowledge of computer oriented numerical methods, theorems & models
- Use mathematical skills in different application areas of engineering
- Enhance analytical and thinking power.

### **5 MACHINE TOOL DESIGN**

1. Knowledge about Design of various elements of machine tools and their structures.
2. Knowledge of drives in machine tools.
3. Learn the methods of acceptance tests for machine tools.
4. Knowledge of NC-CNC machine & their controls.
5. Information about recent trends in machine tools

### **6 CAD /CAM /CIM**

1. Describe the principles of Computer Aided Designing systems and the concepts of Transformation, Geometric modeling, solid modeling, and feature-based design modeling.
2. Create and design and manufacturing of mechanical parts using state of the art CAD System and Rapid Prototyping techniques.
3. Compare and distinguish the difference between the operation and programming of a CNC machine tool using manual programming and the operation and programming of CNC machine 13 tool using CAM systems. Apply practices (manually) to develop the G-code program.
4. Exposure of different types of manufacturing available today such as the Special manufacturing System, the Manufacturing Cell, and the Flexible Manufacturing System (FMS), basic concepts of Group Technology and Computer Aided Process Planning.

### **7 Applied Statistics**

- Understand basic concepts of probability and statistics and apply as per the characteristics in data analysis

- Apply the concept of Hypothesis testing to carry out Regression analysis and ANOVA and planning Design of Experiments
- Apply statistical quality control tools for various applications

## **8 Principles of Design of Machine Elements**

1. Design simple machine parts and components.
2. Understand basic procedure for the selection of machine components
3. Design various joints, gears brakes, dynamometer etc.