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

Vision of the Department

To develop high quality Robotics and Automation Engineers through dynamic education to meet social and global challenges

Mission of the Department

- To provide extensive theoretical & practical knowledge to the students with well-equipped laboratories & 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 working environment.

Name of Programme: B. Tech. Robotics and Automation Engineering

Programme Educational Objectives (PEOs)

- To fulfill need of industry and society with theoretical & practical knowledge
- To perform research, innovation, lifelong learning and continued professional development
- To fulfill professional ethics and social responsibilities

Programme Outcomes (POs)

The graduates will be able to

a. apply knowledge of mathematics, science and engineering fundamentals for solving complex engineering problems

b. identify the need, plan and conduct experiments, analyze data for improving the mechanical processes.

c. design and develop mechanical systems considering social and environmental constraints.

d. design and develop a complex mechanical system using research based knowledge, advanced mathematical, statistical tools and techniques.

e. use information technology (IT) tools for prediction and modeling of routine activities to enhance the work performance.

f. know social responsibilities while doing professional engineering practices.

g. familiarize with eco-friendly, sustainable and safe working environment.

h. take into account professional ethics while designing engineering systems.

i. work efficiently as a group leader as well as an individual.

j. communicate in written and verbal form with subordinates and supervisors.

k. apply project and finance management techniques in multidisciplinary environments.

l. take interest in higher education and update the knowledge.

B. TECH. & ROBOTICS& AUTOMATION: COURSE STRUCTURE CBCS-2020-21

B.Tech. Robotics &Automation Sem.-I

Sr. No.	Course Code	Name of Course	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
			L	P	T	UE	IA	TW	TW & OR	TW & PR	Total	L	P TW/OR/PR	T	Total
1		Linear Algebra, Calculus & Complex Variables	4	-	1	60	40	-	-	-	100	4	-	1	5
2		Waves & Solid State Physics	3	2	-	60	40	25	-	-	125	3	1	-	4
3		Electrical Engineering Systems	4	2	-	60	40	25	-	-	125	4	1	-	5
4		Computer Aided Drafting & Visualization *	4	2	-	60	40	-	-	50	150	4	1	-	5
5		Mechanical Engineering Systems	3	2	-	60	40	50	-	-	150	3	1	-	4
6		Computer Programming: Fundamentals (Using C/C++)	-	4	-	-	-	-	-	100	100	-	2	-	2
	Total		**18**	**12**	**1**	**300**	**200**	**100**	**-**	**150**	**750**	**18**	**6**	**1**	**25**

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

B. Tech. Robotics & Automation Sem.-II

Sr. No.	Course Code	Name of Course	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
			L	P	T	UE	IA	TW	TW & OR	TW & PR	Total	L	P TW/OR/PR	T	Total
1		Differential Equations, Probability & Statistics	4	-	1	60	40	-	-	-	100	4	-	1	5
2		Chemistry of Engineering Materials	3	2	-	60	40	25#	-	-	125	3	1	-	4
3		Electronics Engineering Systems	4	2	-	60	40	25#	-	-	125	4	1	-	5
4		Fundamentals of Robotics	4	2	-	60	40	-	-	50	150	4	1	-	5
5		Engineering Mechanics	3	-	-	60	40	-	-	-	100	3	-	-	3
6		Basics of PLC	-	2	-	-	-	50#	-	-	50	-	1	-	1
7		Object Oriented Programming (Using Python)	-	4	-	-	-	-	-	100	100	-	2	-	2
	Total		**18**	**12**	**1**	**300**	**200**	**100**	**-**	**150**	**750**	**18**	**6**	**1**	**25**

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

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

Course Prerequisites:-	1. Students should have knowledge of basic algebra. 2. Students should have knowledge of vector algebra. 3. Students should have knowledge of complex numbers.
Course Objectives:-	To provide knowledge about 1. Rank, consistency of system of equations and partial differentiation. 2. Vector differentiation and vector integration. 3. Function of complex variable.
Course Outcomes:-	On completion of the course, students will be able to– 1. **Understand** rank of matrix and apply it test consistency of linear system. 2. **Understand** the partial derivative and evaluate indeterminate forms. 3. **Understand** vector differential operator and vector identities. 4. **Understand** line, surface and volume integrals and **apply** it evaluate to work done. 5. **Understand** the analytic functions. 6. **Understand** Taylors and Laurentz series.

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' Hospital'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 realpart (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 simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof).Taylor's and Laurent's series (without proof). Definition of Singularity, Zeroes, poles of f(z), Residues, Cauchy's Residue Theorem (without proof).		

Assignments:

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

Text Books

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

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

Students are expected prepare report on any one topic, write its definition, applications and analyze the 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' Hospital's Rule
5. Dimension and basis
6. Curl and divergence
7. Work done
8. Gauss divergence theorem

9. Stokes theorem
10. Eigen values and Eigen vectors
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 and Solid State Physics		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory:- 03 Hours/ 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:-	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 lay foundation for the Mechanical Engineering.
Course Outcomes:-	1. Infer the wave nature of light and apply it to measure stress, pressure and dimension etc. 2. Summarize the structure and properties of lasers to their performance and intended applications. 3. Explain mechanical properties of solid matter, and connect to applications in the field of engineering. 4. Use the knowledge of nanoscience to develop new materials with tunable properties. 5. Use analytical instruments for understanding the nanomaterials. 6. Interpret the superconductivity and perfect diamagnetism, and give a qualitative description of the Meissner effect and its 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. **Polarisation -**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 Hetro-junction 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 bandsin 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 junctiondiode 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	**Nano-science**	**(06 Hrs.)**
Introductions 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 plan convex lens/wavelength of light/Flatness testing by Newton's rings
2. Determination of wavelength of light using diffraction grating
3. Determination of resolving power of telescope
4. Determination of 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 wavelength of laser by diffraction grating
9. To study Hall effect and determine the Hall voltage
10. Calculation of conductivity by four probe method
11. Study of solar cell characteristics and calculation of fill factor
12. Determination of band gap of semiconductor
13. Synthesis of metal oxide nanoparticles (ZnO/ZnS/Gold)
14. UV-VIS spectra of synthesized semiconductor nanoparticles
15. To determine the velocity 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 velocity of sound in liquid by ultrasonic interferometer
20. Ultrasonic probe - a study
21. Mini-project based on contents of syllabus.

Assignments

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

Text Books

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 topic for project based learning (Not Limited to) based on the syllabus contents:

1. Measurement and effect of environmental noise in the college
2. Construction and application of heat sensor in process control
3. Design and simulation of automatic solar powered time regulated water pumping
4. Solar technology: an alternative source of energy for national development
5. Double pendulum and its application
6. The study on the effect of length on the resistance of a copper wire (verification of ohms law r directly proportional to l)
7. Comparison of various method used in measuring the gravitational constant g
8. Design and construction of digital distance measuring instrument
9. Electric power generation by road power
10. Study of vibration of bars
11. Determination of absorption coefficient of sound absorbing materials
12. Quantum confinement effect in wide band semiconductors
13. Tesla Coil
14. Thin film interference in soap film-formation of colours
15. LiFi- 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**		
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: -	1. **Understand** and **apply** knowledge of Basic laws and network theorems to solve electrical networks 2. **Understand** and **apply** knowledge of AC Circuits, Switch gear and electrical measuring instruments 3. **Understand** and **apply** fundamental concept of magnetic and electromagnetic circuits for operation of Transformers 4. **Understand** AC motors, it's control techniques for various mechanical engineering applications 5. **Understand** DC motors, it's control techniques for various mechanical engineering applications 6. **Understand** working of Transmission, Distribution of power use of safety rules.

Course Contents

Unit-I	**DC Circuit Analysis**	**(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.		
Unit-II	**AC Circuits and Switch Gear**	**(08 Hrs.)**
Representation of sinusoidal waveforms, peak and RMS values, Phasor representation of AC quantities, realpower, 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 balancedcircuits, voltage and current relations in star and delta connections, Power measurement in three phase circuits.		
Unit-III	**Network Theorems and Electrical Measurement**	**(08 Hrs.)**
Network Theorems: Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem (simple numerical problems). Electrical instruments such as wattmeter, energy meter, tong-tester, megger and power analyzer. Introduction to LT Switchgear, NO and NC Contacts, Contactors, relay, timers, use in control panel, application in interlocking and protection, symbols.		
Unit-IV	**Induction Machines**	**(08 Hrs.)**
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, circle diagram, construction and calculation, speed control of 3 phase motor, starting methods for 3 phase induction motor.		

Single phase motor: Double revolving field theory, starting methods, no load and block rotor test, equivalent circuit, types of single-phase motor. **Servomotor:** Servomotor, construction, types, working, characteristics, application in automation and robotics.		
Unit-V	**DC Machines**	**(08 Hrs.)**
DC Generator: Construction features, 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 generator. **DC Motor:** Working principle, voltage equation, condition for maximum power, characteristics, operatingcharacteristics of dc motor, torque developed, starting ,3 point and 4 point starter, speed control methods, Swinburn's and break test of dc shunt motor.		
Unit-VI	**Basic of Power transmission and distribution, Safety Measures**	**(08 Hrs.)**
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 in electrical system, basic principles of earthing-types of earthing.		

List of Assignments:

The students will be given total **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 Minimum **Eight** Experiments from the following list.

1. Plotting B-H characteristics for a material
2. Verification of Kirchhoff"s Laws
3. Verification of 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 R-L series and 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 single phase transformer
14. Mini-project based on contents of syllabus.

Text Books

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 (SatyaPrakashan)
5. Electronic Devices and Circuit Theory- R. L. Boylestad and L. Nashelsky (PHI)
6. Electrical, Electronics Measurements and Instruments - (SatyaPrakashan)

Project Based Learning

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

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

Unit Tests

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

Designation of Course	**Computer Aided Drafting & Visualization**		
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 & Oral	50 Marks	01
	Total	**150 Marks**	**05**

Course Prerequisites: -	Fundamentals of Mathematics
Course Objectives: -	1. To understand the basic principles of engineering drawing and highlight the importance of Computer Aided Drafting in engineering. 2. To develop the graphical skills for communication of concepts & idea through technical drawings.
Course Outcomes:-	1. **Understand** the fundamental concepts of CAD Drawing, its applications, different types of lines, curves and dimension technique with practical application. 2. **Understand** the concept of Orthographic projections and **apply** it to draw detail views by using 1st angle projection method. 3. **Understand** the concept of isometric projection and **apply** it to construct 3D view of a component. 4. **Understand** the concept of projections of Point, Line and plane; and **apply** to draw its projection by using 1st angle projection method and to locate its traces. 5. **Understand** the concept of projections of different types of solids and sectioned solids; and **apply** to draw its projection by using 1st angle projection method. 6. **Understand** the concept of Development of Lateral surfaces; and **apply** to development 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 CircleMethod, Involutes of a circle, Cycloid, Archimedean Spiral, Helix on cone and Cylinder. Fundamentals of Computer Aided Drafting (CAD) and its applications, Various Softwares for Computer Aided Drafting. AutoCAD initial setting and AutoCAD commands		
Unit-II	**Orthographic Projection**	**(08 Hrs.)**
Basic principle 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 by using AutoCAD.		
Unit-III	**Isometric Projections**	**(08 Hrs.)**
Principles of Isometric Projections-Isometric Scale, Isometric Axes, Isometric Projections and Isometric Drawing. Constructions of Isometric view from given Orthographic Views and given origin. Isometric Drawing by 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 true shape of 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 solid inclined both references plane, Projection of common solids such as prism, pyramid, cylinder and cone. Projection of solids cut by AIP and AVP, obtaining 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.**

Sheets

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 size Drawing Book

Textbooks

1. “Elementary Engineering Drawing”, N.D. Bhatt, Charotar Publishing house, Anand India.
2. “Text Book 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)", 10 Edition, S. K. Kataria and Sons, 2005.
5. P. J. Shah, "Engineering Drawing", C. Jamnadas and Co., 1 Edition, 1988.

Project Based Learning

Following is the list of topic 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 method of projection.
2. To develop the model/charts based on engineering curves.
3. To prepare model/chart for identification of engineering curves in nature for industrial, societal, etc application.
4. To demonstrate different methods of orthographic projection.
5. To demonstrate projection of Points.
6. To demonstrate projection of Lines.
7. To demonstrate projection of Planes.

8. To demonstrate 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 Isometric projection method through model of a cube.

Unit Tests

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

Designation of Course	**Mechanical Engineering Systems**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory: - 03 Hour/ Week	End Semester Examination	60 Marks	03
Practical: -02 hours/Week	Internal Assessment	40 Marks	
	Term Work	50 Marks	01
	Total	**150 Marks**	**04**

Course Prerequisites: -	Higher Secondary Physics
Course Objective: -	To teach students about 1. Introduction to systems in Thermal Engineering 2. Introduction to systems in Manufacturing Engineering. 3. Introduction to systems in Welding and Joining processes
Course Outcomes: -	Students should 1. **Understand** the fundamentals of power producing and absorbing devices. 2. **Understand** the fundamental concepts of power transmitting devices 3. **Understand** the fundamentals of mechanism of machines 4. **Understand** the fundamentals of Fusion welding processes and **create** job as per given specification. 5. **Understand** the fundamentals of resistance and solid-state welding processes and **create** job as per given specification. 6. **Understand** the fundamentals of machine tools and manufacturing processes.

Course Contents

Unit 1	**Power Producing and Absorbing Systems**	**(06 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 turbine. 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 2	**Power Transmitting Devices**	**(06 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 3	**Introduction to Mechanisms of Machines**	**(06 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, Grashoff's law, Slider crank chain and its inversions, Double slider crank chain and its inversions. Geneva Mechanisms, Ratchet and Paul Mechanisms.

Unit 4	**Introduction to Welding Processes**	**(06 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, limitation 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 5	Resistance Welding and Solid-State Welding	(06 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, Merit's, demerits and application of the above process. ISO welding symbols.		
Unit 6	**Introduction to Machine Tools**	**(06 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.		

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 operations on resistance welding processes.
8. Study and demonstration of gas welding operations.
9. Study and demonstration of Soldering and brazing
10. Study and demonstration of operations on center lathe.

Assignment

1. Assignment on power producing and absorbing devices
2. Assignment on mechanism of machines
3. Assignment on Power Transmitting Devices
4. Assignment on gas welding
5. Assignment on resistance welding
6. Assignment on centre lathe, drilling and Grinding.
7. Assignment on Milling machine
8. Assignment on NC, CNC machine

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.
4. O.P.Khanna , A Text Book of Welding Technology, Dhanpat Rai and Sons

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
6. Richard Little, "Welding And Welding Technology" Pearsons Education second Edition

Project Based Learning

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

1. To prepare chart of comparison among specification of various models of two wheeler available.
2. To develop demonstration model of low-cost household refrigerator
3. To develop demonstration model of low-cost air conditioner
4. To develop demonstration model of Biogas plant
5. To develop demonstration model of geothermal power plant
6. To develop demonstration model of wind power plant

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

Unit Test

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

Designation of Course	Computer Programming: Fundamentals (Using C/C++)		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Practical: -04 hours/Week	Term Work & Practical	100 Marks	02
	Total	**100 Marks**	**02**

Course Prerequisites:-	Basic Mathematics
Course Objective: -	The goal of the course is that students should develop techniques for problem solving using a programming language.
Course Outcomes	Students should 1. **Understand** basics of C/ C++ and **apply** that knowledge to write simple programs. 2. **Understand** the uses of operators and **apply** them in writing programs. 3. **Understand** the concept of conditional statements **apply** them in writing programs. 4. **Understand** the concepts of loops in C /C++ **apply** them in writing programs. 5. **Understand** the concepts of user defined functions, recursion and **apply** them in writing programs 6. **Understand** the concept of overloaded functions and **apply** them in writing programs

Course Contents

Unit-I	**Introduction to C/ C++**	**(08 Hrs.)**
Introduction to C, C++; Object oriented programming; Programming Fundamentals; Data and Data Types		
Unit-II	**Operators in C/C++**	**(08 Hrs.)**
Declarations in C/C++; Operators in C/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/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 syllabus.

1. C/C++ "Hello, World!" Program
2. C/C++ Program to Print Number Entered by User
3. C/C++ Program to Add Two Numbers
4. C/C++ Program to Find Quotient and Remainder
5. C/C++ Program to Find Size of int, float, double and char in Your System
6. C/C++ Program to Swap Two Numbers
7. C/C++ Program to Find ASCII Value of a Character

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

Designation of Course	**Differential Equations, Probability and Statistics**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory:- 04 Hours/ Week	End Semester Examination	60 Marks	04
Tutorial:- 01 Hours/ Week	Internal Assessment	40 Marks	
	Tutorial		01
	Total	**100 Marks**	**05**

Course Prerequisites:-	Students should have knowledge of 1. Derivative 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 equation. 2. Integral transform and application of partial differential equation. 3. Methods of interpretation of numerical data and probability distribution.
Course Outcome:-	Students will be able to 1. **Understand** methods of first order and first-degree differential equation. 2. **Understand** the methods of nth ordinary differential equation and **apply** it to mass spring system. 3. **Understand** Laplace transform and evaluate particular solution of wave, one- and two-dimensional heat equation. 4. **Understand** the multiple integrals and apply it to evaluate area and volume. 5. **Understand** various technique to **analyze** and numerical data. 6. **Understand** probability distribution and testing of hypothesis.

Course Contents

Unit-I	**Differential Equation**	**(08 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**	**(08 Hrs.)**
Solution of nth order LDE with Constant Coefficients, Method of Variation of Parameters, Cauchy's & Legendre's DE, Solution of Simultaneous & Symmetric Simultaneous DE, Mass spring system.		
Unit-III	**Laplace Transforms and Applications of Partial Differential Equations**	**(08 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 Convolution theorem (without proof). Applications of partial differential equation: 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 its Applications**	**(08 Hrs.)**
Double and Triple integrations, Applications to Area, Volume, Mean and Root Mean Square Values.		

Unit-V	Statistics	(08 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**	**(08 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 following topics from previous year question papers of GATE/ESE Mechanical Engg. examinations.

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

Tutorials:

Problems and/or theory questions on following topics from previous year question papers of GATE/ESE Mechanical Engg. 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 equation
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

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

Students are expected prepare 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 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 equation in mechanical engineering
8. Multiple integrals applications
9. Applications of Multiple integrals applications 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**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory: - 03 Hour/ 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 the interest among the students regarding chemistry and their applications in engineering. 2. To develop confidence among students about chemistry, how the knowledge of chemistry is applied in technological field. 3. The student should understand the concepts of chemistry to lay the groundwork for subsequent studies in the field such as Mechanical Engineering.
Course Outcomes: -	After completion of the course students will be able to 1. **Apply** the concept X-ray diffraction technique to study crystal structure. 2. **Understand** the concept of the metallurgy in the study of metals. 3. **Understand and apply** the knowledge of Ferrous & Non-Ferrous materials for various engineering applications. 4. **Apply** the knowledge polymer and plastics to study advanced materials. 5. **Understand** the knowledge of composite materials for various engineering applications. 6. **Understand** different types of corrosion and suggest control measures 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 composite, different types of reinforce materials, characteristics of reinforced materials, matrix materials composition, properties and uses of fibre reinforced plastics (FRP), Carbon fibres, 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 Electrode position, Electroplating methods, Electroless plating, Some other metallic coatings, Modificationof 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 molecular weight/radius of macromolecule polystyrene/ polyvinyl alcohol byviscosity measurement.
3. Estimation of percentage of Iron in Plain Carbon Steel by Volumetric Method.
4. Study of corrosion of metals in medium of different pH.
5. Determination of rate of corrosion of aluminum in acidic and basic medium.
6. Determination of percentage of Ca in given cement sample
7. Preparation of phenol-formaldehyde resin/ urea-formaldehyde.
8. Estimation of copper in brass solution.
9. Determination of rate of corrosion of aluminum in acidic and basic medium.
10. To obtain metallic coating on base metal by using both the methods, Electroplating andElectroless plating.

Assignments

1. Linear and Planner density calculations with volume density calculations.
2. Extractive Metallurgy.
3. Purposes of making alloy 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 oftool steels
9. Organic Coatings, Paints, Varnishes, Enamels, Special paints for corrosion prevention.
10. Types of corrosion and its 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 Text Book 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, BlackieAcademic & Professional, 1994.

Project Based Learning

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

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

Unit Test -

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

Designation of Course	**Electronics Engineering Systems**		
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 the basic knowledge of Electrical Engineering
Course Objective	1. To teach the construction, working, ratings and application of passive devices like resistors, capacitors, inductors, transformers and relays 2. To introduce types of Voltage and current sources 3. To teach the construction, working and ratings of devices like pn junction diode, Schottky diode, zener diode 4. To teach the construction, working and ratings of field effect transistor 5. To introduce the concept of Transducers and their applications 6. To teach handling of electrical machine
Course Outcomes:-	The students should be able to- 1. Classify resistors, capacitors, inductors and transformer based on their construction, types and ratings and analyze simple circuits consisting of passive devices 2. Analyze circuits using voltage and current sources 3. Classify active devices based on their types and ratings and plot their characteristic curves 4. Understand the basic electronics devices and linear ICs 5. Use of various Instruments, transducers and working of electronic circuits used in electronic test and measuring instruments 6. To Understand and apply the concepts of Electric wiring for safety.

Course Contents

Unit 1	**Passive Electronic Components**	**(08 Hrs)**
Introduction to the concept of active and passive electronic devices, Types of resistors, construction, ratings and typical applications, Types of capacitors, construction, ratings and typical applications, Types of inductors, construction, ratings and typical applications, Types of transformers, construction, ratings and typical applications, Construction of relays, types and ratings, Analysis of series and parallel resistors and capacitor circuits (R-L, R-C, RLC series circuit, R-L-C parallel circuit).		
Unit 2	**Sources**	**(08 Hrs)**
Types of voltage and current sources (AC and DC), Concept of ideal and non-ideal voltage source, Concept of ideal and non-ideal current source, Series and parallel combinations of sources, Loading effect, Dependent voltage and current sources, Electrochemical cells and batteries, Types and characteristics, Regulation concept (Line regulation, load regulation, temperature stability factor), power, energy, Kirchoff's laws and applications to network solutions using mesh analysis		
Unit 3	**Diodes**	**(08 Hrs)**
Classification of material based on band gap theory, Types of semiconductors (p-type and n-type),LED and LDR, VI characteristics and applications, pn junction diode and its characteristics, Schottky diode, zener diode, Diode models, Rectifiers: Half wave, Full wave and Bridge rectifiers - capacitor filter-wave forms-ripple factor regulation characteristics		
Unit 4	**Transistors**	**(08 Hrs)**
Introduction to BJT (npn and pnp) and its construction and working mechanism, BJT configurations and their input and output characteristics, FET-construction, V-I characteristics and working, MOSFET-construction, V-I characteristics and working.		
Unit 5	**Opto-Electronics**	**(08 Hrs)**
Construction and working of LDR and its characteristics, simple application , Construction and working of LED and its characteristics and ratings, Photo-transistor and its characteristics , Introduction to the concept of electrical isolation and its importance , Construction of opto-isolator(opto-coupler) and its ratings , Construction and working of photovoltaic cell and its characteristics and ratings		

Unit 6	Electrical Wiring and Illumination system	(08 Hrs)
Basic layout of distribution system, Types of Wiring System & Wiring Accessories, Necessity of earthing, Types of earthing, Different types of lamps (Incandescent, Fluorescent, Sodium Vapour, Mercury Vapour, Metal Halide, CFL, LED)		

List of Experiments-

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

1. Study of resistors, capacitors and inductors
2. To study and plot regulation characteristics of half wave and full wave rectifier.
3. Plot V-I Characteristics of PN Junction Diode
4. Plot V-I Characteristics of Zener Diode
5. Plot Input and Output Characteristics of BJT in CE Configuration
6. Plot Transfer and output characteristics of FET
7. Plot Transfer and output characteristics of EMOSFET
8. Plot characteristics of LDR
9. To Study characteristics of LVDT for displacement measurement.
10. Study of Relays

Text Books/ Reference Books

1. Passive Components for Circuit Design, Ian Sinclair,1st Edition 2000, ISBN: 9780750649339, Newnes
2. Grob's Basic Electronics, Mitchel Schultz,11th Edition,2010, ISBN-13: 978-0-07-351085-9, McGraw Hill
3. Fundamentals of Electronic Devices and Circuits, David A. Bell, 5th Edition,2008, ISBN:0195425235, 9780195425239, Oxford University Press,
4. Microelectronics Circuits, Adel S. Sedra & Kenneth C. Smith,7th Edition, 2015, ISBN 978–0–19–933913–6, Oxford University Press
5. Dr. D.S.Kumar, Mechanical Measurement & Control, Metropolitan Book Co. Pvt. Ltd. New Delhi,2007
6. R. P. Jain, Modern Digital Electronics, McGraw Hill

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

Assignments:

At least ONE assignment on each unit

Project Based Learning

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

To prepare a demonstration model on:

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 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& Transistors 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 photo-transistor.

Unit Tests

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

Designation of Course	Fundamentals of Robotics		
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 & Oral	50 Marks	01
	Total	**150 Marks**	**05**

Course Prerequisites: -	The student should have 1. Basic knowledge of higher secondary Physics 2. Basic knowledge of Mathematics
Course Objective: -	The student should acquire the knowledge of 1. The concepts of Robotic system, its components and Configurations. 2. Robot Grippers, Drive systems and Robotics sensors. 3. Application of robots in various fields.
Course Outcomes: -	The student should be able to 1. **Understand** the basic components and configurations of robots. 2. **Understand** different types of grippers and **apply** them based on applications. 3. **Understand** the robot drive systems. 4. **Understand** the fundamentals of sensors and **apply** them based on application. 5. **Understand** the robot control systems. 6. **Understand** the applications of robots in various fields.

Course Contents

Unit-I	**Introduction to Robotics**	**(08 Hrs.)**
History of robots, Classification of robots, Present status and future trends. Basic components of roboticsystem. Robot Joints, Robot Anatomy, Basic terminology- Accuracy, Repeatability, Resolution, Degree of freedom. Basic Configuration of Robots.		
Unit-II	**Robot Grippers**	**(08 Hrs.)**
Introduction to End effectors. Consideration in selection of gripper, Types of grippers, Mechanical Grippers, Hooks and Scoops, Magnetic Grippers, Vacuum Grippers, Expandable Bladder Type Grippers, Adhesive Grippers. Specifications of robot. Industrial Robots in Manufacturing trial robots specifications. Selection based on the Application.		
Unit-III	**Robotics Drives Systems**	**(08 Hrs.)**
Introduction, Functions of drive systems, Hydraulic actuators- Linear Hydraulic actuators and Rotary Hydraulic actuators. Pneumatic Actuators- Linear Pneumatic actuators and Rotary Pneumatic actuators. Electric Actuators-D.C. Motor, Reversible A.C. Motors, Brushless D.C. Motors, D.C. Servomotors, A.C. Servomotors, Stepper Motors.		
Unit-IV	**Robotics Sensors**	**(08 Hrs.)**
Sensors in robot –Introduction, Classification, Internal and external sensors**,** Touch sensors, Tactile sensor,Proximity and range sensors, Robotic vision sensor, Light sensors, Pressure sensors. Position sensors &Velocity sensors, acceleration sensors, sound sensors, Proximity sensors & Force or Torque sensors.		
Unit-V	**Robot Control system.**	**(08 Hrs.)**
Robot controls-Point to point control, Continuous path control, Intelligent robot, Control system for robotjoint, Control actions, Feedback devices, Encoder, Resolver, LVDT, Motion Interpolations, Control architecture- position, path velocity, and force control systems.		
Unit-VI	**Applications of Robots**	**(08 Hrs.)**
Robot applications: Robots in continuous arc welding, Spot welding, Spray painting, assembly operation, cleaning, and robot for under water applications. material handling, Robotics and Automation for Industry 4.0,Applications in unmanned systems, defense, medical, biomedical, industries, Co-bot etc.		

Term work:

Term work shall consist of any six experiments from the following list:

1. To study an introduction to basic components of Robot.
2. To study an introduction to Robot configuration
3. To introduce different types of robotics and demonstrate them to identify different parts and components.
4. To study and demonstrations of various robotics sensors.
5. To study and demonstrations of Hydraulic actuators.
6. To study and demonstrations of Pneumatic actuators.
7. To study and demonstrations of Electric actuators.
8. Two Case Studies of Applications in Industry
    a. Introduction and general considerations in robot applications.
    b. Case study I: Robot application for Welding.
    c. Case study II: Robot application for Spray painting.
9. Mini project is based on above syllabus.

Assignment

Assignments questions based on following topic

1. Classification, configuration and characteristics of robot.
2. Robot grippers and their types.
3. Drive systems used in Robots.
4. Sensors used in Robots.
5. Robot control systems.
6. Applications of Robots.

Text Books

1. Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta,
2. “Industrial Robotics, Technology programming and Applications", McGraw Hill, 2012.
3. Craig. J. J. “Introduction to Robotics- mechanics and control”, Addison- Wesley, 1999.

Reference Books

1. S.R. Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education., 2009.
2. Richard D. Klafter, Thomas .A, Chri Elewski, Michael Negin, "Robotics Engineering an IntegratedApproach", PHI Learning. 2009.
3. Francis N. Nagy, Andras Siegler, "Engineering foundation of Robotics", Prentice Hall Inc., 1987.
4. P.A. Janaki Raman, "Robotics and Image Processing an Introduction", Tata McGraw Hill PublishingCompany Ltd., 1995.
5. Carl D. Crane and Joseph Duffy, "Kinematic Analysis of Robot manipulators", Cambridge Universitypress, 2008.
6. Fu. K. S., Gonzalez. R. C. & Lee C.S.G., “Robotics control, sensing, vision and intelligence”, McGrawHill Book co, 1987
7. Ray Asfahl. C., “Robots and Manufacturing Automation”, John Wiley & Sons Inc.,1985

Project Based Learning

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

1. 2D models of basic components of robotic system
2. 2D models of different configuration of robots and its application
3. Working model and application of mechanical gripper
4. Working model and application of magnetic l gripper
5. Working model and application of adhesive gripper
6. Working model and application of expandable ladder gripper
7. Working model of robotic drive system using pipe and syringe

a. Linear actuator b. Rotary actuator

8. Selection of electric actuators with respect to its specification and application.

9. Detail description and working model of touch sensor.
10. Detail description and working model of tactile sensor.
11. Detail description and working model of proximity sensor.
12. Detail description and working model of pressure sensor.
13. Detail description and working model of sound sensor.
14. Detail description and working model of temperature sensor.
15. Detail description and working model of torque sensor.
16. Detail description and working model of accelerometer.

Unit Test

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

Designation of Course	Engineering Mechanics		
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 Centroid and moment of inertia 3. To study friction in machines 4. To study Kinetics of linear and circular motion 5. To study basics of civil engineering
Course Outcomes:-	The students should be able to 1. **Understand** the concept of force and **apply** it along with the concept of equilibrium in 2D and 3D system with the help of free body diagram. 2. **Understand** the significance of centroid and moment of inertia **3. Understand** the concept of friction and estimate required force to overcome friction**.** 4. **Analyze** body in motion using force and acceleration, work energy, impulse momentum principles 5. **Analyze** body in motion using centripetal and centrifugal force principles 6. **Understand** the basic concept of civil material, building component and foundation techniques.

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, least moment of inertia. Introduction to frictional force, preliminary concepts, 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 body**	**(06 Hrs.)**
Rectilinear motion, velocity and acceleration in terms of rectangular coordinate system, Motion along plane curve path, tangential and normal component 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 aluminium **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 following topics from previous year question papers ofGATE/ESE Mechanical Engg. 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 rigid body
7. Kinetics of particle
8. Structural materials and foundations

Text Books

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., McMillan 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 Wileyand 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 topic for project based learning (Not Limited to) based on the syllabus contents:

1. Prepare model for various types of beams.
2. Prepare model for various types supports.
3. Prepare chart for various types of force system with suitable real-life examples.
4. Collect the various situations where varignon's theorem is used.
5. Prepare model or chart for equilibrium system of forces of various engineering applications.
6. Prepare chart for different types for trusses with showing various members.
7. Prepare prototype model of any one type of truss.
8. Calculate the forces in members of truss by using analytical method and check it graphically (At least three problems for different types of trusses)
9. Prepare prototype models of the basic geometrical figures and locate the centroid of them.
10. Prepare prototype models of the I and T section and locate the centroid of them.
11. Prepare chart for parallel axis and perpendicular axis theorem with suitable example.
12. Prepare chart regarding the types of friction in various field conditions.
13. Prepare chart for application of friction.
14. Prepare chart for motion curves.

15. Prepare chart related to lifting machine and relevant industrial applications.
16. Development of excel sheet for projectile motion (at least three problems).
17. Development of excel sheet for work energy principle (at least three problems).
18. Prepare chart for work energy and Impulse momentum principle with suitable example.
19. Collect the different structural materials and compare its mechanical properties.
20. Prepare models of different types of foundations.

Unit Tests

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

Designation of Course	Basics of PLC		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Practical:- 02 Hours/ Week	Term Work	50 Marks	01
	Total	**50 Marks**	**01**

Course Prerequisites:-	1. Basic knowledge of c program 2. Basic Boolean algebra 3. Basic knowledge of computer
Course Objective:-	1. Compare conventional sequential control with programmable logic control system 2. Interface analog and digital input/ output devices with PLC 3. Develop programs using different PLC programming languages for sequential and continuous process
Course Outcomes:-	1. Explain the basic knowledge of PLC and compare with computer 2. Identify the hardware components and I/O devices interfacing with PLC 3. Identify the basic logic to implement Ladder diagram 4. Introduce the basic PLC programming with industrial examples 5. Identify various PLC instructions 6. Identify data handling functions

Course Contents

Unit-I	**Introduction to Programmable Logic Controllers (PLCs)**	**(04 Hrs.)**
Introduction; definition & history of the PLC; Principles of Operation; Various parts of a PLC: CPU & programmer/ monitors; PLC input & output modules; Solid state memory; the processor; I/O modules; power supplies. PLC advantage & disadvantage; PLC versus Computers, PLC Application. Programming equipment; proper construction of PLC ladder diagrams; process scanning consideration; PLC operational faults.		
Unit-II	**Hardware Components and its interfacing with PLC**	**(04 Hrs.)**
PLC Hardware Components: The I/O section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules, I/O specifications, The CPU, Memory design, Memory Types, Programming Devices, Selection of wire types and size. Various INPUT /OUTPUT Devices and its interfacing with PLC. Different types of Input devices : Switches: Push button Switches, Toggle Switches, Proximity switches, Photo switches, Temperature Switch, Pressure Switch, and Level Switch, Flow Switches, manually operated switches, Motor starters, Transducers and sensors, Transmitters etc. Their working, specification and interfacing with PLC. Different types of Output devices: Electromagnetic Control Relays, Latching relays, Contactors, Motors, Pumps, Solenoid Valves etc. Their working, specification and interfacing with PLC..		
Unit-III	**Fundamentals of Logic**	**(04 Hrs.)**
The Binary Concept, AND, OR and NOT functions, Boolean Algebra, Developing circuits from Boolean Expression expressions, Producing the Boolean equation from given circuit, Hardwired logic versus programmed logic, Programming word level logic instructions. Converting Relay schematics and Boolean equation into PLC Ladder Programs, Writing a ladder logic program directly from a narrative description.		
Unit-IV	**Basics of PLC Programming**	**(04 Hrs.)**
Processor Memory Organization, Program Scan, PLC Programming languages, Relay type instructions, Instruction addressing, Branch Instructions, Internal Relay Instructions, Programming Examine if Closed and examine If Open instructions, Entering the ladder diagram, Modes of operation. Creating Ladder Diagrams from Process Control Descriptions. Ladder diagram & sequence listing; large process ladder diagram construction, flow charting as programming method, Industrial Examples		
Unit-V	**Data Handling Functions**	**(04 Hrs.)**
Bit Logic Instructions: NO, NC, Set, Reset, rising edge Pulse, Falling Edge Pulse, RS, SR, NOP, OUTPUT etc. Clock: READ RTC, SET_RTC. Different Logical operation Instructions: INVERT BIT, BYTE, WORD DOUBLE WORD. OR: BIT, BYTE, WORD DOUBLE WORD. AND: BIT, BYTE, WORD DOUBLE WORD. X-OR: BIT, BYTE, WORD DOUBLE WORD.		

Program Control Instructions: The PLC SKIP and MASTER CONTROL RELAY Functions. Introduction; the SKIP function & application; the MASTER CNTROL RELAY function & application. Introduction: Jump with non-return; jump with return		
Unit-VI	**Allen bradley PLC**	**(04 Hrs.)**
PLC Data Move Systems. Introduction; PLC MOVE function & application; moving large blocks of PLC data; PLC table & registers moves; other PLC MOVE functions. Other PLC Data Handling Functions. Different Move Instructions: BIT, BYTE, WORD DOUBLE WORD, REAL, SWAP Byte, Move Byte Immediate Read, Move Byte Immediate Write. Different Shift/Rotate Instructions		

List of Experiments:-

1. Introduction to ladder programming& to implement basic logic gates.
2. Develop, Simulate and Test Ladder diagram for a. A Door Bell Operation b. A Combination Lock.
3. Develop, Simulate and Test Ladder diagram for Bottle Filling system.
4. Develop, Simulate and Test Ladder diagram for Traffic Light Control System.
5. Develop, Simulate and Test Ladder diagram for Car Parking system.
6. Develop Simulate and Test Ladder diagram for an alarm annunciator system.
7. Develop, Simulate and Test Ladder diagram for Batch Mixer.
8. Develop, Simulate and Test Ladder diagram for Drink Dispenser system.
9. Develop and test PLC program for three phase motor in both direction.
10. Develop, Simulate and Test Ladder diagram for stepper motor control in forward and reverse direction.
11. Develop and test PLC program for two axis Robotic arm for pick and place application
12. Develop, Simulate and Test Ladder diagram for Packing line system.
13. Develop, Simulate and Test Ladder diagram for an Elevator system.
14. Develop and test PLC program for PID Controller for Temperature control Application.
15. Develop and test PLC program in FBD, SFC, IL, ST, and Ladder Logic Language for Motor starter application.
16. Detail study of PLC Hardware and its interfacing

Text Books:

Lab Manual, Web resources for components data sheets.

1. Complete PLC Design Using Or CAD Capture and PCB Editor 1st Edition, Kindle Edition ·
2. https://www.plccart.com/article/content/PLC-manufacturing-process.html
3. https://www.autodesk.in/products/eagle/free-download

Designation of Course	Object Oriented Programming (Using Python)		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Practical: - 04 Hours/ Week	Term Work & Practical	100 Marks	02
	Total	**100 Marks**	**02**

Course Prerequisites:-	1. Basics of C and C^{++} Programming
Course Objective	1. Readily use the Python programming language 2. Apply various data types and control structure. 3. Understand and begin to implement code 4. Understand Object Oriented Programming
Course Outcomes:-	Upon completion of the course, students will be able to 1. **Understand** how to install and run python 2. **Understand** flow control 3. **Understand** complex datatypes 4. **Understand** and **Apply** functions 5. **Understand** various modules 6. **Understand** Object Oriented Programming

Course Contents

Unit-I	**Python introduction**	**(08 Hrs.)**
Learn to install and run Python on your computer, Keywords and Identifiers, Statement, Indentation and Comments, Variables, Constants and Literals, Data Types, Type Conversion and Type Casting, Input, Output and Import		
Unit-II	**Python Flow Control**	**(08 Hrs.)**
Learn to install and run Python on your computer, Keywords and Identifiers, Statement, Indentation and Comments, Variables, Constants and Literals, Data Types, Type Conversion and Type Casting, Input, Output and Import		
Unit-III	**Datatypes**	**(08 Hrs.)**
Function Arguments, Recursion, Anonymous/Lambda Function, Global, Local and Nonlocal variables, Global Keyword		
Unit-IV	**Python Functions**	**(08 Hrs.)**
Modules in Python, import modules in Python, import statement, Import with renaming, from...import statement, Import all names, Python Module Search Path		
Unit-V	**Matplotlib**	**(08 Hrs.)**
Install matplotlib, Pyplot API, Figure Class, Axes Class, Multiplot, Subplots () Function, Formatting Axes, Setting Limits, Setting Ticks and Tick Labels		
Unit-VI	**Object Oriented Programming**	**(08 Hrs.)**
Object, Class, The self **,** The__init__method **,** Class and Instance Variables (Or attributes) **,** Class and Instance Variables (Or attributes) **,** Printing Objects**,** Inheritance, examples of object, is sub class and super.		

Term Work

1. Basic Exercise for Beginners

   Practice and quickly learn Python's necessary skills by solving simple questions and problems.Topics: Variables, Operators, Loops, String, Numbers, List

2. Python Loop Exercise

   This Python loop exercise aims to help developers to practice branching and Looping techniquesin Python.

   Topics: If-else statements, loop, and while loop.

3. Python Functions Exercise
   Practice how to create a function, nested functions, and use the function arguments effectively inPython by solving different questions.
   Topics: Function's arguments, built-in functions.
4. Python String Exercise
   Solve Python String exercise to learn and practice String operations and manipulations.
5. Python Data Structure Exercise
   Practice widely used Python types such as List, Set, Dictionary, and Tuple operations in Python
6. Python List Exercise
   This Python list exercise aims to help Python developers to learn and practice list operations.
7. Python Dictionary Exercise
   This Python dictionary exercise aims to help Python developers to learn and practice dictionaryoperations.
8. Python Tuple Exercise
   This exercise aims to help Python developers to learn and practice tuple operations.
9. Object Oriented
   Simple Python program that creates a class with a single method.
10. Object Oriented
    A Sample class with in it method

Text Books

1. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher,
2. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.

Reference Books

1. Python Programming using problem solving Approach by Reema Thareja, Oxford University, Higher Education Oxford University Press; First edition (10 June 2017), ISBN-10: 0199480173.
2. Data Structures and Algorithms in Python by Michael T Goodrich and Robertto Thamassia, Micheal S Goldwasser, Wiley Publisher (2016)
3. Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material Course Technology Inc. 1st edition (6th February2009)

Supplementary Resources:

1. http://www.w3schools.com
2. http://docs.python.org
3. http://www.tutorialspoint.com
4. http://www.learnpython.org