Bharati Vidyapeeth
(Deemed to be University)
College of Engineering, Pune
Department of Mechanical Engineering

Vision of the Bharati Vidyapeeth (Deemed to be University) College of Engineering is:

To be a World Class Institute for Social Transformation through Dynamic Education

Missions of the Bharati Vidyapeeth (Deemed to be University) College of Engineering are:

- *To provide quality technical education with advanced equipment, qualified faculty members, and infrastructure to meet the needs of the profession & society.*
- *To provide an environment conducive to innovation, creativity, research, and entrepreneurial leadership.*
- *To practice and promote professional ethics, transparency, and accountability for the social community, economic & environmental conditions.*

Goals of the Bharati Vidyapeeth (Deemed to be) University College of Engineering are:

- *Recruiting experienced faculty.*
- *Organizing faculty development programs.*
- *Identifying socio-economically relevant areas & emerging technologies.*
- *Constant review & upgradation of curricula.*
- *Upgradation of laboratories, library & communication facilities.*
- *Collaboration with industry and research & development organizations.*
- *Sharing of knowledge, infrastructure, and resources.*
- *Training, extension, testing, and consultancy services.*
- *Promoting interdisciplinary research.*

The vision of the Mechanical Engineering Department is:

To develop high-quality Mechanical Engineers through dynamic education to meet social and global challenges.

Mission Statements of the Mechanical Engineering Department are:

- *To provide extensive theoretical and practical knowledge to the students with well-equipped laboratories and ICT tools through motivated faculty members.*
- *To inculcate aptitude for research, innovation, and entrepreneurial qualities in students.*

- *To acquaint students with ethical, social, and professional responsibilities to adapt to the demands of the working environment.*

Program Educational Objectives (PEOs) of the B. Tech. Mechanical are:

Graduates will be able,

- *To fulfill the needs of industry and society with theoretical and practical knowledge.*
- *To engage in research, innovation, lifelong learning, and continued professional development.*
- *To fulfill professional ethics and social responsibilities.*

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually based mathematics, numerical analysis, data analysis, statistics, and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas of the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior, and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability, etc., with mutual understanding and respect, and of inclusive attitudes.

PROGRAM OUTCOMES

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals, and an engineering specialization as specified in WK1 to WK4, respectively, to develop solutions to complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems, reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for public health and safety, whole-life cost, net zero carbon, culture, society, and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge, including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering & IT tools, including prediction and modelling, recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for their impact on sustainability with reference to economy, health, safety, legal framework, culture, and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity, and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, making effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for and have the preparation and ability for i) independent and life-long learning, ii) adaptability to new and emerging technologies, and iii) critical thinking in the broadest context of technological change. (WK8)

Statements of Program Specific Outcomes (PSOs)

PSO1: Use the knowledge of thermal, design, manufacturing engineering, and computational sciences to solve Mechanical Engineering problems.

PSO2: Use Mechanical Engineering principles for research, innovation, and develop entrepreneurial skills.

B. TECH. MECHANICAL: COURSE STRUCTURE: CBCS: 2021

B. Tech. (Mechanical) Sem.-I

Sr. No.	Course Code	Name of Course	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
			L	P	T	ESE	IA	TW	OR	PR	Total	L	P	T	Total
1	C101	Linear Algebra, Calculus & Complex Variables	4	-	1	60	40	-	-	-	100	4	-	1	5
2	C102	Waves & Solid-State Physics	3	2	-	60	40	25#	-	-	125	3	1	-	4
3	C103	Electrical Engineering Systems	4	2	-	60	40	25#	-	-	125	4	1	-	5
4	C104	Statics and Dynamics	3	-	-	60	40	-	-	-	100	3	-	-	3
5	C105	Computer Aided Drafting &Visualization*	3	4	-	60	40	25	25	-	150	3	2	-	5
6	C106	Metal Joining Processes	-	2	-	-	-	50#	-	-	50	-	1	-	1
7	C107	Soft Computing-I	-	4	-	-	-	50	-	50	100	-	2	-	2
		Total	**17**	**14**	**1**	**300**	**200**	**175**	**25**	**50**	**750**	**17**	**7**	**1**	**25**

*End Sem. Examination of 4 Hrs.; Based on TW & internal oral examination

B. Tech. (Mechanical) Sem.-II

Sr. No.	Course Code	Name of Course	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
			L	P	T	ESE	IA	TW	OR	PR	Total	L	P	T	Total
1	C108	Differential Equations, Probability &Statistics	3	-	1	60	40	-	-	-	100	3	-	1	4
2	C109	Chemistry of Engineering Materials	3	2	-	60	40	25#	-	-	125	3	1	-	4
3	C110	Mechanical Engineering Systems	4	2	-	60	40	25	25	-	150	4	1	-	5
4	C111	Electronics Engineering Systems	4	2	-	60	40	25#	-	-	125	4	1	-	5
5	C112	Computer-Aided Machine Drawing*	3	4	-	60	40	25	-	25	150	3	2	-	5
6	C113	Sheet Metal Operations	-	2	-	-	-	50#	-	-	50	-	1	-	1
7	C114	Soft Computing-II	-	2	-	-	-	25	-	25	50	-	1	-	1
		Total	**17**	**14**	**1**	**300**	**200**	**175**	**25**	**50**	**750**	**17**	**7**	**1**	**25**

*End Sem. Examination of 4 Hrs.; Based on TW & internal oral examination

Designation of Course	Linear Algebra, Calculus, and Complex Variables		
Course Code	**C101**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory: - 04 Hours/ Week	End-of-Semester Examination	60 Marks	04
Tutorial: - 01 Hours/ Week	Internal Assessment	40 Marks	
	Tutorial	-	01
	Total	**100 Marks**	**05**

Course Prerequisites:-	1. Students should know basic algebra. 2. Students should know vector algebra. 3. Students should know complex numbers.
Course Objectives:-	To provide knowledge about 1. Rank, consistency of the system of equations, and partial differentiation. 2. Vector differentiation and vector integration. 3. Function of a complex variable.
Course Outcomes:-	On completion of the course, students will be able to – 1. Determine the rank of a matrix and apply it to analyze the consistency of a system of linear equations. 2. Compute partial derivatives and evaluate indeterminate forms using appropriate mathematical techniques. 3. Explain and apply vector differential operators and vector identities to solve engineering problems. 4. Evaluate line, surface, and volume integrals and apply them to calculate work done and other physical quantities. 5. Identify and analyze analytic functions with the help of Cauchy–Riemann equations. 6. Develop and apply Taylor's and Laurent's series to represent complex functions.

Course Contents

Unit-I	**Linear Algebra: Matrices**	**(08 Hrs.)**
Rank, Normal form, System of Linear Equations, Linear Dependence and Independence, Linear and Orthogonal Transformations. Eigen values, Eigen Vectors, Cayley–Hamilton Theorem. Application to problems in Engineering		
Unit-II	**Partial Differentiation and Indeterminate Forms**	**(08 Hrs.)**
Functions of two or more variables, Partial derivatives, Homogeneous functions, Euler's theorem, Total derivative, Change of variables. Indeterminate Forms: L'Hôpital's Rule, Evaluation of Limits		
Unit-III	**Vector Differential Calculus**	**(08 Hrs.)**
Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.		
Unit-IV	**Vector Integral Calculus and Applications**	**(08 Hrs.)**
Line, Surface, and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem. Applications to problems in Fluid Mechanics, Continuity equations, Streamlines, Equations of motion, Bernoulli's equation.		
Unit-V	**Complex Variables**	**(08 Hrs.)**
Function f(z) of complex variable, limit, continuity and differentiability of f(z), Analytic function, necessary and sufficient conditions for f(z) to be analytic (without proof), Cauchy-Riemann equations in cartesian coordinates (without proof)Milne-Thomson method to determine analytic function f(z) when real part (u) or Imaginary part (v) or its combination (u + v or u-v) is given. Harmonic function, Harmonic conjugate and orthogonal trajectories.		

Unit-VI	Complex Integration	(08 Hrs.)
Line Integral, Cauchy's Integral theorem for simply connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof). Taylor's and Laurent's series (without proof). Definition of Singularity, Zeros, poles of f(z), Residues, Cauchy's Residue Theorem (without proof).		

Assignments:

Problems and/or theory questions on t h e following topics from previous year's question papers of GATE/ESE Mechanical Engineering Examinations.

1. Linear algebra: matrices
2. Partial differentiation and indeterminate forms
3. Vector differential calculus
4. Vector integral calculus and applications
5. Complex variables
6. Complex integration

Tutorials:

Problems and/or theory questions on t h e following topics from previous year question papers of GATE/ESE Mechanical Engineering Examinations.

1. Matrix algebra and system of linear equations.
2. Eigen values and eigenvectors.
3. Partial differentiation.
4. Indeterminate forms.
5. Fourier series; gradient, divergence, and curl.
6. Directional derivative, scalar potential, and vector identities.
7. Line, surface, and volume integrals.
8. Application of Gauss, Stokes, and Green's theorems.
9. Analytic functions, Cauchy-Riemann equations.
10. Limit continuity and differentiability.
11. Cauchy's integral theorem and integral formula.
12. Taylor and Laurent series.

Textbooks

1. P. N. Wartikar and J. N. Wartikar, "Applied Mathematics (Volumes I)", 7th Ed., Pune Vidyarthi Griha Prakashan, Pune, 2013.
2. P. N. Wartikar and J. N. Wartikar, "Applied Mathematics (Volumes II)", 7th Ed., Pune Vidyarthi Griha Prakashan, Pune, 2013.

References

1. B. S. Grewal, "Higher Engineering Mathematics", 42nd Ed., Khanna Publication, Delhi
2. B.V. Ramana, "Higher Engineering Mathematics", 6th Ed., Tata McGraw-Hill, New Delhi, 2008.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Ed., John Wiley & Sons, Inc., 2015.
4. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th Ed., Cengage Learning, 2012.
5. Michael Greenberg, "Advanced Engineering Mathematics", 2nd Ed., Pearson Education, 1998.

Project-Based Learning

Students are expected to prepare a report on a single topic, define it, describe its applications, and analyze hypothetical data. Also, write pseudo code for it, wherever applicable.

1. System of linear equations solution
2. Rank of matrix
3. Total derivative

4. L’Hôpital’s Rule
5. Dimension and basis
6. Curl and divergence
7. Work done
8. Gauss divergence theorem
9. Stokes' theorem
10. Eigenvalues and Eigenvectors
11. Bernoulli’s equation
12. Cauchy-Riemann equations in detail
13. Harmonic conjugate and orthogonal trajectories
14. Cauchy’s Integral formula
15. Cauchy’s Residue Theorem

Unit Test-

Unit Test-I	Unit- I, II, III
Unit Test-II	Unit- IV, V, VI

Designation of Course	Waves & Solid-State Physics		
Course Code	**C102**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory: - 03 Hours/ Week	End-of-Semester Examination	60 Marks	03
Practical: - 02 Hours/ Week	Internal Assessment	40 Marks	
	Term Work	25 Marks	01
	Total	**125 Marks**	**04**

Course Prerequisites:-	Students are expected to have a basic understanding of physics and calculus.
Course Objective	1. To impart knowledge of basic concepts in physics relevant to engineering applications in a broader sense, with a view to laying the foundation for Mechanical Engineering.
Course Outcomes:-	On completion of the course, students will be able to – 1. Analyze the wave nature of light and apply optical phenomena to measure stress, pressure, and dimensions in engineering applications. 2. Explain the structure and properties of lasers and correlate them with their performance and evaluate their suitability for specific applications. 3. Describe the mechanical properties of solid materials and relate them to engineering applications involving strength and elasticity. 4. Apply the principles of nanoscience to design and develop novel materials with tunable physical and chemical properties. 5. Operate and analyze data from analytical instruments to characterize and interpret the properties of nanomaterials. 6. Interpret the concepts of superconductivity and perfect diamagnetism and illustrate the Meissner effect along with its engineering applications.

Course Contents

Unit-I	**Wave Optics**	**(06 Hrs.)**
Interference- Interference of waves, interference due to thin film (Uniform and non-uniform), Applications of interference (optical flatness, interference filter, non-reflecting coatings. **Diffraction-** Introduction, Classes of diffraction, Diffraction at a single slit (Geometrical method), Conditions for maximum and minimum, Plane diffraction grating, Conditions for principal maxima and minima. **Polarization -**Introduction, Double refraction and Huygen's theory, Positive and negative crystals, Nicol prism, Dichroism.		
Unit-II	**Lasers**	**(06 Hrs.)**
Principle of laser, Einstein's coefficients, Spontaneous and stimulated emission, Population inversion, Ruby laser, Helium-Neon laser, Semiconductor laser, Single Heterojunction laser, Gas laser: CO_2 laser, Properties of lasers, Laser speckles, Applications of lasers (Engineering/ industry, medicine, communication, Computers, Holography.		
Unit-III	**Solid State Physics**	**(06 Hrs.)**
Free electron theory, Density of states, Bloch theorem (Statement only), Origin of band gap, Energy bands in solids, Effective mass of electron, Fermi-Dirac probability function and position of Fermi level in intrinsic semi-conductors (with derivation) and in extrinsic semi-conductors, Band structure of p-n junction diode under forward and reverse biasing, Conductivity in conductor and semi-conductor, Hall effect and Hall coefficient, Photovoltaic effect, Solar cell and its characteristics.		
Unit-IV	**Nanoscience**	**(06 Hrs.)**

Introduction of nanoparticles, properties of nanoparticles (Optical, electrical, Magnetic, structural, mechanical), synthesis of nanoparticles (Physical and chemical), synthesis of colloids, growth of nanoparticles, synthesis of nanoparticles by colloidal route, applications, quantum dots – wide band semiconductors, direct/indirect band gap semiconductors.		
Unit-V	**Analytical Instruments**	**(06 Hrs.)**
Motion of a charged particle in electric and magnetic fields, Electrostatic and Magnetostatics focusing,		
Electron sources, Wavelength and resolution, Specimen limitation, Depth of field and focus, Transmission electron microscope (TEM), Scanning electron microscope (SEM), Field emission scanning electron microscope (FESEM), X-ray Spectroscopy, Energy Dispersive X-ray Spectroscopy (EDS), Atomic force microscopy (AFM), X-ray diffraction (XRD), Bragg's law, Powder X-Ray diffraction.		
Unit-VI	**Smart Materials and Superconductors**	**(06 Hrs.)**
Introduction to smart materials, active smart polymers, shape memory alloys, Electro and Magneto Rheological Fluids, Introduction to composites, types of composites. Introduction to superconductivity; Properties of superconductors: zero electrical resistance, critical fields, persistent current, Meissner effect - Type I and Type II superconductors, Low and high temperature superconductors (introduction and qualitative)		

Term Work:
Practical (Any Eight of the Following)

1. Determination of radius of a planar convex lens/wavelength of light/Flatness testing by Newton's rings
2. Determination of the wavelength of light using a diffraction grating
3. Determination of the resolving power of the telescope
4. Determination of the thickness of a thin wire by air wedge
5. Determination of refractive index for O-ray and E-ray
6. Determination of divergence of a laser beam
7. Particle size by semiconductor laser
8. Determination of the wavelength of a laser by a diffraction grating
9. To study the Hall effect and determine the Hall voltage
10. Calculation of conductivity by the four-probe method
11. Study of solar cell characteristics and calculation of fill factors
12. Determination of the band gap of a semiconductor
13. Synthesis of metal oxide nanoparticles (ZnO/ZnS/Gold)
14. UV-VIS spectra of synthesized semiconductor nanoparticles
15. To determine the speed of sound
16. Measurement of average SPL across spherical wave front and behavior with the distance
17. Expansion chamber muffler: investigation of muffler response as a filter in the low frequency approximation by determining insertion loss.
18. Interference of sound using PC speakers
19. Determination of the velocity of sound in a liquid by an ultrasonic interferometer
20. Ultrasonic probe - a study
21. Mini project based on the contents of the syllabus.

Assignments

Six assignments to be given by the subject teacher (Theory)-one from each unit/one mini project with a report, students can work in a group of 4, Maximum

Textbooks

1. A Textbook of Engineering Physics, M N Avadhanulu, P G Kshirsagar, and TVS Arun Murthy, S. Chand Publishing (2018)
2. Engineering Physics, R K Gaur and S L Gupta, Dhanpat Rai Publishing Co Pvt Ltd (2015)

3. Concepts of Modern Physics, Arthur Beiser, Shobhit Mahajan, and S. Rai Choudhury, McGraw-Hill Education (2017)

Reference Books

1. Fundamentals of Physics, Jearl Walker, David Halliday, and Robert Resnick, John Wiley and Sons(2013)
2. Optics, Francis Jenkins and Harvey White, Tata McGraw-Hill (2017)
3. Principles of Physics, John W. Jewett, Cengage Publishing (2013)
4. Introduction to Solid State Physics, C. Kittel, Wiley and Sons (2004)
5. Principles of Solid-State Physics, H. V. Keer, New Age International (1993)
6. Laser and Non-Linear Optics, B. B. Laud, New Age International Private Limited (2011)
7. Nanotechnology: Principles and Practices, Dr. S. K. Kulkarni, Capital Publishing Company (2014)
8. Science of Engineering Materials- C.M. Srivastava and C. Srinivasan, New Age International Pvt. Ltd. (1997)
9. Introduction to Electrodynamics –David R. Griffiths, Pearson (2013)
10. Renewable Energy: Power for a Sustainable Future, Boyle, Oxford University Press (2012)

Project-Based Learning

Following is the list of topics for project-based learning (Not Limited to) based on the syllabus contents:

1. Case study on the measurement and effect of environmental noise in the college
2. To develop a demonstration model of a heat sensor in process control
3. To develop a demonstration model of automatic solar-powered time-regulated water pumping
4. Case study on solar technology: an alternative source of energy for national development
5. To develop a demonstration model of a double pendulum.
6. The study on the effect of length on the resistance of a copper wire (verification of Ohm's law, r is directly proportional to l)
7. To prepare a chart on the comparison of various methods used in measuring the gravitational constant g
8. To develop a demonstration model of a digital distance measuring instrument
9. Case study on electric power generation by road power
10. Case study on vibration of bars.
11. To determine the absorption coefficient of sound-absorbing materials
12. To develop a demonstration model to interpret the quantum confinement effect in wide band semiconductors
13. To develop a demonstration model of Tesla Coil
14. To develop a demonstration model of thin film interference in film formation of colors
15. To develop a demonstration model of Wi-Fi, a wireless data transfer system using light

Unit Tests

Unit Test-I	Unit I, II, III
Unit Test-II	Unit-IV, V, VI

Designation of Course	Electrical Engineering Systems		
Course Code	**C103**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory: - 04 Hours/ Week	End-Semester Examination	60 Marks	04
Practical: - 02 Hours/ Week	Internal Assessment	40 Marks	
	Term Work	25 Marks	01
	Total	**125 Marks**	**05**

Course Perquisites: -	Students should have basic knowledge of Physics, Chemistry, and Mathematics.
Course Objectives: -	1. The course introduces fundamental concepts of DC and AC Circuits, Electrical Measurement, Transformers, Induction Machines, DC Machines, Basics of power transmission, distribution & safety measures.
Course Outcomes: -	On completion of the course, students will be able to – 1. Apply basic laws and network theorems to analyze and solve electrical networks. 2. Examine and evaluate AC circuits, switchgear, and electrical measuring instruments for engineering applications. 3. Explain the fundamental concepts of magnetic and electromagnetic circuits and apply them to the operation and performance analysis of transformers. 4. Analyze the characteristics and demonstrate control techniques of AC motors for various mechanical engineering applications. 5. Analyze the characteristics and implement control techniques of DC motors for various mechanical engineering applications. 6. Illustrate the working principles of power transmission and distribution systems and apply safety rules for efficient operation.

Course Contents

Unit-I	**DC Circuit Analysis and Network Theorems**	**(08 Hrs.)**
Circuit Concepts: Concepts of network, active and passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements, R, L, and C as linear elements, source transformation, Kirchhoff's laws, loop and nodal methods of analysis, star-delta transformation. **Network Theorems:** Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem (simple numerical problems).		
Unit-II	**AC Circuits and Switch Gear, Electrical Measurement**	**(08 Hrs.)**
AC Circuits: Representation of sinusoidal waveforms, peak and RMS values, phasor representation of AC quantities, 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), series and parallel resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections. **Measuring Instruments:** Power measurement in three-phase circuits. Electrical instruments such as a wattmeter, energy meter, tong-tester, megger, and power analyzer. **Switch Gear:** Introduction to LT Switchgear, NO and NC Contacts, Contactors, relays, timers, use in control panel, application in interlocking and protection, and symbols.		
Unit-III	**Magnetic Circuit and Electromagnetic Induction**	**(08 Hrs.)**

Magnetic Circuit: flux, flux density, field strength, analogy between electric & magnetic circuits, magnetic circuits with DC and AC excitations, magnetic leakage, B-H curve, hysteresis and eddy current losses, magnetic circuit calculations, mutual coupling.

Electromagnetic Induction: Faraday's law of EMI, induced emf, Lenz's law, self-inductance, coefficient of self-inductance (L), mutual inductance, coefficient of mutual inductance (M), self-induced emf, and mutually induced emf, coefficient of coupling, inductance in series, types of inductor, their application, and energy stored in the magnetic field

Transformers: Single phase and three phases: Working principle, Construction, Types, applications.

Unit-IV	**Induction Machines**	**(08 Hrs.)**

Three Phase Induction Motor: construction, types, rotating magnetic field, principle of operation, slip, frequency of rotor current, rotor emf, rotor current, expression for torque, conditions for maximum torque, torque slip characteristics, starting torque in squirrel cage and slip ring motors, effect of change in supply voltage on torque, slip and speed, relation between full load torque and maximum torque, power stages in induction motor, vector diagram and equivalent circuit, no load and block rotor test, speed control of 3 phase motor, starting methods for 3 phase induction motor, circle diagram, construction and calculation.

Single Phase Motor: construction, double revolving field theory, starting methods & types of single-phase motor, equivalent circuit.

Servomotor: construction, types, working, characteristics, application in automation and robotics.

Unit-V	**DC Machines**	**(08 Hrs.)**

DC Generator: construction, emf equation of DC generator, methods of excitation, losses, condition for maximum efficiency, armature reaction, interpoles and compensating winding, commutation, methods of improving commutation, characteristics of separately excited and self-excited DC generators.

DC Motor: Working principle, voltage equation, condition for maximum power, torque developed, operating characteristics of DC motor, starting: 3-point and 4-point starter, speed control methods, Swinburne's brake test of a DC shunt motor. Soft-starting of DC motors.

Unit-VI	**Basic of Power transmission and distribution, Safety Measures**	**(08 Hrs.)**

Basic of Power transmission and distribution: classification of transmission lines, transmission line parameters, ABCD constants, voltage regulation, Ferranti effect, efficiency of transmission line. 3-phase 3-wire and 3-phase 4-wire distribution system, feeders, distributors, main lines, comparison of various distribution systems, load power factor improvement techniques.

Safety Measures: Safety measures in the electrical system, safety rules, basic principles of earthing types of earthing.

List of Assignments:

The students will be given a total of **twelve** assignments (Two assignments on each Unit, respectively).

1. DC Circuit Analysis
2. Network Theorems
3. AC Circuits and Switch Gear
4. Electrical Measurement
5. Single-Phase Transformer
6. Three-Phase Transformer
7. 3 Phase induction motor
8. Single-phase motor
9. DC Generator
10. DC Motor
11. Power transmission and distribution
12. Safety Measures

List of Experiments:

Note: Term work shall consist of a Minimum of **Eight** Experiments from the following list.

List of Practicals to be performed in the laboratory:

1. Plotting B-H characteristics for a material
2. Verification of Kirchhoff's Laws

3. Verification of the Superposition Theorem
4. Verification of Thevenin's Theorem
5. Verification of Maximum Power Transfer Theorem
6. Study of R-L series, R-C series, R-L-C series circuit
7. Time response of the R-L series and the R-C series circuit
8. Verification of voltage and current relationships in star and delta-connected 3-phase networks
9. Single lamp controlled by two different switches (staircase)
10. Two lamps controlled independently from two different switches (parallel)
11. Series-connected lamps
12. Study of Electricity bill (Industrial/commercial)
13. Direct loading tests on a single-phase transformer
14. Mini project based on the contents of the syllabus.

Textbooks

1. Basic Electrical Engineering - D. P. Kothari, J Nagarath (TMC)

Reference Books

2. Electrical Technology - Edward Huges (Pearson)
3. Electrical power system technology - S. W. Fordo, D. R. Patric (Prentice Hall)
4. Principles of Electronics-Dr. H. M. Rai (Satya Prakashan)
5. Electronic Devices and Circuit Theory- R. L. Boylestad and L. Nashelsky (PHI)
6. Electrical, Electronics Measurements and Instruments - (Satya Prakashan)

Project-Based Learning

Following is the list of topics for project-based learning (Not Limited to) based on the syllabus contents:

1. To develop a practical kit for the verification of Thevenin's theorem.
2. To develop a practical kit for the verification of the Superposition theorem.
3. To develop a practical kit for verification of the Maximum power transfer theorem
4. To develop a practical kit for the verification of Norton's theorem.
5. To develop a practical kit for the study of the R-L-C Series circuit.
6. To develop a practical kit for the study of the R-L-C parallel circuit.
7. To develop a practical kit for the study of voltage and current relationships in star star-star-connected network.
8. To develop a practical kit to interpret voltage and current relationships in delta delta-connected network.
9. To develop a demonstration model of a single-phase transformer for practical application.
10. Case study on transformer operation and testing by using professional software.
11. To develop a demonstration model of a Smart Energy meter using GSM
12. To develop a demonstration model of Safety measures in the electrical system.
13. Case studies on – Learning Industrial Safety through films/Videos
14. Case studies on – Learning industrial Safety through posters/charts

Unit Tests

Unit Test-I	Unit I, II, III
Unit Test-II	Unit- IV, V, VI

Designation of Course	Statics and Dynamics		
Course Code	C104		
Teaching Scheme	Examination Scheme		Credits Allotted
Theory: - 03 Hours/ Week	End Semester Examination	60 Marks	03
	Internal Assessment	40 Marks	
	Total	**100 Marks**	**03**

Course Prerequisites:-	1. Engineering Physics 2. Engineering mathematics
Course Objective	1. To study different types of forces in a plane. 2. To study the Centroid and moment of inertia 3. To study friction in machines 4. To study the Kinetics of linear and circular motion 5. To study the basics of civil engineering
Course Outcomes:-	On completion of the course, students will be able to: 1. Explain the concept of force and apply the conditions of equilibrium in 2D and 3D systems using suitable free body diagrams. 2. Determine the centroid and moment of inertia for different geometric sections and interpret their engineering significance. 3. Explain the concept of friction and calculate the force required to overcome friction under various conditions. 4. Analyze the motion of bodies using the principles of force and acceleration, work and energy, and impulse and momentum. 5. Examine the motion of rotating bodies using centripetal and centrifugal force principles. 6. Describe the basic properties of civil engineering materials, building components, and foundation systems used in construction.

Course Content

Unit-I	**Resultant and Equilibrium**	**(06 Hrs.)**
Types and Resolution of forces, Moment and Couple, Free Body Diagram, Types of Supports, Classification and Resultant of a force system in a Plane - Analytical and Graphical approach. Equilibrant, Conditions of Equilibrium, Equilibrium of a force system in a Plane, Force and Couple system about a point, Virtual work.		
Unit-II	**Centroid, Moment of Inertia, and Friction**	**(06 Hrs.)**
Centroid of line and plane areas, Moment of Inertia of plane areas, parallel and perpendicular axis theorem, radius of gyration, and least moment of inertia. Introduction to frictional force, preliminary concepts, and laws of friction. Introduction to machines, Relation between Mechanical advantage, Velocity ratio and efficiency, Reversible and non-reversible Machines. Simple lifting machines and their velocity ratio, gear train.		
Unit-III	**Analysis of Trusses, Frames, and Cables**	**(06 Hrs.)**
Two force members: Introduction to trusses, types of trusses, perfect and redundant trusses, Analysis of plane trusses by method of joint and method of section, cables subjected to point loads. Multi-force member: plane frame.		
Unit-IV	**Kinematics of particles and rigid bodies**	**(06 Hrs.)**
Rectilinear motion, velocity, and acceleration in terms of the rectangular coordinate system, Motion along a plane curve path, tangential and normal components of acceleration, motion curves (a-t, v-t, s-t),		

Projectile motion Rigid body- Introduction to general plane motion,		
Unit -V	**Kinetics of Particle**	**(06 Hrs.)**
Force and acceleration, introduction to basic concepts, D'Alembert's principle, equation of dynamic equilibrium, Newton's second law of motion. Work energy principle and law of conservation of energy, impulse and momentum, law of conservation of momentum, Impact and collision.		
Unit-VI	**Structural Materials and Foundations**	**(06 Hrs.)**
Types of structures based on loading, material, and configuration; structural materials: concrete, construction steel, bricks, flooring material and tiles, paints, plywood, glass, and aluminum. **Foundations-** Function of foundation, concept of bearing capacity and its estimation, types of foundation and its suitability, causes of failure of foundation.		

List of Assignments

Numerical and/or theory questions on t h e following topics from previous year question papers of GATE/ESE Mechanical Engineering examinations.

1. Resultant and equilibrium of forces
2. Centroid & Moment of Inertia
3. Friction
4. Trusses, frames, and cables
5. Kinematics of particles
6. Kinematics of a rigid body
7. Particle Kinetics
8. Structural materials and foundations

Textbooks

1. "Engineering Mechanics", Bhavikatti S.S. and Rajashekarappa K. G., New Age International (P) Ltd.
2. "Engineering Mechanics (Statics and Dynamics)", Tayal A.K., Umesh Publication.
3. "Engineering Mechanics-I and II (Statics and Dynamics)", Mokashi V.S., Tata McGraw-Hill Publication.

Reference Books

1. "Engineering Mechanics (Statics and Dynamics)", Hibbeler R. C., McGraw-Hill Publication.
2. "Vector Mechanics for Engineers-Vol.-I and Vol.-II (Statics and Dynamics)", Beer F.P. and Johnston E.R., Tata McGraw-Hill Publication.
3. "Engineering Mechanics (Statics and Dynamics)", Shames I.H., Prentice Hall of India (P) Ltd.
4. "Engineering Mechanics (Statics and Dynamics)", Singer F.L., Harper and Row Publication
5. "Engineering Mechanics (Statics and Dynamics)", Meriam J.L. and Kraige L.G., John Wiley and Sons Publication.
6. "Engineering Mechanics (Statics and Dynamics)", Timoshenko S.P. and Young D.H., McGraw-Hill Publication.

Project-Based Learning

Following is the list of topics for project-based learning (Not Limited to) based on the syllabus contents:

1. To prepare a demonstration model for various types of beams.
2. To prepare a demonstration model for various types of support.
3. To prepare a chart for various types of force systems with suitable real-life examples.
4. Case study on various situations where Varignon's theorem is used.
5. To prepare a demonstration model or to prepare a chart on the equilibrium system of forces of various engineering applications.
6. To prepare a chart on different types of trusses showing various members.

7. To prepare a demonstration model of any one type of truss.
8. To prepare a demonstration model of the basic geometrical figures and locate the centroid of each.
9. To prepare a demonstration model of the I and T section and locate the centroid of.
10. To prepare a chart for the parallel axis and perpendicular axis theorem with a suitable example.
11. To prepare a chart on the types of friction in various field conditions.
12. To prepare a chart on the application of friction.
13. To prepare a chart on motion curves.
14. To prepare a chart related to the lifting machine and relevant industrial applications.
15. Development of an Excel sheet for projectile motion (at least three problems).
16. Development of an Excel sheet for the work energy principle (at least three problems).
17. To prepare a chart on work energy and Impulse impulse-momentum principle with a suitable example.
18. Case study on different structural materials and comparison of their mechanical properties.
19. To prepare a demonstration model of different types of foundations.

Unit Tests

Unit Test-I	Unit I, II, III
Unit Test-II	Unit-IV, V, VI

Designation of Course	Computer Aided Drafting & Visualization		
Course Code	**C105**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory: - 04 Hours/ Week	End Semester Examination	60 Marks	04
Practical: - 02 Hours/Week	Internal Assessment	40 Marks	
	Term Work and Oral	50 Marks	01
	Total	**150 Marks**	**05**

Course Prerequisites: -	Fundamentals of Mathematics
Course Objectives: -	1. To interpret the basic principles of engineering drawing and highlight the importance of Computer Aided Drafting in engineering. 2. To develop graphical skills for the communication of concepts & ideas through technical drawings.
Course Outcomes:-	On completion of the course, students will be able to – 1. Explain the fundamental concepts of CAD drawing and demonstrate the applications of different types of lines, curves, and dimensioning techniques in practical scenarios. 2. Interpret the principles of orthographic projection and construct detailed 2D views of components using the first-angle projection method. 3. Illustrate the concept of isometric projection and develop 3D pictorial views of given components. 4. Analyze the projections of points, lines, and planes, and draw their projections using the first-angle projection method, locating their traces appropriately. 5. Differentiate among various types of solids and sectioned solids, and construct their projections using the first-angle projection method. 6. Apply the principles of development of lateral surfaces to prepare the development drawings of simple and sectioned solids.

Course Contents

Unit-I	**Fundamentals of CAD and Engineering Curves**	**(08 Hrs.)**
Introduction to Engineering Drawing, Types of lines and Dimensioning, Layout and size of drawing sheets, Scales. **Engineering Curves**-Ellipse drawing by Focus-Directrix Circle Method and Concentric Circle Method, Involutes of a circle, Cycloid, Archimedean Spiral, Helix on a cone, and Cylinder. Fundamentals of Computer Aided Drafting (CAD) and its applications, Various software for Computer Aided Drafting. AutoCAD initial settings and AutoCAD commands		
Unit-II	**Orthographic Projection**	**(08 Hrs.)**
Basic principal planes of Projections, First and Third angle method of Projection, Orthographic Projections of given Pictorial view by first angle projection method only, Sectional orthographic Projection. Orthographic Drawing using AutoCAD.		
Unit-III	**Isometric Projections**	**(08 Hrs.)**
Principles of Isometric Projections-Isometric Scale, Isometric Axes, Isometric Projections, and Isometric Drawing. Constructions of an Isometric view from the given Orthographic Views and the given origin. Isometric Drawing using AutoCAD.		
Unit-IV	**Projection of Points, Lines, and Plane Surfaces**	**(08 Hrs.)**
Projections of Points, Projections of Oblique Lines in First Quadrant, Traces. **Projections of Planes-** Projection of perpendicular and oblique planes (polygonal and circular surfaces), Obtaining the true shape of a plane surface. Projection of Points, Lines, and Plane Surfaces by using AutoCAD.		

Unit-V	Projection of Solids and Sectioned Solids	(08 Hrs.)
Introduction of solids-Types of solids, Projection of a solid inclined to both reference planes, Projection of common solids such as prism, pyramid, cylinder, and cone. Projection of solids cut by AIP and AVP, obtaining the true shape of a section. Projection of Solids and Sectioned Solids by using AutoCAD.		
Unit-VI	**Development of Lateral Surfaces**	**(08 Hrs.)**
Development of the lateral surfaces of solids like Prisms, pyramids, cylinders, and cones. Development of cut solids. Development of Lateral Surfaces by using AutoCAD.		

Term work

Term work shall consist of **seven** A2-size (594 mm x 420 mm) sheets using **AutoCAD.**

1. Types of lines, Dimensioning practice, 1st and 3rd angle methods symbol.
2. Engineering Curves
3. Orthographic Projections
4. Isometric views
5. Projections of Points and Lines, and Planes
6. Projection of Solids and Section of Solids
7. Development of Lateral Surfaces

Assignments: Minimum five problems on each unit in A3 A3-sized drawing Book

Textbooks

1. "Elementary Engineering Drawing", N.D. Bhatt, Charotar Publishing House, Anand, India.
2. "Textbook on Engineering Drawing", K. L. Narayana & P. Kannaiah, Scitech Publications, Chennai.

Reference Books

1. "Fundamentals of Engineering Drawing", Warren J. Luzzader, Prentice Hall of India, New Delhi.
2. "Engineering Drawing and Graphics", Venugopal K., New Age International Publishers.
3. M. B. Shah and B. C. Rana, "Engineering Drawing", 1st Ed, Pearson Education, 2005.
4. P. S. Gill, "Engineering Drawing (Geometrical Drawing)", 10th Edition, S. K. Kataria and Sons, 2005.
5. P. J. Shah, "Engineering Drawing", C. Jamnadas and Co., 1st Edition, 1988.

Project-Based Learning

Following is the list of topics for project-based learning (Not Limited to) based on the syllabus contents:

1. To obtain industrial drawings to identify the types of lines, dimensioning methods, and methods of projection.
2. To develop the model/charts based on engineering curves.
3. To prepare a model/chart for the identification of engineering curves in nature for industrial, societal, etc. applications.
4. To demonstrate different methods of orthographic projection.
5. To demonstrate the projection of Points.
6. To demonstrate the projection of Lines.
7. To demonstrate the projection of Planes.
8. To demonstrate the projection of Solids.
9. To demonstrate developments of surfaces for solids.
10. To demonstrate industrial application of development of surfaces such as steam carrying pipes, Ducts of air conditioning systems, etc.
11. To demonstrate the Isometric projection method through a model of a cube.

Unit Tests

Unit Test-I	Unit I, II, III
Unit Test-II	Unit-IV, V, VI

Designation of Course	Metal Joining Processes		
Course Code	C106		
Teaching Scheme	Examination Scheme		Credits Allotted
Practical: -02 hours/Week	Term Work	50 Marks	01
	Total	**50 Marks**	**01**

Course Prerequisites:-	Students should have basic knowledge of Materials, Physics, Chemistry, and Vocational. Course.
Course Objectives:-	The student should 1. Acquire knowledge of Arc and Gas Welding Processes 2. Acquire the knowledge of Resistance and Solid-state Welding Processes
Course Outcomes:-	On completion of the course, the students will be able to – 1. Explain the working principles of various Arc and Gas Welding processes and apply them for joining different types of weld joints. 2. Describe the principles of Resistance and Solid-State Welding processes and demonstrate their application in welding suitable joints.

Course Contents

Unit-I	Introduction to Welding Processes	(12 Hrs.)

Introduction, Classification of welding processes, Advantages and disadvantages of welding processes, Soldering, Brazing.

Arc Welding Processes-Carbon arc, Submerged arc, Tungsten inert gas (TIG), Metal inert gas (MIG), Plasma arc, Stud welding, and related arc welding processes –Theory, Comparison on merits, limitations, and applications, Fluxes used in arc welding. Characteristics of Welding Processes.

Gas Welding– Processes and equipment used, Types of flames, Gas cutting– Merits, demerits, and applications.

Unit-II	Resistance Welding and Solid-State Welding	(12 Hrs.)

Resistance Welding– Spot, Seam, Projection, Butt, Percussion welding, Tube welding, Electric resistance welding process, its merits, demerits, and applications.

Introduction of Solid-State Welding- Pressure, Diffusion, Ultrasonic, Explosive, Friction, Forge, Principle, Equipment used and Flux used, Merits, demerits, and application of the above process.

Term Work: List of Experiments

1. Edge Preparation of various welding Joints.
2. Making the Joint with the Arc Welding Process. (One Individual Job)
3. Making the Joint with the Resistance Welding Process. (One Individual Job with spot welding)
4. Making the Joint with TIG or MIG Welding Process. (One Individual Job)
5. Making the Joint with the Gas Welding Process. (One Individual Job)
6. Making the Joint with the Soldering Process. (One Individual Job)
7. Making the Joint with Braze Welding Process. (One Individual Job)
8. Study / Demonstration on Ultrasonic Welding.
9. Study / Demonstration on Friction Welding
10. One Industrial Visit to get the detailed Knowledge of Advanced Welding Processes and Latest Technology in Welding.

Text Books

1. O.P.Khanna, A Text Book of Welding Technology, DhanpatRai and Sons
2. Md. Ibrahim Khan, Welding Science and Technology, New Age International (P) Ltd.
3. Chapman W.A.J. “Workshop Technology “volume I, II.III, ELBS.

Reference Books

1. P.N.Rao, Manufacturing Technology- Vol I, McGraw-Hill Education, India Pvt.
2. Hajra Choudhary S.K., Bose S.K. “Elements of Workshop Technology” Volume I, II
3. Richard Little, “Welding and Welding Technology,” Pearson Education, second Edition.

Designation of Course	Soft Computing- I		
Course Code	C107		
Teaching Scheme	Examination Scheme		Credits Allotted
Practical: -04 hours/Week	Term Work and Practical	100 Marks	02
	Total	**100 Marks**	**02**

Course Prerequisites	Basic Mathematics
Course Objective	The goal of the course is for students to develop techniques for problem-solving using a programming language.
Course Outcomes	On successful completion of the course, students will be able to – 1. Explain the basic concepts of C++ programming and apply them to develop simple programs. 2. Demonstrate the use of various operators in C++ and implement them effectively in program design. 3. Illustrate the use of conditional statements and construct decision-making programs. 4. Analyze and apply different looping constructs to develop iterative solutions in C++. 5. Develop programs using user-defined functions and recursion to enhance modularity and reusability. 6. Apply the concept of function overloading to design efficient and flexible programs.

Course Contents

Unit-I	**Introduction to C++**	(08 Hrs.)
Introduction to C, C++; Object oriented programming; Programming Fundamentals; Data and Data Types		
Unit-II	**Operators in C++**	(08 Hrs.)
Declarations in C++; Operators in C++; Introduction to classes and objects, and strings		
Unit-III	**Conditional Statements**	(08 Hrs.)
Relational and logical operators; If statements; Switch Statements		
Unit-IV	**Loops**	(08 Hrs.)
Loops in C++; For loop; While loop; Do while loop; Jump statement		
Unit-V	**Functions I**	(08 Hrs.)
Functions, basic formats; Recursion		
Unit-VI	**Functions II**	(08 Hrs.)
Overloaded functions; Local, Global, and Static Variables		

Term Work

Term work shall consist of programs (not limited to) listed below, based on the syllabus.

1. C++ "Hello, World!" Program
2. C++ Program to Print Number Entered by User
3. C++ Program to Add Two Numbers
4. C++ Program to Find Quotient and Remainder
5. C++ Program to Find the Size of int, float, double, and chart in Your System
6. C++ Program to Swap Two Numbers
7. C++ Program to Find the ASCII Value of a Character
8. C++ Program to Multiply Two Numbers
9. C++ Program to Check Whether a Number is Even or Odd

10. C++ Program to Check Whether a Character is a Vowel or a Consonant.
11. C++ Program to Find the Largest Number Among Three Numbers
12. C++ Program to Find All Roots of a Quadratic Equation
13. C++ Program to Calculate the Sum of Natural Numbers
14. C++ Program to Check Leap Year
15. C++ Program to Find Factorial
16. C++ Program to Generate Multiplication Table
17. C++ Program to Display Fibonacci Series
18. C++ Program to Find GCD
19. C++ Program to Find LCM
20. C++ Program to Reverse a Number
21. C++ Program to Calculate the Power of a Number
22. C++ Program to Check Whether a Number is a Palindrome or Not
23. C++ Program to Check Whether a Number is Prime or Not
24. C++ Program to Display Prime Numbers Between Two Intervals
25. C++ Program to Check Armstrong Number
26. C++ Program to Display Armstrong Numbers Between Two Intervals
27. C++ Program to Display Factors of a Number
28. C++ Programs To Create a Pyramid and a Pattern
29. C++ Program to Make a Simple Calculator to Add, Subtract, Multiply, or Divide Using switch...case
30. C++ Program to Display Prime Numbers Between Two Intervals Using Functions
31. C++ Program to Check Prime Number By Creating a Function
32. C++ Program to Check Whether a Number Can Be Express as a Sum of Two Prime Numbers
33. C++ program to find the Sum of Natural Numbers using Recursion
34. C++ program to calculate the Factorial of a Number Using Recursion
35. C++ Program to Find G.C.D Using Recursion
36. C++ Program to Convert Binary Number to Decimal and vice-versa
37. C++ Program to Convert Octal Number to Decimal and vice-versa
38. C++ Program to Convert Binary Number to Octal and vice-versa
39. C++ program to Reverse a Sentence Using Recursion
40. C++ Program to Calculate Power Using Recursion

Text Books

1. "Let Us C++", Kanetkar Yashavant, BPB Publications

Reference Books

1. “C++ Programming Today”, Barbara Johnston, Prentice Hall of India, New Delhi.
2. “C++ how to program”, Paul Deitel and Henry Deitel, Prentice Hall of India, New Delhi.
3. "Accelerated C++: Practical Programming by Example", Andrew Koenig and Barbara E. Moo, Addison-Wesley Publications
4. "C++: The Complete Reference", Herbert Schildt, McGraw-Hill Publications.
5. "C++ Primer"; Barbara E. Moo, Josée Lajoie, and Stanley B. Lippman; Addison-Wesley Professional
6. "Programming: Principles and Practice Using C++", Bjarne Stroustrup, Addison-Wesley Professional

B. Tech. Mechanical
Sem.-II

Designation of Course	Differential Equations, Probability & Statistics		
Course Code	**C108**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory:- 03 Hours/ Week	End Semester Examination	60 Marks	03
Tutorial:- 01 Hours/ Week	Internal Assessment	40 Marks	
	Tutorial	-	01
	Total	**100 Marks**	**04**

Course Prerequisites:-	Students should know of 1. Derivatives and Integration 2. Partial derivative 3. Basic of statistics
Course Objectives:-	To provide knowledge about 1. Various methods to solve first-order and first-degree, and n^{th} order differential equations. 2. Integral transform and application of partial differential equations. 3. Methods of interpretation of numerical data and probability distribution.
Course Outcome:-	On completion of the course, the students will be able to – 1. Apply appropriate methods to solve first-order and first-degree differential equations. 2. Solve ordinary differential equations and develop mathematical models for physical systems such as the mass–spring system. 3. Utilize Laplace transforms to analyze and solve wave, and one- and two-dimensional heat equations. 4. Evaluate multiple integrals to determine areas and volumes of given regions. 5. Apply various statistical techniques to analyze and interpret numerical data. 6. Explain probability distributions and perform hypothesis testing for given datasets.

Course Contents

Unit-I	**Differential Equation**	**(06 Hrs.)**
Formation of the ordinary differential equations (ODEs), Solution of an ordinary differential equation, Equations of the first order and first degree, Linear differential equation, Bernoulli's equation, Exact differential equations, Equations reducible to exact equations		
Unit-II	**Linear Differential Equations**	**(06 Hrs.)**
Solution of N^{th} order LDE with Constant Coefficients, Method of Variation of Parameters, Cauchy's & Legendre's DE, Solution of Simultaneous & Symmetric DE, Mass Spring system.		
Unit-III	**Laplace Transforms and Applications of Partial Differential Equations**	**(06 Hrs.)**
Laplace transform: Definition of Laplace transforms, Properties of Laplace Transform (Properties without proof). Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivative, Partial fractions method & first shift property to find inverse Laplace transform. Inverse Laplace transform using the Convolution theorem (without proof). Applications of partial differential equations: Basic concepts, modeling of Vibrating String, Wave equation, One- and two-dimensional Heat flow equations, method of Separation of variables.		
Unit-IV	**Multiple Integrals and Their Applications**	**(06 Hrs.)**
Double and Triple integrations, Applications to Area, Volume, Mean, and Root Mean Square Values.		

Unit-V	Statistics	(06 Hrs.)
Measures of central tendency, Standard deviation, Coefficient of variation, Moments, Skewness, and Kurtosis, Correlation and Regression, Reliability of Regression estimates.		
Unit-VI	**Probability and Probability Distributions**	**(06 Hrs.)**
Probability, Bayes Theorem, Probability density function, Probability distributions: Binomial, Poisson, Normal, Test of hypothesis: Chi-square test, t-test.		

Assignments

Problems and/or theory questions on the following topics from previous year question papers of GATE/ESE Mechanical Engineering examinations.

1. Differential equation.
2. Linear differential equations.
3. Laplace transforms and applications of partial differential equations.
4. Multiple integrals and their applications.
5. Statistics.
6. Probability and probability distribution.

Tutorials:

Problems and/or theory questions on the following topics from previous year question papers of GATE/ESE Mechanical Engineering examinations.

1. First-order equation (linear and nonlinear),
2. Higher-order linear differential equation with constant coefficients
3. Euler-Cauchy equation
4. Legendre's DE
5. Laplace transformation
6. Applications of partial differential equations
7. Double and Triple integrations
8. Applications to area, volume, mean, and root mean square values.
9. Sampling theorems, conditional probability; mean, median, mode, and deviation.
10. Correlation and regression, reliability of regression estimates.
11. Probability, Bayes' theorem, probability density function
12. Binomial, poisson, and normal distributions.

Text Books

1. P. N. Wartikar and J. N. Wartikar, "Applied Mathematics (Volumes I and II)", 7th Ed., Pune Vidyarthi Griha Prakashan, Pune, 2013.

Reference Books

1. B. S. Grewal, "Higher Engineering Mathematics", 42nd Ed., Khanna Publication, Delhi
2. B.V. Ramana, "Higher Engineering Mathematics", 6th Ed., Tata McGraw-Hill, New Delhi, 2008.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Ed., John Wiley & Sons, Inc., 2015.
4. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th Ed., Cengage Learning, 2012.
5. Michael Greenberg, "Advanced Engineering Mathematics", 2nd Ed., Pearson Education, 1998.

Project-based learning topics:

Students are expected to prepare a report on any one topic, write its definition, applications, and analyze the hypothetical data. Also, write pseudo code for it, wherever applicable.

1. Formation of a differential equation
2. Exact Differential Equation
3. Linear differential equation

4. Solution of nth order LDE with Constant Coefficients
5. Mass spring system
6. Transform (Properties with proof).
7. Applications of partial differential equations in mechanical engineering
8. Multiple integrals applications
9. Applications of Multiple Integrals to Area, Volume
10. Random Sampling
11. Stratified random sampling
12. Reliability of Regression Estimates.
13. Bayes' Theorem
14. Probability density function
15. Testing of hypothesis

Unit Test -

Unit Test-I	Unit- I, II, III
Unit Test-II	Unit- IV, V, VI

Designation of Course	Chemistry of Engineering Materials		
Course Code	**C109**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory: - 03Hour/ Week	End Semester Examination	60 Marks	03
Practical: -02 Hours/Week	Internal Assessment	40 Marks	
	Term Work	25 Marks	01
	Total	**125 Marks**	**04**

Course Prerequisites: -	Higher Secondary Chemistry.
Course Objective: -	The student should acquire the knowledge of 1. To develop interest among the students in chemistry and its applications in engineering. 2. To develop confidence among students about chemistry and how the knowledge of chemistry is applied in the technological field. 3. The student should interpret the concepts of chemistry to lay the groundwork for subsequent studies in the field, such as Mechanical Engineering.
Course Outcomes: -	On completion of the course, the students will be able to: 1. Apply the principles of X-ray diffraction to analyze and determine the crystal structure of materials. 2. Explain and analyze the fundamental concepts of metallurgy in understanding the behavior and properties of metals. 3. Classify, compare, and apply the knowledge of ferrous and non-ferrous materials for suitable engineering applications. 4. Apply the knowledge of polymers and plastics to evaluate and select advanced materials for engineering use. 5. Analyze and evaluate the characteristics and applications of composite materials for various engineering purposes. 6. Identify, analyze, and recommend suitable control measures for different types of corrosion encountered in industries.

Course Contents

Unit-I	**Crystal Structures**	**(06 Hrs.)**
Study of crystal structure, indexing of planes and directions, Slip planes, linear and Planner density calculations, volume density calculations, Imperfections in crystals, effect of crystal structure defects on various properties, Allotropic and polymorphism of metals, formation of solid solutions.		
Unit-II	**Extractive Metallurgy**	**(06 Hrs.)**
Introduction, Occurrence of metals, types of ores, concentration of ores by physical methods, Crushing and Sizing, Froth- Flotation, Magnetic Separation, Gravity separation method. Chemical methods- calcination, Roasting, Reduction of ore by Pyrolysis, Chemical reductions, Electrolytic refining of metals.		
Unit-III	**Ferrous & Non-Ferrous Materials**	**(06 Hrs.)**
Metallic materials: Introduction, Alloy- definition and classification, purposes of making alloys. Ferrous alloys, Introduction to steel making, blast furnace and electric steel making: Plain carbon steels (mild, medium and high), Nonferrous alloys: Copper alloy (Brass), Nickel alloy (Nichrome), Aluminum alloy (Duralumin and Alnico). **Green Chemistry:** Definition, Twelve Principles of Green Chemistry.		
Unit-IV	**Introduction to Polymers, Plastics, and Rubbers**	**(06 Hrs.)**
Polymers: Introduction, plastics, thermo softening and thermosetting plastics, industrially important plastics like phenol formaldehyde, urea formaldehyde, and epoxy resins, Conducting polymers and Biopolymers (Introduction, examples, and applications), types of rubbers, Acrylics.		
Unit-V	**Introduction to Composites**	**(06 Hrs.)**
Introduction, types of composites, different types of reinforcing materials, characteristics of reinforced materials, matrix materials composition, properties and uses of fiber reinforced plastics (FRP), Carbon fibers, Boron Nylon, etc., and glass reinforced plastic (GRP). Ceramic matrix composite. Metal Matrix composite.		

Unit-VI	Corrosion & Protective Coatings	(06 Hrs.)
Introduction, corrosion, types of corrosion, hydrogen embrittlement, stress corrosion, pit-type corrosion, corrosion prevention methods, Metallic coatings, Electroplating, Methods of cleaning articles before electrodeposition, Electroplating methods, Electroless plating, Some other metallic coatings, Modification of environment, Cathodic Protection, chemical conversion coatings, Organic Coatings, Paints, Varnishes, Enamels, Special paints. CVD and PVD coatings.		

Term Work

List of Experiments

1. Preparation of polystyrene/phenol-formaldehyde/urea-formaldehyde resin.
2. To determine the molecular weight/radius of macromolecule polystyrene/ polyvinyl alcohol by viscosity measurement.
3. Estimation of the percentage of Iron in Plain Carbon Steel by the Volumetric Method.
4. Study of corrosion of metals in a medium of different pH.
5. Determination of the rate of corrosion of aluminum in acidic and basic media.
6. Determination of the percentage of Ca in the given cement sample
7. Preparation of phenol-formaldehyde resin/ urea-formaldehyde.
8. Estimation of copper in brass solution.
9. Determination of the rate of corrosion of aluminum in acidic and basic media.
10. To obtain a metallic coating on base metal by using both the methods, Electroplating and Electroless plating.

Assignments

1. Linear and Planner density calculations with volume density calculations.
2. Extractive Metallurgy.
3. Purposes of making alloys like Ferrous alloys.
4. Twelve principles of Green Chemistry.
5. Conducting polymers and Biopolymers.
6. Thermo softening and thermosetting plastics.
7. Fiber-reinforced plastics (FRP).
8. Heat treatment of tool steels
9. Organic Coatings, Paints, Varnishes, Enamels, Special paints for corrosion prevention.
10. Types of corrosion and their preventive measures.

Test Book

1. A Textbook of Engineering Chemistry by S. S. Dara and S. S. Umare, S. Chand & Company Ltd., New Delhi.
2. A Textbook of Engineering Chemistry by C. P. Murthy, C. V. Agarwal, and A. Naidu, B S Publications, Hyderabad.
3. A Textbook of Engineering Chemistry, Shashi Chawla, Dhanpat Rai & Co, 2004

Reference Books

1. Material Science and Engineering Metallurgy by V D Kodgire, Everest Publications
2. Materials Science by O P Khanna, Khanna Publications
3. Engineering Chemistry (16th Edition) Jain, Jain, Dhanpat Rai Publishing Company, 2013.
4. Engineering Chemistry by Dr. A. K. Pahari and Dr. B. S. Chauhan, Laxmi Publications (P) Ltd, New Delhi.
5. Polymer Science, V. R. Gowarikar, N. V. Viswanathan, Jayadev Sreedhar, Wiley Eastern Limited
6. Polymer Science and Technology (2nd Edition), P. Ghosh, Tata McGraw-Hill, 2008
7. Polymers: Chemistry & Physics of Modern Materials (2nd edition) J.M.G. Cowie, Blackie Academic & Professional, 1994.

Project-Based Learning

Following is the list of topics for project-based learning (Not Limited to) based on the syllabus contents:

1. To prepare a demonstration model on Biopolymers.
2. To prepare epoxy resins using a suitable method.
3. To write a review paper based on applications of fibre reinforced plastics (FRP) and get it published in a reputed journal (eg, Google Scholar).
4. With the help of green chemistry principles, to prepare any organic dye by using Traditional and Green pathway.
5. To prepare a demonstration model, a hardware model based on Electroless plating and calculate cell voltage.
6. To write a review paper based on conducting polymers and get it published in a reputed
journal (eg, Google Scholar).

Unit Test -

Unit Test-I	Unit- I, II, III
Unit Test-II	Unit- IV, V, VI

Designation of Course	**Mechanical Engineering Systems**		
Course Code	**C110**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory: - 04 Hour/ Week	End Semester Examination	60 Marks	04
Practical: -02 Hours/Week	Internal Assessment	40 Marks	
	Term Work	25 Marks	01
	Total	**125 Marks**	**05**

Course Prerequisites: -	Higher Secondary Physics
Course Objective: -	To teach students about 1. Introduction to Systems in Thermal Engineering 2. Introduction to Systems in Design Engineering 3. Introduction to Systems in Manufacturing Engineering
Course Outcomes: -	On successful completion of the course, the students will be able to: 1. Explain the fundamentals and working principles of power-producing and power-absorbing devices. 2. Differentiate and analyze the fundamental concepts of renewable and non-renewable energy systems. 3. Describe and illustrate the fundamentals of the mechanisms of machines. 4. Identify and analyze the fundamentals and applications of power-transmitting devices. 5. Explain and apply the basic concepts of machine tools and manufacturing processes. 6. Describe and evaluate the fundamentals and applications of robotics in engineering systems.

Course Contents

Unit-I	**Power Producing and Absorbing Systems**	(08 Hrs.)
Power Producing Systems: I.C. Engines- Basic nomenclature, Classification, S.I. and C.I. Engines, Two-stroke and four-stroke engines. Boilers- classification, water tube and fire tube boilers. Steam Turbines: Classification, simple Impulse, and reaction turbines. Water Turbines: Classification, Impulse, and Reaction Turbines. Gas Turbines: classification, open and closed gas turbines. Construction, working, and applications of all these devices. **Power Absorbing Systems:** Compressors; Classification, Rotary, reciprocating air compressors, Blower, Pumps: Classification, Rotary, reciprocating pumps, Household refrigerator, and window air conditioner.		
Unit-II	**Renewable and Non-Renewable Energy Systems**	(08 Hrs.)
Renewable energy systems: Solar- P-V Cells, collectors- Flat plate, Parabolic, Trough collector, Heliostat. Wind- Classification of wind Turbines, Horizontal and vertical axis. Biomass gasification, Biogas Plant, Geothermal, Tidal, micro-hydro plant. **Non-renewable energy systems:** Thermal power plant, hydroelectric power plant, nuclear power plant, Gas Turbine plant, I.C. engine power Plant,		
Unit-III	**Introduction to Mechanisms of Machines**	(08 Hrs.)
Kinematic link, Kinematic pair, Types of constrained motions, Kinematic chain, Types of joints, Mechanism, Machine, Degree of freedom (Mobility), Kutzbach criterion, Grubler's criterion. Four-bar chain and its inversions, Grashof's law, Slider crank chain and its inversions, Double slider crank chain and its inversions. Geneva Mechanisms, Ratchet and Paul Mechanisms		
Unit-IV	**Power Transmitting Devices**	(08 Hrs.)
Types of Belts and belt drives, Chain drive, rope drive, Types of gears, Types of Couplings, Types of friction clutch, Power transmission shafts, axles, keys, types of Keys, Sliding Contact and Rolling Contact Bearing, Bush and ball bearings, Types of brakes.		
Unit-V	**Introduction to Machine Tools**	(08 Hrs.)

Demonstration of: Lathe machine, Centre lathe, wood working lathe, Drilling machine, types of drilling machine, milling machine, Power saw. Grinding machine, cylindrical grinder, and surface grinder. NC Machine, CNC machine.		
Unit-VI	**Introduction to Robotics**	(08 Hrs.)
History of robotics, Definition of robotics and robot, laws of robotics and classification of robot, application of robot, robot anatomy, Degree of freedom, Degree of mobility, Kinematics, joints, work envelope, pay load, reach, speed, acceleration, accuracy, precision, repeatability, Mounting, Footprint, cycle time, Components of robots such as sensor, power conversion unit, Actuators, Manipulators, Controllers, Base and user interface, Future of robotics.		

Term work: Term work shall consist following experiments.

1. Study and demonstration of low-pressure boilers.
2. Study and demonstration of IC Engines.
3. Study and demonstration of Refrigeration and Air Conditioning.
4. Study and demonstration of Pumps and Compressors.
5. Study and demonstration of turbines.
6. Study and demonstration of Inversions of 4-bar, Single and Double Slider Crank Mechanisms.
7. Study and demonstration of power transmitting elements.
8. Study and demonstration of operations on the center lathe.
9. Study and demonstration of operations on the drilling machine.
10. Study and demonstration of robot anatomy.
11. Mini Project on Contents of Syllabus.

Assignment

1. Assignment on power-producing and absorbing devices
2. Assignment on renewable and non-renewable energy
3. Assignment on the mechanism of machines
4. Assignment on Power Transmitting Devices
5. Assignment on Machine Tools
6. Assignment on Robotics

Text Books

1. A Textbook of Production Engineering, P.C. Sharma, S. Chand Publication, New Delhi, 2nd edition, 8th Edition (2014).
2. A Textbook of Manufacturing Technology: Manufacturing Processes, R. K. Rajput, Laxmi Publications (P) Ltd, 2nd Edition 2015
3. R.S. Khurmi and J K Gupta, Textbook of Thermal Engineering, S Chand Publications.

Reference Books

1. V. Ganeshan, Internal Combustion Engine, Tata McGraw-Hill Publication, 4th Edition (2012).
2. R. K. Rajput, Thermal Engineering, Laxmi Publications
3. Ambekar A.G. Mechanisms and Machine Theory, Prentice-Hall of India, Eastern Economy Edition (2007)
4. S.S. Ratan, Theory of Machines, Tata McGraw-Hill, 4th Edition
5. Introduction to Robotics, S. K. Shah. McGraw-Hill, 2nd Edition

Project-Based Learning

Following is the list of topics for project-based learning (Not Limited to) based on the syllabus contents:

1. To prepare a chart of comparison among specifications of various models of two-wheelers available.
2. To develop a demonstration model of a low-cost household refrigerator
3. To develop a demonstration model of a low-cost air conditioner
4. To develop a demonstration model of a Biogas plant

5. To develop a demonstration model of a geothermal power plant
6. To develop a demonstration model of a wind power plant
7. To develop a demonstration model of a solar energy plant
8. To develop a demonstration model of the Whitworth quick return mechanism
9. To develop a demonstration model of a single slider crank chain mechanism with its inversion
10. To develop a demonstration model of the Ratchet and Paul mechanism
11. To develop a demonstration model of a mini conveyor using the Geneva mechanism

Unit Test

Unit Test-I	Unit- I, II, III
Unit Test-II	Unit- IV, V, VI

Designation of Course	Electronics Engineering Systems		
Course Code	**C111**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory:- 04 Hours/ Week	End Semester Examination	60 Marks	04
Practical:- 02 Hours/ Week	Internal Assessment	40 Marks	
	Term Work	25 Marks	01
	Total	**125 Marks**	**05**

Course Prerequisites:-	Students should have basic knowledge of Electrical Engineering
Course Objectives:-	1. To provide a n overview of electronics engineering that serves a s the foundation of advanced studies in mechanical engineering. 2. This course provides a comprehensive idea about the working principle 3. Operation and characteristics of electronic devices, transducers, digital electronics, and communication systems.
Course Outcomes:-	On completion of the course, students will be able to: 1. Analyze the working principles of basic electronic devices and linear ICs. 2. Apply the concepts of digital electronics to design simple digital circuits. 3. Demonstrate methods of signal conditioning and evaluate their applications in practical systems. 4. Explain and compare the principles of Analog and Digital Communication systems. 5. Select and apply suitable transducers and data acquisition systems for given applications. 6. Illustrate and implement the concepts of Microprocessors and Microcontrollers in real-time applications.

Course Contents

Unit-I	**Electronic Devices and Linear ICs**	**(08 Hrs.)**
Rectifiers: Half-wave, Full wave, and Bridge rectifiers - capacitor filter-wave forms-ripple factor regulation characteristics. Special semiconductor devices: FET, SCR. LED, MOSFET, DIAC, TRIAC, relays, VI characteristics – applications		
Unit-II	**Digital Electronics**	**(08 Hrs.)**
Number system – Binary, Decimal, Octal, Hexadecimal, Digital Signal, Combinational and sequential logic circuits, clock signal, Boolean Algebra and Logic gates, Arithmetic Operations, Multiplexers, Demultiplexers, Encoders, Decoders, Flip-flop, Registers, Counters. Integrated circuits & logic families: – Logic levels, noise immunity, fan out, propagation delay, TTL logic family, CMOS logic family, Comparison with the TTL family		
Unit-III	**Signal Conditioning**	**(08 Hrs.)**
Operational amplifiers, Inverting, non-inverting, voltage follower, summing, subtractor, Instrumentation, 555 timer-operating modes: monostable, stable multivibrator, Analog to Digital & Digital to Analog Converters		
Unit-IV	**Communication Systems**	**(08 Hrs.)**
Analog Communication & Digital Communication: Block diagram of a basic communication system, Frequency spectrum, need for modulation, Methods of modulation- Principles of AM, FM, Pulse analog &pulse digital modulation, AM/FM transmitters & receivers, satellite communication–Radar system, data transmission and MODEM, Mobile communication systems: cellular concept, simple block diagram of GSM system		
Unit-V	**Transducers and Data Acquisition Systems**	**(08 Hrs.)**

Basic requirements of transducers, classification of transducers, passive transducers: Resistive, capacitive, inductive, LVDT, potentiometric strain gauge, thermistor, hall effect, proximity sensors. Active transducers: Piezoelectric, photoelectric, and thermocouple. Static characteristics of the transducer, selection of the transducer er. Block diagram of data acquisition systems and their applications.		
Unit-VI	**Microprocessor & Microcontroller**	**(08 Hrs.)**
Overview of generic microprocessor, architecture & functional block diagram comparison of Microprocessor & microcontroller. 8051 Architecture, ports, registers, timers/counters. Serial communications interrupt. Interfacing relay, stepper motor, LCD Display, Keyboard, ADC.		

Term Work:

Term work shall consist of a Minimum of Eight **Experiments.**

1. To study and plot the regulation characteristics of a half-wave and a full rectifier.
2. To study characteristics of SCR.
3. To study the characteristics of TRIAC
4. To study basic logic gates: AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR.
5. Implementation of Boolean functions using logic gates.
6. To study Operational Amplifiers (Op-amps).
7. Study of Amplitude Modulation and Demodulation
8. Study of Frequency Modulation and Demodulation
9. To study characteristics of LVDT for displacement measurement.
10. To study Microprocessor &Microcontroller

Assignment:

Assignment based on each unit.

Textbooks:

1. K.P. Ramchandran, G. K. Vijyaraghavan, M.S. Balasundaram, Mechatronics: Integrated Mechanical Electronic Systems, Wiley Publication,2008
2. W. Bolton, Mechatronics - A Multidisciplinary Approach, 4th Edition, Prentice Hall,2009.
3. Dr. D. S. Kumar, Mechanical Measurement & Control, Metropolitan Book Co. Pvt. Ltd, New Delhi, 2007
4. M. D. Singh and J. G. Joshi, Mechatronics, 3rd Edition, Prentice Hall, New Delhi,2009.
5. Mottershead Allen, Electronic Devices & Circuits, PHI
6. R. P. Jain, Modern Digital Electronics, M Graw

Reference Books

1. Thomas L. Floyd, Electronic Devices, Pearson Education (Sixth edition)
2. Millman & Halkis, Electronic Devices & Circuits, PHI
3. Malvino Leach, Digital Principles & Applications, McGraw-Hill
4. Millman & Halkis, Integrated Electronics, MGH

Project-Based Learning:

The following are project-based topics for project-based learning (Not Limited to) based on the syllabus contents:

To develop a demonstration model.

1. Potential Divider and Variable DC bias circuit.
2. DC lighting circuit.
3. Automatic LED Emergency Light.
4. Flashing LED.
5. Dancing Light.
6. Voltage regulator using a Zener diode.

7. Cascode amplifier using FET.
8. JFET as an analog switch.
9. FET used as a Multiplexer.
10. JFET acts as a current limiter.
11. LDR& Transistor-based Light Detector.
12. LDR Based Smart Electronic Candle.
13. Smart Bulb Holder using LDR.
14. MOC3021 Opto-coupler as a solenoid/valve control.
15. Light controller switch using a phototransistor.

Unit Test -

Unit Test-I	Unit- I, II, III
Unit Test-II	Unit- IV, V, VI

Designation of Course	Computer-Aided Machine Drawing		
Course Code	**C112**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory: - 04 Hours/ Week	End Semester Examination	60 Marks	04
Practical: - 02 Hours/Week	Internal Assessment	40 Marks	
	Term Work and Practical	50 Marks	01
	Total	**150 Marks**	**05**

Course Prerequisites:-	1. Fundamentals of Mathematics 2. Mechanical Engineering systems 3. Computer-Aided Drafting and Visualization
Course Objectives:-	3. To make the students Interpret and interpret drawings of machine components 4. To prepare assembly drawings both manually and using standard CAD packages 5. To familiarize the students with Indian Standards on drawing practices and standard components
Course Outcomes:-	On completion of the course, students will be able to: 1. Explain the fundamentals of machine drawing and demonstrate conventional representation of machine elements. 2. Apply the concepts of Geometric Dimensioning and Tolerance (GD&T) in machine drawings. 3. Analyze and construct component assemblies from given drawings. 4. Interpret assembly drawings to develop detailed component drawings.

Course Contents

Unit-I	**Fundamentals of Machine Drawing and Conventional Representation**	**(10 Hrs.)**
Introduction to Machine Drawing and its importance, Code of practice for Engineering Drawing, BIS specifications – Materials, Welding Joint and symbols, riveted joints, pipe joints, keys, and screwed fasteners. Conventional Representation of dimensioning and sectioning, breaks in pipes and shafts, Screw Threads, springs, gears, foundation bolts, Common features, and machine components.		
Unit-II	**Geometric Dimensioning and Tolerancing (GD&T)**	**(10 Hrs.)**
Limits, Fits and Tolerances: Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, types of fits with symbols and applications, Geometrical Tolerances on drawings. Standards followed in the industry, Interpretation of given symbols on drawing. **Characteristics of Surface Roughness**- Machining Symbols, Indications of surface roughness and its characteristics, Symbols for directions of lay.		
Unit-III	**Details to Assembly Drawing**	**(14 Hrs.)**
Classification of Drawings- Machine drawing, Production Drawing, Part Drawing, Assembly drawing, Drawings for catalogues and instruction manuals, patent drawings, Drawing Standards, Introduction to unit assembly drawing, steps involved in preparing assembly drawing from details and vice-versa, Blueprint Readings. **Preparation of Assembly Drawings:** Universal and Oldham's Couplings, Foot-Step Bearings, Lathe Tool Post, Machine Vice, Pipe Vice, Screw Jack, Single Tool post, square tool post, Clapper block, Revolving Centre, C-Clamp.		
Unit-IV	**Assembly to Details Drawing and Production Drawing**	**(14 Hrs.)**
Types of Production Drawings- Detail or Part Drawings, Working Assembly Drawings, Detailed Drawings, and Manufacturing Methods. **Preparation of Detail or Part Drawings:** Plummer Block or Pedestal Bearings, Lathe Tail Stock, Drilling Jig, Piston and Connecting Rod, Gland and Stuffing Box Assembly, Gate valve, Globe valve, Non-Return Valve, and Steam Stop Valve.		

Term Work

1. Three A2-size Details **for assembly** drawing using AutoCAD.
2. Three A2-size sheets of **Assembly drawings to details** using AutoCAD.

Assignments

Minimum **Five** Questions based on each unit in A2 size Sheets

Textbook

1. R.K. Dhavan, "A Textbook of Machine Drawing", S Chand Publication, New Delhi.
2. Gopalakrishna K.R., "Machine Drawing", 22nd Edition, Subhas Stores Books Corner, Bangalore, 2013

References

1. N. D. Bhatt and V.M. Panchal, "Machine Drawing", 48th Edition, Charotar Publishers,2013
2. Junnarkar, N.D., "Machine Drawing", 1st Edition, Pearson Education, 2004
3. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, "Machine Drawing", published by Tata McGraw-Hill, 2006
4. S. Trymbaka Murthy, "A Textbook of Computer Aided Machine Drawing", CBS Publishers, New Delhi, 2007

Project-Based Learning:

Following is the list of topics for project-based learning (Not Limited to) based on the syllabus contents:

1. To develop a chart to represent different types of nuts and bolts conventionally, along with an industrial real-life application.
2. To develop a chart to represent different types of springs conventionally, along with an industrial real-life application.
3. To develop a chart to represent different types of welded and riveted joints conventionally, along with industrial real-life applications.
4. To develop a chart to represent different types of gears conventionally long in industrial real-life
5. To develop a chart to represent different types of bearings conventionally, along with industrial real-life applications.
6. To develop a chart to represent different types of foundation bolt conventionally, along with industrial real-life applications.
7. To collect different types of nuts and bolts available in the market, to identify their specifications and applications.
8. To obtain industrial drawings to identify the limits, fits, and tolerances.
9. To demonstrate geometrical tolerances for different industrial/real-life applications.
10. To prepare assembly and detail drawing of a given machine tool component.
11. To prepare assembly and detail drawing of a given IC engine component.

Unit Tests

Unit Test-I	Unit I, II, III
Unit Test-II	Unit-IV, V, VI

Designation of Course	Sheet Metal Operations		
Course Code	C113		
Teaching Scheme	Examination Scheme		Credits Allotted
Practical:- 02 Hours/ Week	Term Work	50 Marks	01
	Total	**50 Marks**	**01**

Course Prerequisites:-	The student should have, 1. Basic knowledge of workshop tools. 2. Basic knowledge of Materials
Course Objectives:-	1. The student should interpret various tools, operations and use them for carrying out sheet metal operations.
Course Outcomes:-	On completion of the course, students will be able to– 1. Demonstrate knowledge of marking, cutting, and holding tools, and operate machines used in the sheet metal industry. 2. Identify different types of rivets and select appropriate rivets for various sheet metal applications. 3. Explain the principles and describe the construction of dies used in press working operations.

Course Contents

Unit-I	First Aid, Sheet Metal Equipment's and Rivets	(12 Hrs.)
General safety precautions and precautions for the sheet metal industry. Measuring, marking, cutting, and holding tools. Bench Work and Fitting Tools, Gauges, Introduction to machines in sheet metal Industry: shearing machine, bending machine, circular profile cutting machines. Different types of sheet metal folds. Rivets and their different parts, selection of rivet heads, types of rivets, and their uses.		
Unit-II	**Introduction to Press Working**	**(12 Hrs.)**
Punching, blanking, shearing, bending, and piercing. Punch & Die tolerance and clearance. **Introduction to Dies:** Simple Dies, Compound Dies, Progressive Dies. Types of presses.		

Term Work: List of Experiments

1. Cutting different types of shapes with a hand snip.
2. Practical on the bending machine
3. Practical on the shearing machine
4. Practical on the profile cutting machine.
5. Making a hole with a solid punch and a round punch.
6. Practice for riveting.
7. Practical for making components from sheet metal.
8. Demonstrations of press working operations, such as Punching, blanking operations.

Textbooks:

1. Khanna O.P. and Lal. M., " Production Technology", Dhanpatrai Publications (P) Ltd., New Delhi.
2. Jain R.K., "Production Technology", Khanna Publishers, Delhi.
3. Choudhary Hajra S.K., Choudhary Hajra A.K. "Elements of Workshop Technology Vol 1 Manufacturing Processes, Publisher: Media Publishers & Promoters, India.
4. Choudhary Hajra S.K., Choudhary Hajra A.K. "Elements of Workshop Technology Vol 2 Machine Tools, Publisher: Media Publishers & Promoters, India.
5. Rajput R. K., "Manufacturing Technology", Laxmi Publications (P)Ltd, New Delhi.
6. Chapman W.A.J. "Workshop Technology "volume I, II, III, ELBS.

Designation of Course	Soft Computing- II		
Course Code	C114		
Teaching Scheme	Examination Scheme		Credits Allotted
Practical: -02 hours/Week	Term Work and Practical	75 Marks	01
	Total	**75 Marks**	**01**

Course Prerequisites: -	Basic Mathematics
Course Objective: -	The goal of the course is for students to develop techniques for problem-solving using a programming language.
Course Outcomes	On completion of the course, students will be able to– 1. Explain the concept of pointers and demonstrate their use in locating variables in memory. 2. Apply pointer concepts to design and implement functions in C/C++ programs. 3. Illustrate the concept of one-dimensional arrays and construct programs using them. 4. Illustrate the concept of multidimensional arrays and develop programs employing them. 5. Describe the concept of classes and create programs using object-oriented principles. 6. Demonstrate the concept of objects and implement programs using objects and their interactions.

Course Contents

Unit-I	**Pointers I**	(04 Hrs.)
Data Variables and memory; Address operator: &		
Unit-II	**Pointers II**	(04 Hrs.)
Pointers: Functions, Pointers, and Indirection Operators		
Unit-III	**Arrays**	(04 Hrs.)
Arrays Fundamentals; Arrays and Functions; Character Arrays		
Unit-IV	**Multidimensional Arrays**	(04 Hrs.)
Multidimensional Arrays; Multidimensional Arrays and Functions; Array filling from data files		
Unit-V	**Classes I**	(04 Hrs.)
Objects and classes; Class members; Class Destructors		
Unit-VI	**Classes II**	(04 Hrs.)
Array of objects; Overloaded operators and objects		

Term Work

Term work shall consist of programs (not limited to) listed below, based on the syllabus.

1. C++ Program to Calculate the Average of Numbers Using Arrays
2. C++ Program to Find the Largest Element of an Array
3. C++ Program to Calculate Standard Deviation
4. C++ Program to Add Two Matrices Using Multi-Dimensional Arrays
5. C++ Program to Multiply Two Matrices Using Multi-Dimensional Arrays
6. C++ Program to Find the Transpose of a Matrix
7. C++ Program to Multiply Two Matrices by Passing a Matrix to a Function
8. C++ Program to Access Elements of an Array Using a Pointer
9. C++ Program to Swap Numbers in Cyclic Order Using Call by Reference
10. C++ Program to Find the Frequency of Characters in a String

11. C++ Program to Find the Number of Vowels, Consonants, Digits, and White Spaces in a String
12. C++ Program to Remove all Characters in a String Except Alphabets.
13. C++ Program to Find the Length of a String
14. C++ Program to Concatenate Two Strings
15. C++ Program to Copy Strings
16. C++ Program to Sort Elements in Lexicographical Order (Dictionary Order)
17. C++ Program to Store Information of a Student in a Structure
18. C++ Program to Add Two Distances (in inch-feet) System Using Structures
19. C++ Program to Add Complex Numbers by Passing a Structure to a Function
20. C++ Program to Calculate the Difference Between Two Time Periods
21. C++ Program to Store and Display Information Using a Structure
22. Increment ++ and Decrement -- Operator Overloading in C++ Programming
23. C++ Program to Subtract Complex Numbers Using Operator Overloading

Textbooks

1. "Let Us C++", Kanetkar Yashavant, BPB Publications

Reference Books

1. “C++ Programming Today”, Barbara Johnston, Prentice Hall of India, New Delhi.
2. “C++ how to program”, Paul Deitel and Henry Deitel, Prentice Hall of India, New Delhi.
3. "Accelerated C++: Practical Programming by Example", Andrew Koenig and Barbara E. Moo, Addison-Wesley Publications
4. "C++: The Complete Reference", Herbert Schildt, McGraw-Hill Publications.
5. "C++ Primer"; Barbara E. Moo, Josée Lajoie, and Stanley B. Lippman; Addison-Wesley Professional
6. "Programming: Principles and Practice Using C++", Bjarne Stroustrup, Addison-Wesley Professional

Rules and Regulations

Rules regarding the conduction of Internal Assessment (IE):

Internal Assessment (IA) will comprise 40 marks. Out of this, 20 marks will be for Unit Tests, and 20 marks will be for Project-Based Learning. Two Unit Tests, each of 20 marks, will be conducted: The average of marks obtained in these two-unit tests will be considered as UT marks. Roll numbers allotted to the students shall be the examination numbers for the conduct of unit tests.

Rules Regarding ATKT, Standard of Passing and Award of Class of Bharati Vidyapeeth (Deemed to be University) College of Engineering, Pune

A.T. K. T.

1. A candidate who is granted a term for B.Tech. Semester I, III, V, VII will be allowed to keep the term for his/her B.Tech. Semester-II, IV, VI, VIII examinations respectively, even if he/she appears and fails or does not appear at the B.Tech. Semester I, III, V, VII examinations respectively.
2. A candidate shall be allowed to keep the term for the B.Tech. Semester-III course if he/she has a backlog of any number of Heads of passing at B.Tech. Semester I & II taken together.
3. A student shall be allowed to keep the term for the B.Tech. Semester-V of the respective course if he/she has no backlog of B. Tech. Semester I & II, and he/she has a backlog of any number of Heads of passing at B. Tech. Semester-III & IV taken together.
4. A student shall be allowed to keep the term for the B. Tech. Semester-VII of the respective course if he/she has no backlog of B. Tech. Semester I, II, III, IV, and he/she has a backlog of any number of Heads of passing at B. Tech. Semester V & VI taken together.

Standard of Passing:

1. Internal Assessment (IE):

- ✓ There will not be a separate passing head of 16 marks out of 40 marks for Internal Assessment (IA; the overall passing of 40% marks for the combined 100 marks will be imposed. However, the End Semester University Examination of 60 marks should have a separate passing of 40% marks.
- ✓ To grant the term, it is mandatory to appear for all the Unit tests conducted each semester.

2. Overall Passing:

- ✓ The candidate must obtain a minimum Grade Point of 5.0 (40% marks) in the End.
- ✓ Semester University Examinations, and in the combined End Semester + Internal Assessment
- ✓ A student who fails in the End Semester Examinations of a course must reappear only in the End Semester Examinations as a backlog candidate and clear that hurdle to pass.
- ✓ **Award of the Class for the Degree, considering CGPA:**
- ✓ A student who has completed the minimum credits specified for the programme shall be declared to have passed the programme. The result will be in terms of letter grade only and is based on the CGPA of all courses studied and passed. The Criteria for the Award of Honors at the end of the Programme are as follows. (Same as CBCS 2014 Course Curriculum).

Range of CGPA	**Final Grade**	**Performance Descriptor**	**Equivalent range of Marks (%)**
$9.50 \leq CGPA \leq 10.00$	O	Outstanding	$80 \leq Marks \leq 100$
$9.00 \leq CGPA \leq 9.49$	A+	Excellent	$70 \leq Marks < 80$
$8.00 \leq CGPA \leq 8.99$	A	Very Good	$60 \leq Marks < 70$
$7.00 \leq CGPA \leq 7.99$	B+	Good	$55 \leq Marks < 60$

6.00 ≤ CGPA ≤ 6.99	B	Average	50 ≤ Marks < 55
5.00 ≤ CGPA ≤ 5.99	C	Satisfactory	40 ≤ Marks < 50
CGPA below 5.00	F	Fail	Marks Below 40

Rules for Credits of MOOC courses, Social Activities, and Publication of Research Paper:

1. If a candidate completes a **MOOC/NPTEL course** in a particular semester **relevant to the courses in that semester**, he/ she will be allotted **TWO** credits after producing the certificate of completion of the respective course.

   Students shall register to MOOCs which are offered by any of the following agencies:

   a. SWAYAM: www.swayam.gov.in

   b. NPTEL: www.onlinecourse.nptel.ac.in

   c. Course Era: www.coursera.org

   d. edX online learning: www.edx.org

   e. MIT Open Course ware: www.ocw.mit.edu

   f. Udemy: www.udemy.com

   g. Spoken tutorial: www.spoken-tutorial.org

2. If a candidate completes his/her duties in NSS/Social Activities, he/she will be allotted **TWO** credits after producing the certificate of completion of the respective course/ activity from the relevant authorities.
3. If a candidate publishes a research paper in UGC approved CARE journals, he/she will be allotted **TWO** credits after producing the certificate of publication of the respective paper.
4. These credits will be given only after the authentic document is verified by the Head of the Department, and a separate marksheet is submitted by the Head of the Department along with the subject examiner.