SYLLABUS

(With effect from 2017 -18)

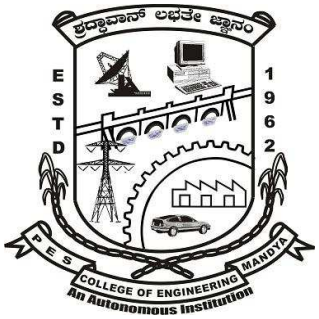
ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕವರ್ಷ 2017–18)

III to IV Semester

Bachelor Degree
in
Automobile Engineering

Out Come Based Education
with
Choice Based Credit System



P.E.S. College of Engineering

Mandya - 571 401, Karnataka
(An Autonomous Institution Affiliated to VTU, Belagavi)
Grant -in- Aid Institution
(Government of Karnataka)
Accredited by NBA, New Delhi
Approved by AICTE, New Delhi.

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

ಮಂಡ್ಯ–571 401, ಕರ್ನಾಟಕ

(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

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Preface

PES College of Engineering, Mandya, started in the year 1962, has become autonomous in the academic year 2008-09. Since, then it has been doing the academic and examination activities successfully. The college is running Eight undergraduate and Eight Postgraduate programs. It consists of Six M.Tech programs, which are affiliated to VTU. Other postgraduate programs are MBA and MCA.

India has recently become a Permanent Member by signing the Washington Accord. The accord was signed by the National Board of Accreditation (NBA) on behalf of India on 13th June 2014. It enables not only the mobility of our degree globally but also establishes equivalence to our degrees with that of the member nations such as Taiwan, Hong Kong, Ireland, Korea, Malaysia, New Zealand, Russia, Singapore, South Africa, Turkey, Australia, Canada and Japan. Among other signatories to the international agreement are the US and the UK. Implementation of Outcome Based Education (OBE) has been the core issue for enabling the equivalence and of Indian degrees and their mobility across the countries.

Our Higher Educational Institution has adopted the CBCS based semester structure with OBE scheme and grading system.

The credit based OBE semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching.

The OBE, emphasize setting clear standards for observable, measurable outcomes of programs in stages. There lies a shift in thinking, teaching and learning processes moving towards Students Centric from Teacher Centric education. OBE standards focus on mathematics, language, science, attitudes, social skills & moral values.

The key features which may be used to judge, if a system has implemented an outcome based education system is mainly Standard based assessments that determines whether students have achieved the stated standard. Assessments may take any form, so long as the process actually measure whether the student knows the required information or can perform the required task. Outcome based education is a commitment that all students of all groups will ultimately reach the same minimum standards. Outcome Based Education is a method or means which begins with the end in mind and constantly emphasizes continuous improvement.

Choice Based Credit System (CBCS) provides choice for students to select from the prescribed courses (core, Foundation, Foundation Elective, elective, open elective and minor or soft skill courses). The CBCS provides a 'cafeteria' type approach in which the students can Choose electives from a wide range of courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, adopt an interdisciplinary approach to learning which enables integration of concepts, theories, techniques, and, perspectives from two or more disciplines to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline. These greatly enhance the skill/employability of students.

In order to increase the Industry/Corporate readiness, many Soft Skills and Personality Development modules have been added to the existing curriculum of the academic year 2015-16. Industry Interactions have been made compulsory to enhance the field experience. In order to enhance creativity and innovation Mini Project and Industrial visit & Interaction are included in all undergraduate programs.

Dr. Umesh D R
Deputy Dean (Academic)
Associate Professor,
Dept. of CS & Engg

(Dr.P S Puttaswamy)
Dean (Academic)
Professor
Dept. of Electrical & Electronics Engg.

PES College of Engineering

VISION

PESCE shall be a leading institution imparting quality engineering and management education, developing creative and socially responsible professionals

MISSION

- Provide state of the art infrastructure, motivate the faculty to be proficient in their field of specialization and adopt best teaching -learning practices
- Impart engineering and managerial skills through competent and committed faculty using Outcome Based Educational curriculum
- Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs
- Promote research, product development and industry-institution interaction.

DEPARTMENT OF AUTOMOBILE ENGINEERING

The discipline Automobile Engineering was established in the year 1980, and now it has gained expertise and contributing vitally to the Automobile Engineering community. The focus is to consistently pursue in providing innovative and quality training to the talented and dedicated students, to empower them in engineering the development of national economy, specialized in transport sector. We are the pioneers in Karnataka to introduce the Department of Automobile Engineering to impart sound automotive knowledge to the students with a passion towards Automobiles. We take honor in being recognized as a 'research centre' in Karnataka by VTU and Mysore University. In addition to these regular programmes, this department is also actively involved in conducting Faculty Development Programmes, Technical talks, Training programmes and technical visits to various industries & regular industrial trainings for the benefits of students. The department has well qualified and well experienced faculty members to meet the present day curriculum requirements both in theory and practical.

VISION

To be a distinguished centre for imparting quality education in automobile engineering to develop competent and socially responsible engineers and carryout research on continuous basis for the betterment of the society.

MISSION

AUM1: To give best learning experience through innovative teaching practices supported by excellent laboratory infrastructure and exposure to recent trends in the automotive industry.

AUM2: Provide in-depth knowledge in automobile engineering with equal emphasis on theoretical and practical aspects and interdisciplinary problem solving skills.

AUM3: Focus on Industry-institute interaction, for better understanding of the state of the art technologies, Promoting research and also to build the spirit of entrepreneurship.

AUM4: Inculcate societal responsibility and ethical values through personality development programs.

Programme Education Objctives (PEOs)

PEO1: To prepare Graduates to pursue a successful career in automotive and allied industries and/or to pursue higher education and/or to become entrepreneur.

PEO2: To develop expertise in the core area of automobile engineering such as design, manufacturing, and servicing with a focus on research and innovation for the benefit of the society.

PEO3: To enable graduates to apply interdisciplinary engineering knowledge to solve practical automobile engineering problems.

PEO4: To prepare graduates to demonstrate professionalism, team work, communication skills, ethical conduct, and societal responsibility and adapt to current trends by engaging in lifelong learning.

Programme Specific Outcomes (PSOs)

Specific skills enhanced in this programme can enable the Graduates to

PSO1. Apply the basic and advanced knowledge of automobile, manufacturing, materials and thermal engineering to analyze and solve a realistic/practical problem.

PSO2. Design basic automotive systems and make use of advanced automotive systems to improve the performance, safety, maintenance and management of automobiles.

PSO3. Use modern tools and carry out research in automotive domain for providing solutions to automotive and societal issues.

Programme Outcomes (PO)

Engineering program must demonstrate that their students attain the following outcomes:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

SCHEME OF TEACHING AND EXAMINATION

III SEMESTER B.E. AUTOMOBILE ENGINEERING

SL. No	Subject Code	Title of the Subject	Course Instructor.	Hrs/ Week Pattern L:T:P:H	Total Credits	Examination Marks		
						CIE	SEE	Total
1	P17MAT31	Engineering Mathematics –III	Maths	4:1:0:5	4	50	50	100
2	P17AU32	Mechanics of Materials	AU	4:0:0:4	4	50	50	100
3	P17AU33	Thermodynamics	AU	4:1:0:5	4	50	50	100
4	P17AU34	Material Science & Metallurgy	AU	4:0:0:4	4	50	50	100
5	P17AU35	Manufacturing Process-I	AU	4:0:0:4	3	50	50	100
6	P17AU36	Measurement and Metrology	AU	4:0:0:4	4	50	50	100
7	P17AUL37	Metallography & Material Testing Lab	AU	1:0:2:3	1.5	50	50	100
8	P17AUL38	Foundry & Forging Lab,	AU	1:0:2:3	1.5	50	50	100
9	P17HUDIP39	Comprehensive Communication Development(CCD)	HS&M	2:0:0:2	[2]	[50]	[50]	[100]
10	P17HU39	** Aptitude and Reasoning Development – BEGINNER (ARDB)	Maths	2:0:0:2	--	(50)	-	-
11	P17HMDIP310	* Indian Constitution, Human Rights & Professional Ethics	HS&M	2:0:0:2	0	-	-	-
12	P17MADIP31	*Additional Maths-I	Maths	4:0:0:4	0	-	-	-
Total					26[28]	400[450]	400[450]	800[900]

* Additional Mathematics-I & Constitution of India and Professional Ethics: Lateral entry students shall have to pass these mandatory Learning courses before completing of VI Semester

**ARDB: All students shall have to pass this mandatory learning course before completing of VI-semester

SCHEME OF TEACHING AND EXAMINATION

IV SEMESTER B.E. AUTOMOBILE ENGINEERING

SL. No	Subject Code	Title of the Subject	Teaching Dept.	Credit Pattern L : T : P:H	Total Credits	Examination Marks		
						CIE	SEE	Total
1	P17MAAC41+/ P17MAES41++	Engg Mathematics-IV	Maths	4:1:0:5	4	50	50	100
2	P17AU42	Fluid Mechanics	AU	4:0:0:4	4	50	50	100
3	P17AU 43	Manufacturing Processes-II	AU	4:0:0:4	3	50	50	100
4	P17AU 44	Theory of Machines-I	AU	4:1:0:5	4	50	50	100
5	P17AU 45	Computer Aided M/c Drawing	AU	2:0:4:6	4	50	50	100
6	P17AU 46	Heat Transfer	AU	4:0:0:4	4	50	50	100
7	P17AU L47	Fuel Testing and Measurement Lab	AU	1:0:2:3	1.5	50	50	100
8	P17AU L48	M/c shop Practice	AU	1:0:2:3	1.5	50	50	100
9	P17HU49	Aptitude and Reasoning Development-Intermediate(ARDI)	HS & M	2:0:0:2	1	50	50	100
10	P17EVDIP410	*Environmental Studies	Env	2:0:0:2	-	-	-	-
11	P17MADIP41	*Additional Mathematics-II	Maths	4:0:0:4	-	-	-	-
Total					**27**	**450**	**450**	**900**

* Additional Mathematics-II & Environmental Studies: Lateral entry Students shall have to pass these Mandatory Learning Courses before completion of VI-semester

Course Title: **Engineering Mathematics-III**			
Course Code: P17MA31	Semester: III	L – T – P – H : 4– 1 – 0 – 5	Credits:4
Contact Period - Lecture: 52Hrs. Exam: 3Hrs.		Weightage: CIE: 50 %;	SEE: 50%

Prerequisites: The student should have acquired the knowledge of Engineering Mathematics-I & II of I and II semester B.E.

Course Learning Objectives (CLOs):

The course P17MA31 aims to:

1. Describe the concepts of elementary numerical analysis such as forward/backward finite differences, central differences, interpolation and extrapolation formulae, techniques of numerical differentiation and integration.
2. Explain the nature of periodic functions Fourier series of general as well as even /odd functions valid in full range/half-range periods along with applications through practical harmonic analysis.
3. Learn modeling in terms of partial differential equations and also, learn different exact/analytical methods of solving with special emphasis on interpretation of the solution of one-dimensional wave, heat and Laplace equations with given initial and boundary conditions in the context of various engineering and technological applications.

Relevance of the course:

Engineering Mathematics-III deals with the Numerical methods to solve interpolation and extrapolation problems in engineering field.

In Fourier series analyze engineering problems arising in control theory and fluid flow phenomena using harmonic analysis

Analyze the engineering problems arising in signals and systems, digital signal processing using Fourier transform techniques.

Z-transforms & Z-transforms of standard functions to solve the specific problems by using properties of Z-transforms.

Identify and solve difference equations arising in engineering applications using inverse Z–transforms techniques

Partial Differential Equations (PDE's), order, degree and formation of PDE's and, to solve PDE's by various methods of solution.

One – dimensional wave and heat equation and Laplace's equation and physical significance of their solutions to the problems selected from engineering field

Course Content

UNIT-I

Numerical Methods-I: Finite differences**:** Forward and Backward differences, Gregory-Newton forward and backward interpolation formulae, Newton's divided difference formula, Lagrange's interpolation formula and inverse interpolation formula. (All formulae without proof) – Problems only

Central differences: Gauss Forward and Backward difference formulae, Sterling's, and Bessel's formulae (All formulae without proof) – problems.

SSC: Problems using Everett's formula in Central differences **10 Hrs**

UNIT-II

Numerical differentiation using Newton's forward and backward interpolation formulae, Newton's divided difference formula and Sterling's formula (All formulae without proof)-problems only and Applications to Maxima and Minima of a tabulated function.

Numerical integration: Newton- Cotes quadrature formula, Trapezoidal rule, Simpson's $(\frac{1}{3})^{rd}$ rule, Simpson's $(\frac{3}{8})^{th}$ rule, Boole's rule and Weddle's rule (All rules without proof)-Illustrative problems.

SSC: Derive Newton- Cotes quadrature formula. **10 Hrs**

UNIT-III

Fourier series: Periodic functions, Fourier series- Euler's formula, Dirichlet's conditions. Fourier series of discontinuous functions, Fourier series of even and odd functions. Change of interval- Fourier series of functions of arbitrary period. Half–range Fourier series expansions, Fourier series in complex form, Practical harmonic analysis- Illustrative examples from engineering field.

SSC: Derivations of Euler's formulae **11 Hrs**

UNIT-IV

Fourier Transforms: Infinite Fourier transforms-properties. Fourier sine and Fourier cosine transforms, properties. Inverse infinite Fourier and inverse Fourier sine & cosine transform – Illustrative examples.

Difference equations and Z-transforms: Definition of Z-transforms- standard Z-transforms, linearity property, damping rule, shifting rules, initial value theorem and final value theorem (All rules and theorems without proof). Inverse Z – transforms. Difference equations- basic definitions. Application of Z-transforms to solve difference equations.

SSC: Convolution theorem, Parseval's identities.related problems. **10 Hrs**

UNIT-V

Partial differential equations (PDE's):

Formation of PDE's. Solution of non-homogeneous PDE by direct integration. Solutions of homogeneous PDE involving derivative with respect to one independent variable only (both types with given set of conditions). Method of separation of variables (first and second order equations). Solution of the Lagrange's linear PDE's of the type: $Pp + Qq = R$.

Applications of PDE's:

One- dimensional wave and heat equations (No derivation), and various possible solutions of these by the method of separation of variables. D'Alembert's solution of wave equation. Two dimensional

Laplace's equation (No derivation) –various possible solutions. Solution of all these equations with specified boundary conditions (Boundary value problems). Illustrative examples from engineering field.

SSC: Finding the solution of non-linear equations of first order: Charpit's Method -simple problem. **11 Hrs**

Text Books:

1. Higher Engineering Mathematics: B.S. Grewal, Khanna Publishers, New Delhi, 42nd Ed. 2012.
2. Advanced Engineering Mathematics: - E. Kreyszig, John Wiley & Sons, 6th Ed.2007.

References:

1. Advanced Modern Engineering Mathematics: - Glyn James, Pearson Education Ltd., 3rd Ed., 2007.
2. Advanced Engineering Mathematics: Peter V O' Neil Thomson, Brooks/Cole, 5th edition, 2007.
3. Higher Engineering Mathematics: - B.V. RAMANA, McGraw Hill Education, 2007

Note: - Each unit contains ***two*** full questions of ***20 marks*** each. Students are required to Answer ***five*** full questions choosing at least ***one*** question from each unit.

Course Outcomes

After learning all the units of the course, the student is able to;

1. Apply forward, backward difference formulae and central differences formulae in solving interpolation- extrapolation problems in engineering field.
2. Apply Numerical differentiation and integration rules in solving engineering where the handling of numerical methods is inevitable.
3. Recognize the importance of Fourier series & Fourier transforms, difference equations and Z-transforms in the field of signals and systems, communication and network theory signal and image processing, control theory, flow & heat transfer and theory of elasticity.
4. Learn modeling in terms of partial differential equations and also, learn different exact/analytical methods of solving with special emphasis on interpretation of the solution.
5. Interpret the solution of one-dimensional wave, heat and Laplace equations with given initial and boundary conditions in the context of various engineering and technological applications.

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Semester: 3	Course code : P17MAT31	Title : Engineering Mathematics –III											
CO's	Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO-1	Apply forward, backward difference formulae and central differences formulae in solving interpolation-extrapolation problems in engineering field.	1	**2**	-	-	-	-	-	-	-	-	-	-
CO-2	Numerical differentiation and integration rules in solving engineering where the handling of numerical methods are inevitable	**2**	**2**	-	-	-	-	-	-	-	-	-	-
CO-3	Apply the knowledge of periodic function, Fourier series, complex Fourier series, Fourier sine/cosine series of a function valid in different periods. Analyze engineering problems arising in control theory/fluid flow phenomena using harmonic analysis.	**3**	**3**	-	-	-	-	-	-	-	-	-	-
CO-4	Understand complex/infinite Fourier transforms, Fourier sine and Fourier cosine transforms with related properties Analyze the engineering problems arising in signals and systems, digital signal processing using Fourier transform techniques. Define Z-transforms & find Z-transforms of standard functions to solve the specific problems by using properties of Z-transforms. Identify and solve difference equations arising in engineering applications using inverse Z– transforms techniques.	**2**	**3**	-	-	-	-	-	-	-	-	-	-
CO-5	Define Partial Differential Equations (PDE's),order, degree and formation of PDE's and, to solve PDE's by various methods of solution Explain one - dimensional wave and heat equation and Laplace's equation and physical significance of their solutions to the problems selected from engineering field.	**2**	**3**	-	-	-	-	-	-	-	-	-	-

Course Title: Mechanics of Materials			
Course Code: P17AU32	Semester: III	L:T:P:H: 4:0:0:4	Credits: 4
Contact Period-Lecturer: 52Hrs. Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

Prerequisites: Engineering Mathematics – (I & II), Engineering Mechanics

Course Learning Objectives (CLOs)

This course aims to

1. Classify different types of stresses, strain and deformations induced in the mechanical components due to external loads.
2. Determine stresses in composite bars, thermal stresses and principal stresses in simple 2D elements.
3. Draw Shear Force Diagrams and Bending Moment Diagrams for different types of loads and support conditions.
4. Compute and analyze bending and shear stresses and deflections induced in beams.
5. Determine stresses in thin and thick cylinders, tensional stresses, and Analyze buckling phenomenon in columns.

Course Content

Unit -1

Simple stresses and strains: Stress, types of stresses, Strain, Saint Venant's principle, stress-strain diagram for mild steel, working stress, proof stress, factor of safety, Hooke's law, modulus of elasticity, strain energy due to gradually applied load, proof resilience, longitudinal strain, lateral strain, poison ratio, stress strain analysis of bars of uniform cross section, stepped bars, bars with continuously varying section, principle of superposition. Modulus of rigidity, volumetric strain, expression for volumetric strain, bulk modulus, relation among elastic constants.

SSC: Identification of various loads coming on machine members. Problems on Principle of Superposition **10hrs**

Unit-2

Compound bars: Stress analysis of composite bars. Thermal stresses in uniform and compound bars**. Compound stresses**: Principal planes and stresses, planes of maximum shear stress in general two dimensional systems, Mohr' circle diagram.

SSC: Principle of Complimentary Shear Stresses. **10 hrs**

Unit -3

Shear force and Bending moment diagrams: Types of beams, loads and supports. Shear forces and bending moments, sign conventions, relationship between load intensity, shear force and bending moment. Shear force and bending moment diagrams for different beams subjected to concentrated loads, UDL, UVL and couple.

SSC: SFD and BMD of building structures. **12 hrs**

Unit-4

Bending and shear stresses in Beams: Theory of simple bending, assumptions in simple bending, relationship between bending stresses and radius of curvature, relationship between bending moment and radius of curvature, section modulus, moment of resistance of a

section. Bending stresses in beams of uniform section. Shearing stresses in beams, shear stress across rectangular, circular, I and T sections. **(*Composite beams are not included and moment of inertia to be supplied for numerical problems*).**

Deflection of Beams: Introduction, relation between slope, deflection and radius of curvature. Macaulay's method for cantilever and simply supported beams with point load and UDL.

SSC: Moment - Area Method for finding Beam Deflections. Moment carrying capacity of different sections. **10 hrs**

Unit -5

Thin and thick cylinders: Types of cylinder, stresses in thin cylinder - Hoop's and longitudinal stress, changes in dimensions of cylinder (diameter, length, volume). Thick cylinders subjected to internal and external pressures. (***Compound cylinders not included***).

Torsional stresses: Introduction to torsion, pure torsion, assumptions, derivation of torsional equation, polar modulus, torsional rigidity, and torque transmitted by solid and hollow circular shafts. C**olumns and struts:** Introduction to Columns, Euler's theory for axially loaded elastic long columns, Euler's equation for columns with different end conditions, Rankin's formula.

SSC: Shear Force and Bending Moment diagrams for Beams subjected to Couples. **10 hrs**

Text Books:

1. S. S. Bhavikatti, "Strength of Materials", Vikas publication House-pvt ltd 2nd edition 2013
2. Dr. B.C. Punmia, "Mechanics of Materials", Ashok Kumar Jain and Arun Kumar Jain, Laxmi publications, New Delhi. 2016 ISBN 10: 8131806464 ISBN 13: 9788131806463
3. Dr. R. K. Bansal , "Strength of Materials", Laxmi publication, New Delhi 4th edition 2017

References:

1. W.A. Nash, Sehaum's Outline Series, "Strength of Materials", Fourth Edition 2007.
2. Ferdinand P Beer ,E Russell Johnston, JR., John T DeWolf adapted by N Shivaprasad & S Krishnamurthy, " Mechanics of Materials"2005, Tata McGraw-Hill
3. James M. Gere, Stephen P. Timoshenko, "Mechanics of Materials", CBS Publishers and Distributers Delhi (year of publication).2006 **ISBN-10:** 8123908946 **ISBN-13:** 978-8123908946

Course Outcomes

After learning all the units of the course, the student is able to

1. Able to Explain the concepts of stress and strain acting on deformable bodies and to compute stress and strains produced under axial and shear loads in homogeneous and composite bars using stress strain relationship.
2. Able to Apply the stress transformation equations and Mohr's circle to calculate the principal stresses.
3. Analyze the performance of the beam for different types of loads and support conditions using SFD and BMD

4. Able to relate bending stress, bending moment, radius of curvature, express shear stress in beams of different cross sections, and determine the deflection of beams subjected to different loads
5. Compute stresses in thick and thin cylinders and load carrying capacity of columns for different end conditions using Euler's equation

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	Able to Explain the concepts of stress and strain acting on deformable bodies and to compute stress and strains produced under axial and shear loads in homogeneous and composite bars using stress strain relationship.	2	2	2	-	-	2	-	-	-	-	-	2	3	2	-
2	Able to Apply the stress transformation equations and Mohr's circle to calculate the principal stresses.	3	2	2	-	-	2	-	-	-	-	-	2	3	2	-
3	Analyze the performance of the beam for different types of loads and support conditions using SFD and BMD	3	3	2	-	-	2	-	-	-	-	-	2	3	2	-
4	Able to relate bending stress, bending moment, radius of curvature, express shear stress in beams of different cross sections, and determine the deflection of beams subjected to different loads	2	2	2	-	-	2	-	-	-	-	-	2	3	2	-
5	Compute stresses in thick and thin cylinders and load carrying capacity of columns for different end conditions using Eulers equation	2	2	2	-	-	2	-	-	-	-	-	2	3	2	-

Course Title: Thermodynamics			
Course Code: P17AU33	Semester: III	L:T: P:H : 4:1:0:5	Credits: 4
Contact Period-Lecturer: 52Hrs. Exam:3 Hrs		Weightage:CIE:50%; SEE: 50%	

Prerequisites: Engineering Physics, Engineering Mathematics-I

Course Learning Objectives (CLOs)

This course aims to

1. Define and understand the concepts of Energy in general and Heat and Work in particular
2. Apply the concepts of thermodynamics to steady and unsteady flow processes.
3. Understand the basics of heat engine and heat pumps and second law of thermodynamics and corollaries.
4. learn and understand necessity of applied thermodynamics and air standard cycles and Demonstrate ability to make use of air standard cycle and able to use reciprocating air compressor Students will be able to use reciprocating air compressor.
5. Get exposure to different types of refrigerants and their desirable properties and vapor absorption and vapor compression refrigeration, use of charts.

Course Content

Unit – I

Fundamental Concepts & Definitions:-

Definition of Thermodynamics. Microscopic and Macroscopic approaches to the study of thermodynamics. Definitions of System (closed system) and Control Volume (open system) with examples. Definition of thermodynamic property, Intensive and extensive properties, thermodynamic state, process, quasi-static process, thermodynamic cycle. Thermodynamic equilibrium; definitions of thermal, chemical and mechanical equilibrium. Zeroth law of thermodynamics, Concept of Temperature, types of commonly used temperature scales and relation between them. Thermodynamic definition of work, sign convention and examples to illustrate the definition of work. Work done at the system boundary, process equation and expressions for work done in different processes. Definition of heat and sign convention. Comparison of work and heat. Simple numerical problems on work and heat transfer only.

SSC: Different temperature measuring instruments. **11 hrs**

Unit – II

First Law of Thermodynamics:

Statement of the First law of thermodynamics for a closed system undergoing a cyclic process. First law thermodynamics for a change of state of the system and concept of energy. Energy as a property of the system and its significance. Internal Energy, Enthalpy and Specific heats. Simple numerical problems on systems undergoing closed process.

Steady flow process, First law applied to steady flow process, derivation of steady flow energy equation and its applications to steady flow process. Simple numerical problems on systems undergoing steady flow process.

SSC: Application of FLOT for different discuss the compressor nozzle etc. **10 hrs**

Unit – III

Second Law of Thermodynamics:

Thermal reservoir, Source and sink, Heat engine, heat pump and refrigerator and their schematic representation, efficiency and coefficient of performance. Kelvin – Planck and Clausius statement of the Second law of thermodynamics and equivalence of the two Statements of second law. Definition of perpetual motion machines of II kind with example. Reversible and Irreversible processes, factors that make a process irreversible. Reversible heat engine-Carnot Cycle and expression for efficiency of Carnot cycle. Simple numerical problems on heat engines and heat pumps.

SSC: Violation of II law leads to PMMK-II proof. **10 hrs**

Unit – IV

Air Standard Cycles: Carnot Cycle, Otto Cycle, and Diesel Cycle, their P-V and T-S diagrams, description, expression for efficiencies and definition of mean effective pressures. Comparison of Otto and Diesel cycles.

Reciprocating Air Compressors: Operation of a single stage reciprocating air compressors, Work input using P-V diagram and steady state flow analysis, Effect of clearance and volumetric efficiency, Adiabatic, isothermal and mechanical efficiencies, Multistage compressors, saving in work, expression for optimum intermediate pressure. Imperfect inter cooling. **10 hrs**

Unit –V

Refrigeration and Air Conditioning: Introduction, Heat Engines and Heat Pumps, Pressure-enthalpy diagram. Vapor compression refrigeration systems, description, analysis, refrigerating effect, capacity, power required, units of refrigeration, and COP. Properties of atmospheric air: Dry Air, Relative Humidity, Specific humidity, degree of saturation, dry bulb and wet bulb temperature. Psychometric Chart and Psychometric Process: Sensible heating or cooling, cooling and dehumidification, heating and humidification and adiabatic mixing of two streams.

SSC: Different make of refrigerator; At least three **11 hrs**

Text Books:

1. P .K. Nag, Basic and Applied Thermodynamics, Tata McGraw Hill, 2009
2. R K Rajput, Engineering Thermodynamics by , Laxmi Publications Pvt Ltd 2011. ISBN-10: 9380298404 ISBN-13: 978-9380298405

Reference Books:

1. Prakash and Gupta, Engineering Thermodynamics
2. Yunus A,Thermodynamics – An engineering approach. Cengal Tata McGraw Hill
3. Van and Wylen, Introduction to Classical Thermodynamics

Course Outcomes

After learning all the units of the course, the student is able to

1. Able to **define** basic definitions, solve problems on temperature scale, Heat and Work.
2. Able to **Identify, formulate and solve** engineering problems in classical thermodynamics involving closed and open systems.
3. Able to a**pply** second law concept and Carnot cycle to solve engineering problems.
4. **Analyze** air standard cycle and reciprocating compressor.
5. **Analyze** refrigeration cycle and Air conditioning cycle

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	Able to **define** basic definitions, solve problems on temperature scale, Heat and Work.	3	3	1	-	-	2	2	-	-	-	-	2	3	2	-
2	Able to **Identify, formulate and solve** engineering problems in classical thermodynamics involving closed and open systems.	3	3	1	-	-	2	2	-	-	-	-	2	3	-	-
3	Able to a**pply** second law concept and Carnot cycle to solve engineering problems.	3	2	1	-	-	2	2	-	-	-	-	2	3	-	-
4	**Analyze** air standard cycle and reciprocating compressor.	3	2	1	-	-	2	2	-	-	-	-	2	3	-	-
5	**Analyze** refrigeration cycle and Air conditioning cycle	3	2	1	-	-	2	2	-	-	-	-	2	3	-	-

Course Title: Material Science and Metallurgy			
Course Code: P17AU34	Semester: III	L:T:P:H -4:0:0:4	Credits: 4
Contact Period-Lecturer: 52Hrs,: Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

Prerequisites: Knowledge of Engineering Physics, Engineering Chemistry, Mechanics of materials

Course Learning Objectives (CLOs)

This course aims to

1. Explain the different crystalline structure of the metals and imperfection associated with them.
2. Explain the laws governing the diffusion phenomena and factors affecting them.
3. Explain the behavior of the materials when subjected to mechanical
4. forces.
5. Describe the phenomena of fatigue and creep in metals
6. Describe the solidification process in metal casting
7. Explain the concept of phase transformation due to temperature in alloys.
8. Explain physical properties and microstructures of iron based on percentage of carbon present
9. Explain the types of heat treatment methods for metals and its affect on the mechanical properties
10. Explain the different alloys, their properties, compositions and uses.
11. Discuss different types of composite materials (PMC,MMC and CMC), their properties and applications, \

COURSE CONTENTS

Unit - 1

Crystal Structure: Fundamental concepts of Unit cell space lattice, Bravais Lattices, Unit cells for cubic structures and HCP. Study of stacking of layers of atoms in cubic structure and HCP, calculations of radius, co-ordination number and Atomic Packing Factor for different cubic structures, Crystal imperfections – point, line, surface & volume defects, Diffusion – diffusion mechanism, Fick's laws of diffusion

Mechanical Behavior: Stress-strain diagram to show ductile and brittle behavior of materials, linear and non linear elastic behavior and properties, mechanical properties in plastic range, yield strength, offset yield strength, ductility, ultimate tensile strength, toughness. True stress & true strain, Plastic deformation of single crystal by slip and twinning

SSC: Hardness, Rockwell, Vickers & Brinell Hardness Testing. **12 Hrs**

Unit II

Fracture: Bonding forces and energies, cohesive strength of metals – Griffith theory – crack initiation, growth and crack arrest – Effect of plastic deformation on crack propagation – Factors leading to crack propagation – Cleavage – inter crystalline, brittle, ductile fracture, influence of slip on fracture – Effect of impact loading on ductile material and its application in forging, etc – **5 Hrs**

Fatigue: stress cycles – effects of stress concentration, size effect, surface texture on fatigue – corrosion and thermal fatigue – mechanism of fatigue failure

Creep: creep curves – structural change – mechanism of creep deformation.
SSC: Study of Peritectic and Monotectic System. **5 Hrs**

Unit III

Solidification & Phase diagrams: Mechanism of solidification, Homogenous and heterogeneous nucleation, Crystal growth, Cast metal structures. Solid solutions Hume Rothary rules- substitutional, and interstitial solid solutions, intermediate phases, Gibbs phase rule, construction of equilibrium diagrams, equilibrium diagrams involving complete and partial solubility, lever rule**.**

Iron carbon equilibrium diagram: phases in the Fe-C system, Invariant reactions, critical temperatures, Microstructures of slowly cooled steels, effect of alloying elements on the Fe-C diagram, ferrite and austenite stabilizers. The TTT diagram, drawing of TTT diagram, TTT diagram for hypo & hyper eutectoid steels, effect of alloying elements on CCT diagram
SSC: Effect of alloying elements on TTT diagram. **10 Hrs**

Unit IV

Heat treatment of metals: Definition and aims of heat treatment – Annealing and its types, normalizing, hardening, tempering, austempering, martempering with microstructure changes
Surface treatment – Diffusion methods – Carburizing, Nit riding, Cyaniding – Thermal methods – flame hardening, induction hardening
SSC: Study of Jominy – End Quench Test. **10 Hrs**

Unit V

Engineering alloys: Properties, composition and uses of low Carbon, medium and high carbon steels, Steel designation AISI and SAE designation; Cats Irons – gray CI, White CI, Malleable CI & SG CI; Microstructures of CI. The light alloys Al, Mg and Ti alloys; Copper and its alloys, Brasses & Bronzes, Glass, Corrosion prevention materials
Advanced Materials: Composite materials-definition, classification, types of matrix materials & reinforcements, fundamentals of production of FRP's and MMC's, advantages and application of composites
SSC: Study of Copper – Zinc Partial Phase diagram. **10 Hrs**

Text Books:

1. Smith, Foundations of Materials Science and Engineering- 5th Edition, McGraw Hill, 2009 **ISBN-10:** 0073529249 **ISBN-13:** 978-0073529240
2. Murthy, Structure and properties of engineering Materials, TATA McGraw hill, 2003. **ISBN:** 007048287X 9780070482876

Reference Books:

1. William D. Callister Jr. **"Materials Science & Engineering- An Introduction"**, Wiley India Pvt. Ltd, New Delhi.2010 ISBN: 9788126521432, 8126521430
2. Donald R. Askland, Predeep P. Phule Thomson, **"Essentials of Materials for Science and Engineering"**, -Engineering, 2007
3. James F. Schakel ford, **"Introduction to materials Science for Engineering"**, 8th edition Pearson, Prentice Hall, New Jersy,2015

Course Outcomes

After learning all the units of the course, the student is able to

1. **Ability to identify** different types of crystalline structure, defects of metals and laws governing the diffusion phenomena.
2. **Ability to apply** the knowledge of mechanical behavior to select appropriate material for given automotive component.
3. **Ability to Interpret** the phase diagrams of metals and alloys and use them in thermal processing of the materials
4. **Ability to Selec**t appropriate heat treatment process for specific requirements
5. **Describe** the effect of alloying elements on properties and fabrication process and applications of composite materials with economic and social concerns

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Ability to identify** different types of crystalline structure, defects of metals and laws governing the diffusion phenomena.	3	3	2	-	-	-	2	-	-	-	-	2	3	1	-
2	**Ability to apply** the knowledge of mechanical behavior to select appropriate material for given automotive component.	3	2	2	-	-	-	2	-	-	-	-	2	3	2	-
3	**Ability to Interpret** the phase diagrams of metals and alloys and use them in thermal processing of the materials	3	3	2	-	-	-	2	-	-	-	-	2	3	2	-
4	**Ability to Selec**t appropriate heat treatment process for specific requirements	2	2	2	-	-	-	2	-	-	-	-	2	3	-	-
5	**Describe** the effect of alloying elements on properties and fabrication process and applications of composite materials with economic and social concerns	2	2	2	-	-	2	2	-	-	-	-	2	3	-	-

Course Title: Manufacturing Process - I			
Course Code: P17AU35	Semester: III	L:T:P:H -4:0:0:4	Credits: 3
Contact Period-Lecturer: 52Hrs. Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

Course Learning Objectives (CLOs)

This course aims to

1. Classify various manufacturing processes.
2. Define pattern making. Classification, tools used and describe construction of pattern making. Explain foundry sands, sand preparation and testing.
3. Explain molding processes and Describe core making process.
4. Discuss different special molding process.
5. Classify furnaces. Describe working and construction features of electric arc furnace and Cupola.
6. Discuss steps involved in casting process. Explain principle of gating and risering.
7. Explain arc welding processes. Describe various welding processes.
8. Discuss special type of welding.
9. Summarize metallurgical aspect in welding.
10. Explain welding defects, causes and remedies.
11. Discuss different methods for inspection for casting and welding.

Course Content

Unit – I

INTRODUCTION: Concept of Manufacturing process, its importance, Classification of Manufacturing processes. Selection of process for production

PATTERNMAKING: Definition, functions, Materials and tools used for pattern, various pattern allowances and their importance. Classification of patterns. Construction of patterns,

FOUNDRY: Introduction, Tools and equipments, Moulding sands, Types of molding sands, Sand additives, Properties of Molding sand. Sand preparation, Sand testing,

SSC*:* Steps involved in pattern making sand preparatory concept of moldings sand test**.**

11 Hrs

Unit – II

Molding processes based on sand used and methods used for Cores and Core makings, Core boxes, Typical molding problems.

Binder: Definition, Types of binders used in molding sand.

Additives: need, types of additives used.

SPECIAL MOULDING PROCESS: Study of Molding processes, CO2 molding, Shell mould, Investment casting, permanent mould casting : Gravity die-casting, Pressure die casting, centrifugal casting, Squeeze Casting, Slush casting, Thixocasting and continuous casting

SSC*:* Concept of Moulding process**.** 1**1 Hrs**

Unit – III

MELTING FURNACES: Classification of furnaces, Constructional features & working principle of Electric Arc Furnace, Cupola furnace

CASTING PROCESS: Introduction to Casting process & steps involved, Varieties of Automotive components produced by casting process, Advantages & Limitations of casting process

Principles of Gating: Elements of gating system, types of gates, gating ratio, function of risers, types of risers – open and blind risers. Types of defects in Castings, Causes and remedies

SSC*:* Steps involved in casting process & types of defects in casting. **10 Hrs**

Unit – IV

WELDING PROCESS: Arc Welding: Principle, Flux Shielded Metal Arc Welding (FSMAW), Inert Gas Welding (TIG & MIG) Submerged Arc Welding (SAW) and Atomic Hydrogen Welding processes (AHW).

SPECIAL TYPE OF WELDING: Resistance welding - principles, Seam welding, Thermit welding, Spot welding, projection welding. Friction welding and Explosive welding

SSC: Resistance welding propel **10 Hrs**

Unit – V

METALLURGICAL ASPECT IN WELDING: Structure of welds, Formation of different zones during welding, Heat affected zone (HAZ), Parameters affecting HAZ, Shrinkage in welds & Residual stresses. Weldability and Weldability testing, Welding defects – Detection causes & remedy. Principle of Soldering, Brazing, different methods and its applications.

Inspection Methods: Methods used for Inspection of casting and welding. Visual, Magnetic particle, Fluorescent particle, Ultrasonic, Radiography, Holography methods of Inspection.

SSC: Welding Applications in Automobile Industry. **10 Hrs**

Text Book

1. S.K.Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy, "Elements of Workshop Technology"-Vol-I-Media Promoters & Publishers Pvt Ltd ,2007.

2. Dr.K.Radhakrishna, "Manufacturing Process-I", -Sapna Book House, 5th Ed, 2006

References:

1. Serope Kalpakjain, Steuen.R.Sechmid, "Manufacturing Technology",-Pearson **Education Asia, 7th Ed. 2014.**

2. Roy A Lindberg, "Process and Materials of Manufacturing" 4th Edn.- Pearson Edu. 2006.

Course Outcomes

After learning all the units of the course, the student is able to

1. **To discuss** various manufacturing processes.
2. **To identify** and study different types of molding and casting processes.
3. **To application** of furnaces in casting process for automotive components manufacturing
4. **To identify** and study different types of welding and special types of welding
5. **To analyze** different defects in welding and study inspection methods

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**To discuss** various manufacturing processes.	2	1	-	-	-	-	-	-	-	-	-	-	3	1	-
2	**To identify** and study different types of molding and casting processes.	3	2	-	-	-	-	-	-	-	-	-	-	3	1	-
3	**To application** of furnaces in casting process for automotive components manufacturing	3	2	-	-	-	2	2	-	-	-	-	2	3	1	-
4	**To identify** and study different types of welding and special types of welding	2	1	-	-	-	-	-	-	-	-	-	-	3	1	-
5	**To analyze** different defects in welding and study inspection methods	2	1	-	-	-	2	2	-	-	-	-	2	3	1	-

Course Title: Measurement and Metrology			
Course Code: P17AU36	Semester: III	L:T:P:H -4:0:0:4	Credits: 4
Contact Period-Lecturer: 52Hrs. Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

Course Learning Objectives (CLOs)

This Course aims to

1. To understand the different standards of measurement.
2. To understand the concepts of comparators
3. To identify, construction and working of the different transducers, and intermediate devices
4. Describe the different Torque and force .measuring methods
5. Discuss the measurement techniques of strain, pressure and temperature

Course Content

Unit – I

Measurements, Measurement Systems and Standards of Measurement:

Definition, significance of measurement, generalized measurement system, definition and concept of accuracy, precision, sensitivity, Calibration, threshold, hysteresis, repeatability, linearity, loading effect, system response, time delay, errors in measurement, classification of errors. Definition and objectives of metrology, Standard of length- International prototype meter, Imperial standard yard, Wave length standard, Subdivision of standards, line and end standard, comparison, Transfer from line standard to end standard, calibration of end bars (Numerical)

SSC: Angle gauges and Sine bars, Concept of sensor in Industrial application **11 hrs**

Unit – II

Transducers, Intermediate Modifying Devices and Interferometer:

Transfer efficiency, primary and secondary transducers, Mechanical, electrical, electronic transducers, advantages of each type of transducers.

Mechanical systems, inherent problems, electrical intermediate modifying devices, input circuitry, signal transmission (hydraulic transmission, magnetic transmission, electrical transmission) Clinometers. Principle of inter-ferometry, autocollimator, optical flats

SSC: Terminating devices: Mechanical counters, Oscillographs and X-Y Plotters. **10 hrs**

Unit – III

Measurement of Force, Torque, and terminating devices:

Principle, analytical balance, platform balance proving ring, torque measurement, types of dynamometers prony brake, Hydraulic dynamometer, Eddy current dynamometer. Mechanical, digital read out devices, ultra-violet recorders, servo-recorders cathode ray oscilloscope, Oscillographs, X-Y plotters

SSC: Concept of measurement of Dual-fluid U-tube manometer **11 hrs**

Unit – IV

Strain Measurement, Pressure Measurement and Temperature Measurement:

Strain gauge, preparation and mounting of strain gauges, gauge factor, Methods of strain measurement Principle, use of elastic members, bridge man gauge, Mc leod gauge, thermal

conductivity gauge, (pirani gauge and thermocouple vacuum gauge) ionization gauge, Resistance thermometers, thermocouple, law of thermocouple, thermocouple circuits, thermocouple materials, pyrometers, optical pyrometer.

SSC: Concept of Angle gauges in industrial field. **10 hrs**

Unit –V

Comparators and Angular Measurements:

Introduction to Comparator, Characteristics, Classification of Comparators, Sigma comparators, dial indicators, optical comparators, principles, ziess ultra optimeter, Electric and electronic comparators –principles, LVDT, pneumatic comparators, back pressure gauges, solex comparators. Bevel protractor. Sine principle, use of sine bars, sine centre, angle gauges (numerical on building of angles).

SSC: Application of optical flat in engineering field **10 Hrs**

Text Books:

1. R.K. JAIN, Engineering Metrology - Khanna Publishers, New Delhi. 2010
2. D.S.KUMAR, Mechanical Measurements and Control - Metropolitan Book Co.Pvt.Ltd, New, 2014

References:

1. ASTME- Hand book of Industrial Metrology - PHI
2. BECKWITH, BUCK & MARAN-GONI, Mechanical Measurements - Narosa Publishing House. 2011
3. DOEBELIN, Measurement systems - Application a Design, (5th Edition) - McGraw Hill. ISBN-13: 978-0072922011 ISBN-10: 007292201X

Course Outcomes

After learning all the units of the course, the student is able to

1. **To understand** the different standards of measurement.
2. **To understand** the concepts of comparators
3. **To identify**, construction and working of the different transducers, and intermediate devices
4. **Describe** the different Torque and force .measuring methods
5. **Discuss** the measurement techniques of strain, pressure and temperature

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**To understand** the different standards of measurement.	3	2	2	-	-	2	2	-	-	-	-	1	2	-	-
2	**To understand** the concepts of comparators	3	2	2	-	-	2	2	-	-	-	-	1	2	-	-
3	**To identify**, construction and working of the different transducers, and intermediate devices	3	3	2	-	-	2	2	-	-	-	-	1	3	2	1
4	**Describe** the different Torque and force .measuring methods	3	2	2	-	-	2	2	-	-	-	-	1	3	2	1
5	**Discuss** the measurement techniques of strain, pressure and temperature	3	2	2	-	-	2	2	-	-	-	-	1	3	2	1

Course Title: Metallography & Material Testing Laboratory			
Course Code: P17AUL37	Semester: III	L:T:P:H -1:0:2:3	Credits: 1.5
Contact Period-Lecturer: 39 Hrs. Exam: 3Hrs		Weightage:CIE:50%; SEE:_50%	

Course Learning Objectives (CLOs)

This Course aims to

1. Discuss Engineering and Manufacturing Roles, Types of Material Processes and get familiar to the Testing Laboratory.
2. Compute stresses, strains and various mechanical properties under different loading conditions, viz. tensile, compression, shear.
3. Predict the variation in characteristic properties with reference to ductility and brittleness of materials before and after heat treatment.
4. Determine the behaviour of the material subjected to high rate of sudden loading so as to find the energy required for the plastic deformation.
5. Determine the wear coefficient for the given material, and conclude the nature of wear.
6. Prepare the sample for microstructure examination, identify the structure and perform image analysis.

	PART-A
1.	Preparation of specimen for Metallographic examination of engineering materials and study the microstructure of plain carbon steel, tool steel, gray C.I, SG iron, Brass, Bronze.
2.	Study and demonstration of different Heat treatment: Annealing, normalizing, hardening and tempering of steel & to study their Rock-well hardness.
3.	Study and demonstration of a. Ultrasonic flaw detector b. Magnetic crack detector c. Dye penetrate testing
	PART-B
4.	Tension test and compression test on mild steel and cast Iron
5.	Bending Test on mild steel and timber
6.	Torsion tests on circular sections
7.	Hardness test on mild steel, cast iron, aluminum etc.,
8.	Shear test on mild steel
9.	Test on helical springs- Determination of spring modulus and rigidity modulus
10.	Impact test (Charpy and Izod) on cast iron and mild steel
11.	Experiment on wear study

Reference Books:

1. Material Science by K.M. Gupta
2. Material Science by Raghavan .S Prentice-Hall of India Pvt.Ltd 2004

Course Outcomes (COs)

At the end of the course the student is able to:

1. **Prepare** material specimen for metallographic studies and recognize the micro structural features of material
2. **Perform** the nondestructive tests like ultrasonic flaw detector, magnetic crack detector , Dye penetration testing
3. **Determine** the various properties of mild steel and cast iron specimen.
4. **Determine** the wear coefficient of material
5. **Analyze** the data and present the results in a report, complete with a discussion relating the theory and practice.

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Prepare** material specimen for metallographic studies and recognize the micro structural features of material	2	2	-	-	-	-	-	-	2	2	-	2	3	-	2
2	**Perform** the nondestructive tests like ultrasonic flaw detector, magnetic crack detector , Dye penetration testing	2	2	-	-	-	-	-	-	2	2	-	2	3	-	2
3	**Determine** the various properties of mild steel and cast iron specimen.	3	3	-	-	-	-	-	-	2	2	-	2	3	-	2
4	**Determine** the wear coefficient of material	2	2	-	-	-	-	-	-	2	2	-	2	3	-	2
5	**Analyze** the data and present the results in a report, complete with a discussion relating the theory and practice.	3	2	-	-	-	-	-	-	2	2	-	2	3	-	2

Course Title: Foundry and Forging Laboratory			
Course Code: P17AUL38	Semester: III	L:T:P:H -1:0:2:3	Credits: 1.5
Contact Period-Lecturer: 39Hrs. Exam: 3Hrs		Weightage:CIE:50%; SEE:_50%	

Prerequisites: Basics of Manufacturing Processes and their classification, like Sand Moulding, Sand and die Casting Forging and Forging process at smith's shop

Course Learning Objectives {CLOs}

This Course aims to

1. Know and explain about Preparation of sand specimens for conduction of various tests and sketching of the same - L 1, L2
2. Know and explain about various Testing of Moulding sand and Core sand sketching of the same -L 1, L2
3. Know about Use of Different foundry tools and other equipments and explain, sketching of the same -L1, L2
4. Practice and prepare moulds using two moulding boxes using patterns or without patterns. (Split pattern, Match plate pattern and Core boxes) - L3
5. Apply the knowledge by preparing one casting (Aluminum or cast iron-Demonstration only) - L3
6. Know about Use of Different Forging tools and other equipments and explain, sketching of the same -L1, L2
7. Practice and prepare minimum three forged models involving upsetting, drawing and bending operations - L3
8. Apply the knowledge by preparing at least one forging model by using Power Hammer- L3

Part-A

1. Testing of Moulding sand and Core sand

Preparation of sand specimens and conduction of the following tests:

- Compression, Shear and Tensile tests on Universal Sand Testing Machine.
- Permeability test
- Core hardness & Mould hardness tests.
- Grain fineness number test (Sieve Analysis test)
- Clay content test.
- Moisture content test

2. Foundry Practice

Use of foundry tools and other equipments.

Preparation of moulds using two moulding boxes using patterns or without patterns. (Split pattern, Match plate pattern and Core boxes).

Preparation of one casting (Aluminum or cast iron-Demonstration only)

Part -B

3. Forging Operations

Preparing minimum three forged models involving upsetting, drawing and bending operations.

Text Books:

1. Hajra Choudhary S. K., Bose S. K., Hajra Choudhary A. K. Elements of Workshop Technology - 2007 Media promotors and publishers pvt. Limited
2. B S Raghuwanshi, Course in Workshop Technology, Dhanpat Rai and Company(P) Limited, 2009

Reference Books:

1. R.k Jain, Production Technology, Khanna Publ., 2012
2. W. A. J. Chapman, William Arthur James Chapman, Workshop Technology, Edward Arnold, 1975

Course Outcomes

After learning all the units of the course, the student is able to

1. **Analyze** sand specimens through different tests.
2. **Apply** different Foundry tools and Develop moulds, that involve different Foundry operations
3. **Apply** different Forging tools and Develop models that involve different Forging operations.

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Analyze** sand specimens through different tests.	3	3	-	-	1	2	1	-	-	-	-	2	3	-	-
2	**Apply** different Foundry tools and Develop moulds, that involve different Foundry operations	3	2	-	-	1	2	1	-	-	-	-	2	3	2	1
3	**Apply** different Forging tools and Develop models that involve different Forging operations.	3	2	-	-	1	2	1	-	-	-	-	2	3	2	1

Course Title: Aptitude and Reasoning Development - BEGINNER. (ARDB)			
Course Code : P17HU39	Semester : III	L-T-P-H : 2-0-0–2-2	Credits: NA
Contact Period: Lecture: 32 Hr. Exam: 3 Hr		Weightage :CIE:100% - [P/NP]	

Prerequisites: Basics of mathematics.

Course Learning Objectives (CLOs)

This course aims to

1. Solve the mathematical calculations easily and quickly using the methods of vedic mathematics.
2. Illustrate different examples to learn about percentages effectively.
3. Compare the different types of series.
4. Explain the logic behind solving problems under series such as A.P., G.P., H.P.
5. Explain divisibility rules, properties of different types of numbers.
6. Explain methods to find the number of factors and sum of factors.
7. Analyze the concept of power cycle, and find last digit and last two digits.
8. Solve problems involving simple equations and inequalities.
9. Explain Componendo, Dividendo, Invertendo, Alternendo and other terms related to ratio and proportion.
10. Explain the concepts behind the logical reasoning modules such as arrangement, blood relations and directions

Relevance of the course:

3rd Semester is considered as the right time to build a base to a student's analytical and logical ability. This course connects the basics of maths learnt in school into the present problem solving techniques. It creates an awareness towards the importance and significance of an individual's logical abilities.

Course Content

Unit – I

Sharpen your axe!!

Vedic mathematics:

Viniculum and de- viniculum, subtractions using viniculum .Nikhilum multiplication: For numbers close to base values, multiplication of any two digit numbers or three digits number using criss cross method. Finding the square, square root, cubes , cube root of two digit and three digit numbers quickly. Approximation in multiplication and division. Checking the answer using digital sum method

SSC- Get hands on multiplication tables, increasing the speed in basic arithmetic operations. Classification of numbers.

Percentage calculations and ratio comparison:

Percentage calculations: Percentage rule for calculating , percentage values through additions, percentage– fraction table, approximation in calculating percentages. Application based problems

Ratio comparison: calculations method for ratio compressions: 1. the cross multiplication method, 2. percentage value compression method 3. numerator and denominator percentage change method. Method for calculating the value of percentage change in the ratio.

Application based problems.

SSC - Thorough with fractions and decimal values. Applications of tabulated fractions. Product of means and extremes. **8 Hrs**

Unit – II

Analytical Reasoning 1: series

Number series: Standard patterns of number series, pure series: perfect square, square cube, prime, combination of this series. Difference series, ratio series, mixed series, geometric series, two-tier arithmetic series, three-tier arithmetic series, change in the order for difference series, change in the order for ratio series, sample company questions.

Letter series: Alphabet and Alphanumeric series, finding the missing term based on logic learnt in number series module, continuous pattern series, correspondence series. sample company questions.

Picture series : image analysis, addition deletion rotation or modification of lines or shapes. Understanding the symmetry of the image. Mirror image analysis. sample company questions.

SSC - Basic knowledge of letter positions, Different number series for example – even, odd, prime, composite etc **6 Hrs**

Unit – III

Number system:

Introduction, **Integers:** Remainder zero concept, Odd and Even Integers, Negative and positive integers, power number a^x, properties of a perfect square number. **Prime number:** General method to identify the prime number, properties of prime numbers. Euler's number. **Factorial number:** Wilson's theorem, important results on factorial. **Divisor:** number of divisors, sum of divisors, number expressed as the product of two factors.

Divisibility rules: divisibility of a whole number by a whole number, divisibility of an expression by an expression. **Modulus concept:** divisibility rules in modulus, rules of operations in modulus. **Finding one remainder:** One divisor, remainder of $(a^n - b^n)$, remainder for more than one divisor.

Unit digit: Concept of power cycle, finding last two digits**.** Number of trailing zeroes.

SSC -Basic arithmetic operations, knowledge about quotient and remainders, multiples and factors. **6 Hrs**

Unit – IV

Simple equations, Ratio Proportions and Variations:

Simple equations: Linear equations-Linear equations in one variable, linear equation in two variables, Different methods of solving linear equations in two variables– Method of elimination, Method of substitution, Method of cross multiplication. Format of equations that can be converted to linear equations, Linear equations of three variables, Inequalities and its properties. Advanced problems on Simple equations. Age problems.

Ratio Proportions and Variations: Understanding the meaning and difference between ratio, proportion and variation. Properties of ratio, Comparison of more than two quantities, Proportion, Properties of proportion - Componendo, Dividendo, Invertendo, Alternendo. Continued proportion, Mean proportion. Variation - Direct variation, Indirect variation, Joint

variation, Short cut methods to solve problems on variation.

SSC -Knowledge about factors, types of factors. Splitting the middle term rule, formula rule.

6 Hrs

Unit – V

Building the fundamentals of logical reasoning:

Arrangement:

Approach to tackle questions, Different types of arrangement– Linear arrangement, Circular arrangement. Selection, Double line map. Possible ways of arrangement– Words or numbers, left side only, right side only, left right alternate, increasing or decreasing order, interchange vs push, Strategy for solutions– some tips for quick answers, general strategy.

Directions:

Basics. Pythagorean theorem, Pythagorean triplets, Solving problems for practice.

Blood relations:

Some typical relations that we come across, family tree, Structuring the given problem step by step. Suggested methods– Backtracking, drawing family tree. Problems on blood relations and professions.

SSC -Basic knowledge of directions, Pythagoras theorem. Logical reasoning skills, Relations, Family tree. **6 hrs**

Reference Books:

1. The Trachtenberg speed system of basic mathematics, published by Rupa publications.
2. CAT Mathematics by AbhijithGuha. published by PHI learning private limited.
3. Quantitative aptitude by Dr. R. S Agarwal, published by S.Chand private limited.
4. Verbal reasoning by Dr. R. S Agarwal , published by S. Chand private limited.
5. Quantitative aptitude for CAT by Arun Sharma, published by McGraw Hill publication.
6. Analytical reasoning by M.K Pandey BSC PUBLISHING.CO.PVT.LTD

Course Outcomes

After learning all the units of the course, the student is able to:

1. Solve mathematical calculations in less duration compared to the conventional method. L2
2. Give examples for AP, GP and HP and differentiate between them. L1
3. Apply divisibility rules , power cycle method and evaluate the significance of the number system module. L2
4. Point out the errors in the problems concerning inequalities and solve simple equations and problems based on ratio, proportion and variation. L5
5. Solve the problems based on blood relations, directions and arrangement. L4

Course Title : Additional Maths-I			
Course Code : P17MADIP31	Semester : 3	L:T:P:H : 4:0:0:4	Credits: 0
Contact Period: Lecture: 52 Hr. Exam: 3 Hr	Weightage: CIE:50%, SEE:50%		

((Mandatory Learning Course: **Common to All Branches)**

(A Bridge course for Diploma qualified students of III Sem. B. E.)

Course Content

UNIT -I

Complex Trigonometry: Complex Numbers: Definitions & properties. Modulus and amplitude of a complex number, Argand's diagram, De-Moivre's theorem (without proof). Roots of complex number - Simple problems.

Vector Algebra: Scalar and vectors. Vectors addition and subtraction. Multiplication of vectors(Dot and Cross products). Scalar and vector triple products-simple problems.

12Hrs

UNIT -II

Differential Calculus: Review of successive differentiation. Formulae for n^{th} derivatives of standard functions- Liebnitz's theorem(without proof). Polar curves –angle between the radius vector and the tangent pedal equation- Problems. Maclaurin's series expansions-Illustrative examples. Partial Differentiation : Euler's theorem for homogeneous functions of two variables. Total derivatives-differentiation of composite and implicit function. Application to Jacobians, errors & approximations. **10 Hrs**

UNIT -III

Integral Calculus: Statement of reduction formulae for $sin^n x$, $cos^n x$, *and* $sin^m x cos^m x$ and evaluation of these with standard limits-Examples. Differentiation under integral sign(Integrals with constants limits)-Simple problems. Applications of integration to area, length of a given curve, volume and surface area of solids of revolution. **10 Hrs**

UNIT-IV

Vector Differentiation: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl and Laplacian (Definitions only). Solenoidal and irrotational vector fields-Problems.

10 Hrs

UNIT-V

Ordinary differential equations (ODE's): Introduction-solutions of first order and first degree differential equations: homogeneous**,** exact, linear differential equations of order one and equations reducible to above types. Applications of first order and first degree ODE's - Orthogonal trajectories of cartesian and polar curves. Newton's law of cooling, R-L circuits-Simple illustrative examples from engineering field. **10 Hrs**

Text Book:

1. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, New Delhi, 42^{nd} Ed. 2012.

References:

1. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 6^{th} Ed., 2007.
2. N.P.Bali and Manish Goyal: Engineering Mathematics, Laxmi Publishers, 7^{th} Ed., 2007.

4th SEMESTER

Course Title: Engineering Mathematics-IV			
Course Code: P17MAAC41	Semester: IV	L – T – P – H : 4– 1 – 0 – 5	Credits:4
Contact Period - Lecture: 52Hrs. Exam: 3Hrs.		Weightage: CIE: 50%; SEE: 50%	

Prerequisites: The student should have acquired the knowledge of Engineering Mathematics-I, II and III of I, II and III semester B.E.

Course Learning Objectives (CLOs):

This Course aims to;

1. Understand the basics of functions of complex variables, analytic functions, conformal and bilinear transformations, complex integration, line/surface/volume integrals and residue theorems with their scientific/engineering importance
2. Solve algebraic, transcendental and ordinary differential equations arising in various engineering flow and design data problems, using numerical techniques along with physical interpretation of the solutions associated with initial/boundary conditions.
3. Apply the basic tools of statistics to understand curve fitting, moments, skewness, kurtosis, correlation and regression, for frequency distributions; explore the idea of probability, probability distributions, required in the analysis of engineering experiments
4. Apply the basic concepts of probability distributions to understand concept of joint probability and to find expectation covariance, correlation coefficient etc. and to understand probability vector, stochastic matrix etc.
   Understand iterative methods in linear algebra such as Gauss-Jacobi, Gauss -Seidel, Relaxation and Power method and their practical utility in engineering fields.
5. Explain functional and extremal of functional Euler's equation and applications of calculus of variations to the standard variational problems and basic concepts of reliability theory including failure laws required in the analysis of engineering experiments occurring in engineering fields.
   Obtain series solution of essential ODE's such as Bessel's and Legendre's differential equations and understand their scientific/engineering utility

Relevance of the Course:

Engineering Mathematics-IV deals with Complex analysis. Here we understand the basics of complex variable, analyticity and potential fields through complex potential and conformal transformations interpret the solution in fluid flow and electromagnetic problems.

The process of complex integration and series representation of functions of complex variables in field theory and other Engineering applications.

Solving algebraic, transcendental and ordinary differential equations arising in various engineering flow and design data problems.

In Statistics interpretation and analyzing the data, fitting of curves of best fit for experimental data arising in engineering calculations and analyze the same by expressing in the form of regression lines.

Probability distributions and use them in analyzing and solving engineering problems associated with probability models

Variational problems used in structural engineering, aerospace, ground water flows and environmental fluid dynamics, etc

Understand series solution of ODE's and special functions in engineering fields.

Course Content

UNIT-I

Complex Analysis: Introduction to functions of complex variables. Definitions- limit, continuity and differentiability. Analytic functions. Cauchy–Riemann equations in Cartesian and polar forms problems on properties of analytic functions (No proof). Construction of analytic function: Milne-Thomson method. Conformal transformation–Definitions. Discussion of transformations: $w=z^2$, $w=e^z$, $w = z + 1/z\ (z \neq 0)$ Bilinear transformations.

Complex integration: complex line integrals. Cauchy theorem, Cauchy integral formula. Taylor's and Laurent's series (Statements only). Singularities, poles and residues. Cauchy residue theorem (statement only). Simple illustrative examples.

SSC: Derivation of Cauchy- Riemann equation in Cartesian and polar form. Derivation of Cauchy theorem, Cauchy integral formula and Cauchy's residue theorem.

11 Hrs

UNIT-II

Numerical Methods-II: Solution of algebraic and transcendental equations: Bisection method, Regula-False & Newton–Raphson method. Fixed point iteration method: Aitken's Δ^2-process - Illustrative examples only.

Numerical solution of ordinary differential equations (ODE's): Numerical solutions of ODE's of first order first degree – Introduction. Taylor's series method. Modified Euler's method, Runge - Kutta method of IV order, Milne's and Adams predictor & corrector methods (All formulae without proof).

Self-Study Component: Solution of second order ordinary differential equations using Runge-Kutta methods. Solution of first order simultaneous differential equations.

10 Hrs

UNIT-III

Statistics: Brief review of measures of central tendency and dispersion. Moments, skewness and kurtosis. Curve fitting-least square method: $y = a + bx; y = ax^b, y = ab^x$ *and* $y = ax^2 + bx + c$. Prof. Karl Pearson's coefficient of correlation and lines of regression.

Probability Theory: Brief review of elementary probability theory. Random variables (discrete and continuous)-Introduction to probability distributions- probability mass/density functions and cumulative probability density functions – Illustrative examples. Discrete probability distributions- Binomial and Poisson's distributions; Continuous probability distributions - exponential and normal distributions. (No derivation of mean and variance). Illustrative examples from engineering and industrial fields.

SSC: Basic definitions of probability and problems up to Bayes' theorem. To fit curves of the type : $y = ae^{bx}$, Derivation of Mean and SD of Binomial &Poisson distribution**.**

11 Hrs

UNIT-IV

Joint probability distributions and Markov chains:
Concept of joint probability. Joint probability distributions of discrete random variables. Expectation, covariance, correlation coefficient – simple examples. Probability vectors, stochastic matrices. Fixed point and regular stochastic matrices.

Linear Algebra-II: Numerical methods for system of linear equations- Gauss-Jacobi and Gauss- Seidel iterative methods. Relaxation method**.** Determination of largest eigen value and corresponding eigen vector by power method.
SSC: Ramanujan's Method to find the smallest root of a polynomial**.**

10 Hrs

UNIT-V

Calculus of Variations: Variation of a function and a functional, extremal of a functional. Variational problems – Euler's equation. Applications to standard variational problems including geodesics, minimal surface of revolution, hanging chain and brachistochrone problems.

Series solutions of ODE's and special functions: Power series solution of a second order ODE, Series solution-Frobenius method. Series solution leading to $J_n(x)$- Bessel's function of first kind. Expansions for $J_{1/2}(x) and\ J_{-1/2}(x)$. -simple related examples. Series solutions of Legendre's differential equation leading to $P_n(x)$-Legendre's polynomials. Rodrigue's formula (No Proof) - simple illustrative examples.

SSC: Basics of Series solutions of ODE's; analytic, singular point and basic recurrence relations **10 Hrs**

Text Books:

1. Higher Engineering Mathematics: B.S. Grewal, Khanna Publishers, New Delhi, 42nd Ed. 2012.
2. Advanced Engineering Mathematics: - E. Kreyszig, John Wiley & Sons, 10th Ed., 2011

References:

1. Probability: - Seymour Lipschutz, Schaum's outline series, McGraw-Hill publications, **2nd Edition, 2002**.
2. Introductory Methods of Numerical Analysis: - S.S.Sastry, PHI, 3rd Ed.2000.
3. Advanced Modern Engineering Mathematics: - Glyn James, Pearson Education Ltd.,
1. 3rd Edition, 2011.
4. Higher Engineering Mathematics: - B.V. RAMANA, McGraw Hill Education, 2007

Note: - Each unit contains ***two*** full questions of ***20 marks*** each. Students are required to Answer ***five*** full questions choosing at least ***one*** question from each unit.

Course Outcomes

After learning all the units of the course, the student is able to;

1. Explain the concept of analyticity and potential fields through complex functional/potential, conformal transformations and interpret the solution in fluid flow and electromagnetic problems and describe the process of complex integration and learn series representation of a function of complex variables, residues and poles.
2. Apply the familiarity of numerical methods for solving algebraic and transcendental equations and demonstrate single-step and multi-step numerical methods for solving ordinary differential equations and interpret the solution in engineering applications.
3. Apply the knowledge of statistics in interpretation the data, fitting of a linear and non-linear curves of best fit for experimental data arising in engineering calculations and analyze the same by expressing in the form of regression lines. And, Illustrate the concept of random variables (discrete/continuous) and related probability distributions and use them in analyzing and solving engineering problems associated with probability models
4. Define the concept of joint probability of two random variables and apply the knowledge of joint probability distribution in interpreting data through statistical measure. And, analyze the notion of higher transition probabilities, the Markov chain and queuing models arising in engineering problems for feasible random events.
   Understand the procedure of numerically solving large systems of linear algebraic equations and obtaining eigen value and eigen vector corresponding to a large eigen vector, with the aid of standard methods of numerical linear algebra.
5. Explain functional and extremal of functional Euler's equation and applications of calculus of variations to the standard variational problems and basic concepts of reliability theory including failure laws required in the analysis of engineering experiments occurring in engineering fields.
   Obtain series solution of essential ODE's such as Bessel's and Legendre's differential equations and understand their scientific/engineering utility

Course Articulation Matrix
Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	Semester: 4	Course code : P17MAES41	Title : Engineering Mathematics –IV										
CO's	**Statement**		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO-1	Solve algebraic, transcendental and ordinary differential equations arising in various engineering flow and design data problems, using numerical techniques along with physical interpretation of the solutions associated with initial/boundary conditions (Unit-I)		**2**	**2**	-	-	-	-	-	-	-	-	-	-
CO-2	Learn logical thinking and analytical /geometrical skills in linear algebra through vector spaces, basis, dimension and linear transformations along with construction a matrix of linear transformations with respect change of Bases of same or different dimensions. Understand iterative methods in linear algebra such as Gauss-Jacobi, Gauss -Seidel, Relaxation and Power method and their practical utility in engineering fields(Unit-II)		**3**	**3**	-	-	-	-	-	-	-	-	-	-
CO-3	Understand the basics of functions of complex variables, analytic functions, conformal and bilinear transformations, complex integration, line / surface / volume integrals and residue theorems with their scientific / engineering importance (Unit-III)		**3**	**3**	-	-	-	-	-	-	-	-	-	-
CO-4	Apply the basic tools of statistics to understand curve fitting, moments, skewness, kurtosis, correlation and regression, for frequency distributions; explore the idea of probability, probability distributions, required in the analysis of engineering experiments (Unit-IV)		**2**	**2**	-	-	-	-	-	-	-	-	-	-
CO-5	Apply the basic concepts of probability distributions to understand concept of joint probability and to find expectation covariance, correlation coefficient etc and to understand probability vector, stochastic matrix etc. Obtain series solution of essential ODE's such as Bessel's and Legendre's differential equations and understand their scientific/engineering utility (Unit-V)		**3**	**3**	-	-	-	-	-	-	-	-	-	-

Course Title: Fluid Mechanics			
Course Code: P17AU42	Semester: IV	L:T:P:H: 4:0:0:4	Credits: 4
Contact Period-Lecturer: 52Hrs. Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

***Prerequisites*:** Basics of Engineering Mathematics and Engineering mechanics

Course Learning Objectives (CLOs)

This Course aims to

1. Define and analyze the properties of fluids. Identify and solve engineering problems on fluid properties
2. Study and Understand the phenomena associated with Fluid Statics -Pressure & Measurement, Hydrostatic forces and Buoyancy Identify and solve engineering problems on fluid statics
3. Describe the conservation laws that govern fluid motion, Identify and solve engineering problems in Fluid Kinematics
4. Study and analyze Fluid dynamics. Analyze and solve engineering problems involving fluid flow
5. Explain and analyze fluid motion for laminar flow and viscous effects and solve engineering problems involving laminar flow and viscous effects.
6. Define, classify and compute the effect of compressible fluids in the practical scenario
7. Analyzing and solving engineering problems involving fluid flow through pipes considering major and minor energy losses and solve engineering problems on flow lossess.
8. Understand and Apply dimensional techniques in study of fluid mechanics

Relevance of the course

Fluid Mechanics course is an introductory in for Automobile Engineering B.E. Undergraduate programme. The subject Fluid Mechanics has a wide scope and is of prime importance in several fields of engineering and science. Present course emphasizes the fundamental underlying fluid mechanical principles and application of those principles to solve real life problems. Special attention is given towards deriving all the governing equations starting from the fundamental principle. There is a well balanced coverage of physical concepts, mathematical operations along with examples and exercise problems of practical importance. After completion of the course, the students will have a strong fundamental understanding of the basic principles of Fluid Mechanics and will be able to apply the basic principles to analyze fluid mechanical systems.

Course Content

Unit – 1

Properties of Fluids: Introduction, properties of fluids, classifications, viscosity, thermodynamic properties, Surface tension and Capillarity, Vapour pressure and Cavitation
Fluid Statics - Pressure and its Measurement: Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, Absolute, gauge, atmospheric and vacuum pressures, simple manometers, and differential manometers. **10 Hrs**

Unit – 2

Fluid Statics - Hydrostatic forces on surfaces: Total pressure and center of pressure, vertical plane surface submerged in liquid, horizontal plane surface submerged in liquid, inclined plane surface submerged in liquid, and curved surface submerged in liquid.
Buoyancy and floatation: Buoyancy center of buoyancy, meta-center and meta-centric height, conditions of equilibrium of floating and submerged bodies. **10 Hrs**

Unit –3

Fluid Kinematics: Introduction, Types of fluid flow, continuity equation in one and three dimension (Cartesian co-ordinate system only), velocity and acceleration, velocity potential function and stream function for 2D flow and types of motion.
Fluid Dynamics: Introduction, equations of motion, Euler's equation of motion, Bernoulli's equation from Euler's equation, Bernoulli's equation for real fluids. **Fluid flow measurements -**Venturimeter, Orifice meter, Pitot tube. **11 Hrs**

Unit – 4

Laminar flow and viscous effects: Reynold's number, critical reynold's number, Laminar flow through circular pipe-Hagen poiseulle's equation, Laminar flow between parallel stationery plates.
Introduction to compressible flow: Basic equations of compressible flow, Velocity of sound in a fluid, Mach number, Propagation of pressure waves in a compressible fluid, Sonic velocity. **10 Hrs**

Unit – 5

Flow through pipes: Introduction, loss of energy in pipes, Major Energy Losses, Darcy-Weisbach equation for loss of head due to friction in pipes, Chezy's equation for loss of head due to friction in pipes, Minor Energy Losses, hydraulic gradient and total energy line.
Dimensional Analysis: Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Buckingham's ∏ theorem, Rayleigh's method, dimensionless numbers, similitude, types of similitude. **11 Hrs**

Text Books:

1. Dr. Bansal.R.K, Fluid Mechanics by, Lakshmi Publications, 2010.
2. Kumar.D.S, Fluid Mechanics and Fluid Power Engineering," Kataria and Sons.,2010

Reference books:

1. Yunus A, Cenegel, John M,Cimbala, Fluid Mechanics, Fundamental & applications, by Tata MacGraw Hill, 2013
2. John F.Douglas, Janul and M.Gasiosek and john A. Swaffield, Fluid Mechanics Published by Prentice Hall 2011.

Course Outcomes

After learning all the units of the course, the student is able to

CO1. Understand and Explain various properties of fluids, Fluid - statics, kinematics & Dynamics and the basic concepts of Fluid mechanics [L1, L2]

CO2. Apply, Interpret and describe about laminar flow, compressible flow, Energy Losses in Flow through pipes and dimensional analysis about various primary & secondary units. [L2, L3]

CO3. Derive Equations for fluids properties, Fluid - statics, kinematics & Dynamics and their applications. [L3]

CO4. Analyze/Compare, solve engineering problems involving fluid flow pertaining to fluids properties, Fluid - statics, kinematics & Dynamics and their applications. [L3,L4]]

CO5. Analyze and solve engineering problems pertaining fluid flow losses, dimensional analysis techniques and practical applications of fluid mechanics in compressible flow. [L3, L4]

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

CO	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	Understand and Explain various properties of fluids, Fluid - statics, kinematics & Dynamics and the basic concepts of Fluid mechanics [L1, L2]	3	3	-	-	-	-	2	-	1	2	-	2	3	2	-
2	Apply, Interpret and describe about laminar flow, compressible flow, Energy Losses inFlow through pipes and dimensional analysis about various primary & secondary units. [L2, L3]	3	3	-	-	-	-	2	-	1	2	-	2	3	2	-
3	Derive Equations for fluids properties, Fluid - statics, kinematics & Dynamics and their applications. [L3]	3	3	2	2	-	-	2	-	1	2	-	2	3	2	-
4	Analyze/Compare, solve engineering problems involving fluid flow pertaining to fluids properties, Fluid - statics, kinematics & Dynamics and their applications. [L3, L4]	3	3	2	2	-	-	2	-	1	2	-	2	3	2	-
5	Analyze and solve engineering problems pertaining fluid flow losses, dimensional analysis techniques and practical applications of fluid mechanics in compressible flow. [L3, L4]	3	3	2	2	-	-	2	-	1	2	-	2	3	2	-

Course Title: Manufacturing Process-II			
Course Code: P17AU43	Semester: IV	L:T:P:H-4:0:0:4	Credits: 3
Contact Period-Lecturer: 52Hrs.	Exam: 3Hrs	Weightage:CIE:50%; SEE:50%	

Prerequisites: The student should have undergone the course on Elements of Mechanical Engineering, Manufacturing process I

Course Learning Objectives (CLO'S):

This course aims to

1. Recognize appropriate parameters in metal cutting. Explain the Mechanism of chip
2. formation; Merchants circle diagram and Cutting tool materials.
3. Explain types and causes of tool wear, Estimate tool life, Explain Heat generation, Mach inability and cutting fluids.
4. Explain the working principles of Lathes, planning and shaping machines. Classification of Lathes, planning and shaping machines.
5. Classify and explain the working principles of drilling and grinding machines.
6. Explain milling machines, Describe Non-traditional machining processes. Also describe various Surface finishing processes.

Course Content

Unit I

THEORY OF METAL CUTTING: Single point cutting tool nomenclature, geometry, orthogonal and oblique cutting, mechanism of chip formation, types of chips, Merchants circle diagram and analysis, Ernst Merchant's solution, shear angle relationship, problems of Merchant's analysis.

CUTTING TOOL MATERIALS: Desired properties, types of cutting tool materials – HSS, carbides, coated carbides CBN, PCD and ceramics

SSC*:* Concepts of measurement of forces & properties cutting tool **10 Hrs**

Unit -II

TOOL WEAR: causes and types of tool wear, effects of cutting parameters on tool life, tool failure criteria, Taylor's tool life equation, problems on tool life evaluation. Heat generation in metal cutting, factors affecting heat generation, measurement of tool tip temperature. Machinability and factors affecting machinability.

CUTTING FLUIDS: desired properties, types and selection. **10 Hrs**

Unit -III

PRODUCTION LATHES: Introduction, principle and working, part of centre lathe specification different operations, definitions of speed, feed and depth of cut, cutting time calculation, Calculation of change of gears in thread cutting, constructional features of turret and capstan lathes.

SHAPING AND PLANING MACHINES: Classification, specification, constructional features, and driving mechanisms. Shaping and planning operations. Comparison between shaping and planning, Problems on calculation of machining time.

SSC*:* Construction & working of centre lathe **10 Hrs**

Unit- IV

DRILLING MACHINES: Classification, Specification, constructional features, drilling & related operations, types of drill & drill bit nomenclature, machining time.

GRINDING MACHINES: Types of abrasives, bonding process, classification, constructional features of cylindrical and surface grinding machines, tool and cutter grinder, specification of grinding wheel, selection of grinding wheel, balancing of grinding wheel. SSC: Operation of Broaching & Jig Boring machines.

SSC: Use of drilling, shaping and planning machine in industry **10 Hrs**

Unit-V

MILLING MACHINES: Classification, constructional features of Column and Knee type, types of milling cutters, milling cutters nomenclature, Fundamentals of the milling process, milling machine operations, Gear cutting methods, Indexing and Indexing methods, Simple problems on Indexing methods.

Non Traditional Machining Processes: Principle and Operation, LBM, Electro Chemical Machining, AJM and Ultrasonic Machining.

Surface finishing processes: Introduction Lapping, honing, Surface finishing, Polishing, buffing, electroplating, hot dipping, Galvanizing and metal spraying.

SSC: Use of Milling machine and Grinding machine in Industry. **12 Hrs**

Text Books

1. S.K. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy,"Elements of Workshop Technology", Vol-II, -Media Promoters & Publishers Pvt. Ltd. 2007
2. R.K.Jain,"Production Technology" -Khanna Publications, New Delhi, 2003.

References:

1. Amitabha Ghosh and Mallik, "Manufacturing Science"- Affiliated East West Press, 2010. ISBN:8176710636
2. G. Boothroyd, "Fundamentals of Metal Machining and Machine Tools"- McGraw Hill, 2005. **ISBN-10:** 1574446592 **ISBN-13:** 978-1574446593
3. A. Bhatta charya."Theory of Metal cutting & practice"

Course Outcomes

After learning all the units of the course, the student is able to

1. **Able to identify** appropriate parameters in metal cutting. Explain the Mechanism of chip formation; Merchants circle diagram and Cutting tool materials.
2. **Able to explain** types and causes of tool wear;analyze tool life, Explain Heat generation, Mach inability and cutting fluids.
3. **Able to explain** the working principles of Lathes, planning and shaping machines. Classification of Lathes, planning and shaping machines
4. **Able to classify** and explain the working principles of drilling and grinding machines.
5. **Able to explain** milling machines, Describe Non-traditional machining processes. Also describe various Surface finishing processes

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Able to identify** appropriate parameters in metal cutting. Explain the Mechanism of chip formation; Merchants circle diagram and Cutting tool materials.	3	3	1	-	-	2	2	-	-	-	-	2	3	1	-
2	**Able to explain** types and causes of tool wear; analyze tool life, Explain Heat generation, Mach inability and cutting fluids.	3	3	1	-	-	2	2	-	-	-	-	2	3	1	-
3	**Able to explain** the working principles of Lathes, planning and shaping machines. Classification of Lathes, planning and shaping machines	3	2	-	-	-	2	2	-	-	-	-	2	3	1	-
4	**Able to classify** and explain the working principles of drilling and grinding machines.	3	2	-	-	-	2	2	-	-	-	-	2	3	1	-
5	**Able to explain** milling machines, Describe Non-traditional machining processes. Also describe various Surface finishing processes	3	2	-	-	-	2	2	-	-	-	-	2	3	1	-

Course Title: Theory of Machines-I			
Course Code: P17AU44	Semester: IV	L:T:P:H :4:1:0:5	Credits: 4
Contact Period-Lecturer:52 Hrs. Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

Prerequisites: Engineering Mechanics, Engineering Mathematics and Strength of material

Course Learning Objectives (CLOs)

This Course aims to

1. Explain the various mechanisms; calculate the degrees of freedom,
2. Explain the various inversions of four bar chain, single and double slider crank chain.
3. Determine velocity by relative velocity method; calculate the Velocity of different mechanism,
4. Determine number of Instantaneous centres and velocity analysis by Instantaneous centre method.
5. Study various Velocity components in a mechanism. Determine the different component of acceleration of various links, on different elements of four bar mechanisms,
6. Study klien's construction to find velocity and acceleration in slider-crank mechanisms.
7. Classify different types of gears, Explain Spur Gear terminology, law of gearing methods of avoiding interference and Back lash, Derive an expression for Path of contact, arc of contact, contact ratio. Calculate the Path of contact, arc of contact and contact ratio.
8. Explain Simple, Compound and Epicyclic gear trains, Calculate velocity ratio, tooth load and torque in epicyclic gear trains
9. Explain cam and follower types, Explain different follower Motions, Construction of the cam profile.
10. Analysis of tangential cam with roller follower and circular arc cam with flat faced follower.

Course Content

UNIT-I:

INTRODUCTION TO MECHANISMS

Rigid and Resistant bodies, Link, kinematics pairs, degrees of freedom, Grubler's criterion, Kinematic chain, mechanism, structure, Mobility of Mechanism, inversion, Machine Inversions of Four bar chain, Single slider crank chain and Double slider crank chain.

Quick return motion mechanisms-whitsworth mechanisms, Crank and slotted lever mechanisms. Principle of Straight line motion mechanism – Peaucelliers Mechanism, Engine Indicator, Intermittent motion mechanisms- Geneva mechanism and Ratchet and pawl mechanism. Toggle mechanism, Pantograph.

SSC: Use of different inversions of mechanisms and its applications **10 Hrs**

UNIT-II:

VELOCITY ANALYSIS OF MECHANISMS

Introduction to Vectors, Absolute and relative motions, Motion of a link, velocity analysis by relative velocity method, four-link mechanism, slider-crank mechanism, crank and slotted lever mechanism. Instantaneous centre, number of I- centres, Kennedy's theorem, locating I-centres, velocity analysis by I-centre method.

SSC: Velocity analysis of Toggle mechanism. **10 Hrs**

UNIT-III :

ACCELERATION ANALYSIS OF MECHANISMS

Total acceleration of a link, acceleration of a point on a link, acceleration diagram for four bar mechanism, slider-crank mechanism, coriolis acceleration component, acceleration diagram for crank and slotted lever quick return motion mechanism, klien's construction to find velocity and acceleration in single slider crank mechanism.

SSC: Klein's construction, velocity and acceleration from displacement-time curve **10 Hrs**

UNIT-IV:

GEARS AND GEAR TRAINS

Classification & application of different types of gears, Spur Gear terminology, law of gearing, gear tooth profiles, Path of contact, Arc of contact, Contact ratio, Interference in involute gears.

Simple gear trains, Compound gear trains, Epicyclic gear trains, Tabular methods of finding velocity ratio of epicyclic gear trains.

SSC: Uses of different gears and gear trains **12 Hrs**

UNIT V

CAMS

Types of cams, types of followers, Follower Motions including SHM, Uniform velocity, uniform acceleration and retardation and Cycloidal motion. Disc cam with reciprocating follower having knife edge, roller and flat faced follower. Disc cam with oscillating follower. Analysis of tangential cam with roller follower and circular arc cam with flat faced follower.

SSC: Displacement diagram and cam profile for a four stroke IC Engine. **10 Hrs**

Text Books:

1. Rattan S.S. "Theory of Machines" Tata McGraw-Hill Publishing Company Ltd. New Delhi and 3rd edition 2009. ISBN 10: 007014477X / ISBN 13: 9780070144774
2. V P Singh, "Theory of Machines" Publisher, Dhanpat Rai Publishing Company (P) Limited, 2004. ISBN 8177000527, 9788177000528

Reference Books :

1. Thomas Bevan, " Theory of Machines-I", CBS Publications, New Delhi.2010
2. Shigley. J.V. and Uickers, J. J., " Theory of Machines & Mechanisms" OXFORD University Press.4th edition 2010
3. R.S.Khurmi and J.K.Gupta, Theory of Machines S.Chand and Co.2015. ISBN 10: 812192524X / ISBN 13: 9788121925242

Course OutComes

1. **Ability to identify** various mechanisms, create inversions of planar four bar chain and calculate degrees of freedom of mechanisms.
2. **Ability to analyze** velocity of simple planar mechanisms using graphical methods.
3. **Ability to analyze** Acceleration of simple planar mechanisms using graphical methods.
4. **Ability to classify** different types of gears and Analyze geometric and meshing characteristics of spur gears. Analyze kinematic characteristics of gear drive
5. **Ability to design** cam profiles for different follower motions and determine kinematic characteristics of the follower.

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Ability to identify** various mechanisms, create inversions of planar four bar chain and calculate degrees of freedom of mechanisms.	2	2	-	-	-	2	-	-	-	-	-	2	3	-	-
2	**Ability to analyze** velocity of simple planar mechanisms using graphical methods.	3	3	2	-	-	2	-	-	-	-	-	2	2	2	-
3	**Ability to analyze** Acceleration of simple planar mechanisms using graphical methods.	3	3	-	-	-	2	-	-	-	-	-	2	2	2	-
4	**Ability to classify** different types of gears and Analyze geometric and meshing characteristics of spur gears. Analyze kinematic characteristics of gear drive	3	2	-	-	-	2	-	-	-	-	-	2	3	2	-
5	**Ability to design** cam profiles for different follower motions and determine kinematic characteristics of the follower.	2	2	-	-	-	2	-	-	-	-	-	2	2	2	-

Course Title: Computer Aided M/c Drawing			
Course Code: P17AU45	Semester: IV	L:T:P:H -2:0:4:6	Credits: 4
Contact Period-Lecturer:52 Hrs. Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

Prerequisites: Basics of Engineering Graphics, Drawing conventions, Sketching, Navigation Commands, Graphic interface of Software, Starting New Drawing Sheet, Sheet Sizes, Naming a Drawing, Drawing Units.

Course Learning Objectives (CLOs)

This Course aims to

1. Sketch 2D and 3Ddrawings manually & using drawing software. Solve Problems on Sections of Solids resting on their bases and sketch true shape of sections.
2. Interpret Pictorial views of simple machine parts &Sketch Orthographic Projections of the same.
3. Distinguish and Sketch Various Thread forms as per the standard dimensions.
4. Distinguish and Sketch Various Fasteners as per the standard dimensions.
5. Sketch Various Keys, Couplings as per the standard dimensions
6. Sketch Various Riveted joints as per the standard dimensions
7. Sketch Proportionate/to scale Automotive Engine components.
8. Sketch and create 2D & 3D part drawings of different of Machine components, then assemble the 3D part drawings to Create an Assembled view of the complete Machine component and Create 2D drawings of Assembled view with required views along with 3D drawings

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Relevance

Computer Aided M/c Drawing is an introductory course in Automobile Engineering for B.E. Under graduate programme. Profound skills in computer-aided methods are of growing importance for every engineer in all fields of professional activity. The fourth-semester course in Automobile Engineering (CAMD) is designed to broaden and increase the knowledge and practical use of computer-aided techniques in Automobile engineering. This course specifically addresses the needs of the practicing Automobile engineer. Its focus lies on the development and application of computer-aided methods and systems at all stages of product development, from the initial conception of machines to the manufacturing process.

Course contents

UNIT-I (2D Only)

Introduction: Review of graphic interface of the software. Review of basic sketching commands and navigational commands. Starting a new drawing sheet. Sheet sizes. Naming a drawing. Drawing units, grid and snap.

Sections of Solids: Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on, axis inclinations, spheres and hollow solids). True shape of sections.

Orthographic views: Conversion of pictorial views into orthographic projections of simple machine parts (Bureau of Indian Standards conventions are to be followed for the drawings) Hidden line conventions. Precedence of lines.

SSC: Review of graphic interface of the software. Review of basic sketching commands and navigational commands. Starting a new drawing sheet. Sheet sizes. Naming a drawing. Drawing units, grid and snap. **9 Hrs**

UNIT-II (2D Only)

Thread Forms: Thread terminology, forms of threads – BSW Thread, Sellers thread, ISO Metric thread, square and Acme thread. Conventional representations of threads.

Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly). Types of Bolt heads, special types of nuts, locking of nuts, Studs, set screws, grub screws.

SSC: Types of Bolt heads, special types of nuts, locking of nuts, Studs, set screws, grub screws. **8 Hrs**

UNIT-III (2D Only)

Keys and Couplings: Types of Keys, Split Muff coupling, flanged coupling (un-Protected and Protected type), Pin type flexible coupling, Oldham's coupling and universal coupling (Hooks' Joint)

Riveted Joints: lap joints- single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag, using snap head rivets)

SSC: Oldham's coupling and universal coupling (Hooks' Joint) **9 Hrs**

Automotive Components: Clutch lever, Spark plug, IC Engine valve, Valve tappet lever, crank lever, rocker arm, Cylinder liner, Cylinder and Cylinder head of two stroke petrol engine, Crank shaft and cam shaft, stub axle. **8 Hrs**

UNIT-V (2D and 3D)

Assembly Drawings

Assembly drawing of following machine parts (3D parts to be created and assembled and then getting 2D drawing with required views, along with 3D part drawings).

1. Plummer block (Pedestal Bearing) 2. Piston, 3. Connecting rod
4. Screw jack 5. Fuel Injector 6. Clutches (Single and multi Plate)

SSC: Fuel Injector Clutches (Single and multi Plate) **18 Hrs**

Text books:

1. N.D.Bhat & V.M.Panchal Machine Drawing, 2011
2. R.B.Gupta, Automobile Engineering Drawing, , Satya Prakashan, New Delhi, 2009. **ISBN-10:** 8176841471 **ISBN-13:** 978-8176841474
3. K.R. Gopala Krishna Machine Drawing, Subhash Publication, 2013

Reference Books

1. VTU, A Primer on Computer Aided Machine Drawing', Published by, Belgaum, 2007
2. S. Trymbaka Murthy, A Text Book of Computer Aided Machine Drawing, CBS Publishers,New Delhi, 2007
3. Sidheshwar, Machine Drawing, Tata McGraw-Hill, New Delhi, 2001

Course Outcomes

After learning all the units of the course, the student is able to

CO1. **Analyze** and Solve different exercises on Sections of Solids and Orthographic views using drawing software[L3,L4]

CO2. **Distinguish** and Sketch Various Thread forms and Fasteners as per the standard dimensions[L3]

CO3. **Distinguish** and Sketch, using standard dimensions, Various Keys, Couplings and Riveted joints.[L3]

CO4. **Distinguish** and Sketch, using standard dimensions Proportionate/to scale Couplings and Automotive Engine components.[L3]

CO5. **Sketch and develop** 2D & 3D part and assembled drawings of different of Machine components using Solid Edge software tool.[L3,L6]

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

CO	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Analyze** and Solve different exercises on Sections of Solids and Orthographic views using drawing software[L3, L4]	3	3	-	-	3	2	1	2	2	2	-	2	3	2	`3
2	**Distinguish** and Sketch Various Thread forms and Fasteners as per the standard dimensions[L3]	3	3	-	-	3	2	1	2	2	2	-	2	3	2	3
3	**Distinguish** and Sketch, using standard dimensions, Various Keys, Couplings and Riveted joints.[L3]	3	3	-	-	3	2	1	2	2	2	-	2	3	2	3
4	**Distinguish** and Sketch, using standard dimensions Proportionate/to scale Couplings and Automotive Engine components.[L3]	3	3	-	-	3	2	1	2	2	2	-	2	3	2	3
5	**Sketch and develop** 2D & 3D part and assembled drawings of different of Machine components using Solid Edge software tool. [L3, L6]	3	3	-	-	3	2	1	2	2	2	-	2	3	2	3

Course Title: Heat Transfer			
Course Code: P17AU46	Semester: IV	L:T:P:H 4:0:0:4	Credits: 4
Contact Period-Lecturer: 52Hrs. Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

Prerequisites:

This subject requires the student to know about the basics of engineering mathematics, basic laws of physics, thermodynamics and fluid mechanic

Course Learning Objectives (CLOs)

This Course aims to

1. Demonstrate and understanding of fundamental principles and laws of conduction, convection, and Radiation modes of heat transfer
2. Formulate, solve and analyze one dimensional steady state heat transfer,
3. Formulate, solve and analyze one dimensional un steady state heat transfer
4. Formulate, solve and analyze one dimensional extended surfaces
5. Formulate, solve and analyze one dimensional critical thickness of insulation
6. Formulate, solve and analyze one dimensional forced convection heat transfer problems
7. Formulate, solve and analyze one dimensional free convection heat transfer problems
8. Formulate, solve and analyze one dimensional application like flow over flat plate etc.
9. Understanding of basic principle of heat exchanger analysis and thermal design
10. Apply laws of radiation heat transfer to solve engineering problems
11. Demonstrate application of knowledge to related problems in an automobile.

Course Content

UNIT-I

Introductory concepts and definitions: - Modes of heat transfer; Basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity; convective heat transfer coefficient; Radiation heat transfer coefficient; combined heat transfer mechanism. Conduction - Basic Equations: - General form of one dimensional heat conduction equation in rectangular, cylindrical and spherical coordinates. Discussion (no derivation) on three dimensional conduction in rectangular, cylindrical and spherical coordinate systems. Boundary conditions of first, second and third kinds; Illustrative problems on mathematical formulation of conduction problems

SSC: Illustrative problems on mathematical formulation of conduction problems

12 Hrs

UNIT-II

One-dimensional Steady state conduction: - Steady state conduction in a slab, in a cylinder and in a sphere without and with heat generation; overall heat transfer coefficient for a composite medium; thermal contact resistance; critical thickness of insulation; Steady state conduction in fins of uniform cross section long fin, fin with insulated tip and fin with convection at the tip; fin efficiency; conduction in solids with variable thermal conductivity**.**

SSC: Conduction in solids with variable thermal conductivity**.** **12 Hrs**

UNIT-III

One-dimensional Transient conduction :- Conduction in solids with negligible internal temperature gradients (Lumped system analysis); Use of Transient Temperature charts (JeiSSCr 's Charts) for transient conduction in slab, long cylinder and sphere; Use of transient temperature charts for transient conduction in semi infinite solids. **Forced Convection**: - Application of dimensional analysis for forced convection problems. Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Use of various correlations for hydrodynamically and thermally developed flows; use of correlations for flow over a flat plate, over a cylinder and across a tube bundle. **10 Hrs**

UNIT-IV

Free or Natural convection :- Application of dimensional analysis for free convection-physical significance of Grashoff number; Use of correlations for free convection from or to vertical, horizontal and inclined flat plates, vertical and horizontal cylinders. Heat Exchangers: - Classification of heat exchangers; overall heat transfer coefficient, Fouling and fouling factor; LMTD and NTU methods of analysis of heat exchangers.

SSC: NTU methods of analysis of heat exchangers. **10 Hrs**

UNIT-V

Radiation Heat Transfer :- Thermal radiation; Definitions of various terms used in radiation heat transfer; Stefan-Boltzman law, Kirchoff's law, Planck's Law and Wein's displacement law' Radiation heat exchange between two parallel infinite black surfaces, between two parallel infinite gray surfaces; Effect of radiation shield; Intensity of radiation and solid angle; Lambert's Law; Radiation heat exchange between two finite surfaces **.** **10 Hrs**

Text Books:

1) P.K. Nag, Heat Transfer by Tata Mc Graw Hill 3rd edition 2011. ISBN 10: 0070702535 / ISBN 13: 9780070702530
2) M Necats Osisik , Heat Transfer- A Basic approach by Mc Graw Hill International Ed 1988

Reference Books:

1) Yunus A Cengel, Heat transfer a practical approaches by Tata Mc Graw Hill 2003. ISBN0072458933, 9780072458930
2) Kreith Thomas, Principles of Heat Transfer by learning 2001.
3) Frank. P. Incropera and David. P, Fundamentals of Heat and Mass Transfer by Dewitt Jhon wiley and Sons 7th edition 2011. **ISBN-10:** 0470917857 **ISBN-13:** 978-0470917855

Course Outcomes

After learning all the units of the course, the student is able to

1. **Able to formulate** to solve problems in fundamentals of heat transfer modes
2. **Able to apply** basic equations of heat conduction in steady one dimensional problems and design of fins
3. **Able to formulate**, solve transient conduction and forced convection problems
4. **Able to formulate**, solve in free convection problems .design of heat exchangers
5. **Able to apply** the concepts of radiation heat transfer to solve problems

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Able to formulate** to solve problems in fundamentals of heat transfer modes	3	3	2	-	-	1		-	-	-	-	2	3	2	-
2	**Able to apply** basic equations of heat conduction in steady one dimensional problems and design of fins	3	3	2	-	-	1	-	-	-	-	-	2	3	2	-
3	**Able to formulate**, solve transient conduction and forced convection problems	3	3	2	-	-	1	-	-	-	-	-	2	3	2	-
4	**Able to formulate**, solve in free convection problems .design of heat exchangers	3	3	2	-	-	1	-	-	-	-	-	2	3	2	-
5	**Able to apply** the concepts of radiation heat transfer to solve problems	3	3	2	-	-	1	-	-	-	-	-	2	3	2	-

Course Title: Fuel Testing and Measurement Lab			
Course Code: P17AUL47	Semester: IV	L:T:P:H -1:0:2:3	Credits: 1.5
Contact Period-Lecturer: 39Hrs. Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

Prerequisites:

1. Subject requires student to know about
2. Properties of fuel used in I C engines
3. Properties of lubricants used in I C engines
4. Automotive engines operation
5. Use of different instruments used in automotive industry/ workshop

Course learning objectives (CLOS)

1. Determine the properties of any given fuel.
2. Determine the properties of any given lubricating oil.
3. Draw a valve timing /port timing diagram for an engine
4. Determine the coefficient of discharge of venturi meter, orifice meter.
5. Calibrate the instruments used in automobile lab like pressure gauge, thermocouple, load cell and micrometer etc.,

Course Content

Part-A

1. Determination of flash and fire point of lubricating oil using abel pensky martins apparatus.
2. Determination of calorific value of solid, liquid and gaseous fuels.
3. Determination of viscosity of a lubricating oil using Redwoods, say bolts and torsion viscometer.
4. Valve timing/port opening diagram of an I C engine.
5. Measurement of areas of irregular figures using planimeter.
6. Determination of compression ratio

Part –B

1. Calibration of pressure gauge
2. Calibration of thermocouple
3. Calibration of load cell.
4. Calibration of vernier caliper and micrometer.
5. Measurement of angle using sine bar/ sine center / bevel protractor.
6. Determination of coefficient of discharge of venturi meter, orifice meter.

Course Outcomes

After learning all the units of the course, the student is able to

1. **Determine** the properties of any given fuel
2. **Determine** the properties of any given lubricating oil.
3. **Analyze** a valve timing /port timing diagram for an engine
4. **Determine** the coefficient of discharge of venturi meter, orifice meter
5. **Calibrate** the instruments used in automobile lab like pressure gauge, thermocouple, load cell and micrometer etc.,

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Determine** the properties of any given fuel	3	2	2	2	2	1	-	-	1	2	-	2	3	2	2
2	**Determine** the properties of any given lubricating oil.	3	2	2	2	2	1	-	-	1	2	-	2	3	2	2
3	**Analyze** a valve timing /port timing diagram for an engine	3	2	2	2	2	1	-	-	1	2	-	2	3	2	2
4	**Determine** the coefficient of discharge of venturi meter, orifice meter	3	2	2	2	2	1	-	-	1	2	-	2	3	2	2
5	**Calibrate** the instruments used in automobile lab like pressure gauge, thermocouple, load cell and micrometer etc.,	3	2	2	2	2	1	-	-	1	2	-	2	3	2	2

Course Title: M/c shop Practice			
Course Code: P17AUL48	Semester: IV	L:T:P:H -1:0:2:3	Credits: 1.5
Contact Period-Lecturer: 39Hrs. Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

Prerequisites: The student should have studied Elements of Mechanical Engineering and Manufacturing Processes

Course Learning Objectives:

At the end of the Course the students should be,

1. Student should be able to understand different machine tools like Lathe, Milling, Drilling, Grinding and Shaping machines
2. Student will learn different operations of lathe; Facing, Plain turning, step turning, taper turning thread cutting and knurling- at least three models.
3. Student will able to do calculations of taper turning, thread cutting.
4. Student will able to do operations on Drilling machine.
5. Student will able to do operations on Shaping machine for two models.
6. Student will learn different operation on milling machine for gear cutting

Part-A

1. Introduction to cutting tools, Machine tools and preparing the layout of machine shop.
2. Preparation of models on lathe involving Facing, Plain turning, Taper turning, Step turning.
3. Thread cutting, Knurling.
4. Boring and Reaming operations.
5. Drilling operations.
6. Eccentric turning.

Part -B

1. Machining V Groove Rectangular groove using Shaping machine
2. Gear Teeth cutting using Milling Machine

Course Outcomes

After learning all the units of the course, the student is able to

1. **Identify** the machine and tools for different operations
2. **use** practical base knowledge in different machining operations
3. **Demonstrate** effective skills in the development and presentation of team projects.
4. **Exhibit** knowledge and skills consistent with the expectations
5. **Practicing** engineering technologist.

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	**Identify** the machine and tools for different operations	3	2	-	-	2	-	2	-	2	-	2	1	2	1	-
2	**use** practical base knowledge in different machining operations	3	2	-	-	2	-	2	-	2	-	2	1	2	1	-
3	**Demonstrate** effective skills in the development and presentation of team projects.	3	2	-	-	2	-	2	-	2	-	2	1	2	1	-
4	**Exhibit** knowledge and skills consistent with the expectations	3	2	-	-	2	-	2	-	2	-	2	1	2	1	-
5	**Practicing** engineering technologist.	3	2	-	-	2	-	2	-	2	-	2	1	2	1	-

Course Title : Aptitude and Reasoning Development - Intermediate (ARDI)			
Course Code : P17HU49	Semester : IV	L - T - P : 2-0 - 0 - 2	Credits: 01
Contact Period: Lecture: 32 Hr. Exam: 3 Hr	Weightage: CIE:50%;SEE:50%		

Prerequisites: ARDB

Course Learning Objectives (CLOs)

This course aims to

1. Explain proportionality rule, average speed, relative speed and concepts in circular track.
2. Explain the application of time, speed distance in solving problems related to races, trains, boats and streams, and clocks.
3. Explain different methods to calculate number of smaller cubes, the date and the day of any year and the concepts of clocks.
4. Explain the methodology of strengthening or weakening the given statement.
5. Explain application of Venn diagrams in solving set theory problems.
6. Explains the concept of syllogism and provides the methodology to tackle the problems.
7. Describes all the important properties of triangle, polygons, circle and other geometrical figures and solve application based questions.
8. Describe the properties of cone, cylinder, sphere, cube and cuboid and solve the application based questions.
9. Differentiates between individual work and group work.
10. Integrates the concept of individual work in solving problems related to pipes and cisterns

Relevance of the course:

4th semester deals with more of quantitative aptitude. It is the intermediate level of aptitude which involves modules like Time speed distance. Time and work, set theory. This course also touches upon logical abilities through modules like cubes and Calendars.

Course Content

Unit – I

Time, Speed and Distance:

Concept of motion and mathematical representation of motion, The rule of proportionality, Conversion between kmph to m/s, Concept of average speed and its application in different scenarios, Relative speed– Importance, application and observation in day to day life, same direction and opposite direction, An application of allegation in Time speed and distance, Trains– Different scenarios. Boats and streams– resultant speed, upstream and downstream concept. Circular motion– Two or three bodies meeting at the starting point or anywhere in the track. Races– Concept of head start, solving problems under different constraints. Application of solving problems under Clocks.

SSC: Basic relation between the 3 different quantities. Conversions between different units of measurement. Speed and velocity. **6 Hrs**

Unit – II

Cubes, Clocks & Calendars:

Cubes: Number of faces, vertices and edges. Colored cubes. Number of colored faces and the formulae to find-out the same. Problems on cubes.

Clocks & Calendars: Minute spaces. Hour hand and minute hand. Angle between the hands. Relative speed. Faulty clocks. Time gained or lost by the clock. Odd days. Leap year. Ordinary year. Counting of odd days. Problems on clocks and calendars.

Self-study Component- Knowledge about shapes and dimensions, Area and volume. Leap year, number of days. Important dates. **8 Hrs**

Unit – III

Set theory and Venn diagram: Set builder form, Tabular form, Venn diagram, Types of sets, Operation of sets using venn diagram, Important properties, Algebraic laws of sets, Maxima and minima in set operation, Venn diagram for four sets.

Syllogism: Meaning of syllogisms, Format of problems and standard qualifiers, Concept of distribution, Standard question pattern, Application of venn diagram to solve problems.

Logical Venn diagrams: Analysis of the given problem and solve it.

Self-study Component- Basics about sets, operations using venn diagram. Basic applications. **6 Hrs**

Unit – IV

Geometry and Mensuration:

Theory, straight lines, triangles– theorems, area, lines inside triangle and geometric centre, Special property of an equilateral triangle, Application of Pythagoras theorem, Congruency and similarity of triangles, Basic proportionality theorem, Polygons, Quadrilaterals, Trapezium, Parallelogram, Rectangle, Rhombus, Square, Division of polygons, Circumscribed and Inscribed polygons, Concyclic points concept, Cyclic quadrilateral, Circle– Radius, Area and perimeter, Arc, Chord, Sector, Segment, Tangent, Secant, Area of common region Solid figures– Introduction, Classification of a solid, Net of a solid, Cuboid, Cube, Right cylinder, Pyramid– right pyramid, triangular pyramid, Cone– frustum of a cone, Sphere, Combination of solid.

Co-ordinate geometry:

Cartesian coordinate geometry– rectangular coordinate axis, distance formula, Section formula, Area of a triangle, Centre of gravity or Centroid of a triangle, In-centre of a triangle, Circumcentre of a triangle, Orthocentre of a triangle, Collinearity of three points, Slope of a line, Different forms of equations of a straight line, Perpendicularity and parallelism, Length of perpendicular.

Self-study Component-Basics of geometry, formula, dimensions, shapes. Different types of lines. Example – parallel, intersecting etc… **8 Hrs**

Unit – V

Time and Work:

Relationship between time and work. Importance of efficiency, Conventional method of solving problems, L.C.M method, Negative work, The specific case of building a wall, Group work, Constant product rule, When work is not constant, Pipes and cistern– Similarity

of logic.

SSC: LCM methods, basic arithmetic. Fractions and efficiency. **4 Hrs**

Reference Books:

1. The Trachtenberg speed system of basic mathematics, published by Rupa publications.
2. CAT Mathematics by AbhijithGuha. published by PHI learning private limited.
3. Quantitative aptitude by Dr. R. S Agarwal, published by S.Chand private limited.
4. Verbal reasoning by Dr. R. S Agarwal , published by S. Chand private limited.
5. Quantitative aptitude for CAT by Arun Sharma, published by McGraw Hill publication.
6. Analytical reasoning by M.K Pandey BSC PUBLISHING.CO.PVT.LTD

Course Outcomes (CO)

After learning all the units of the course, the student is able to:

1. Solve problems of higher difficulty level with ease in the following topics– Time , speed and distance and Geometry. L5
2. Analyze the number of colored faces in a cube when it is cut into different number of pieces and solve the problems under clocks and calendars. L5
3. Apply the concept of L.C.M in the module time and work to solve the problems with comprehension. L2
4. Analyze the concepts in Co-ordinate geometry by spatial visualization. L4
5. Interpret the logic in the statements of syllogism by critical thinking and apply venn diagram for the effectives ways of deriving at the conclusion. L4
6. Determine the solutions for complicated problems of set theory using the concept of venn diagram. L4

Course Title : Additional Mathematics-II			
Course Code : P17MADIP41	Semester : 4	L :T:P:H : 4:0:0:4	Credits: 0
Contact Period: Lecture: 52 Hr. Exam: 3 Hr		Weightage: CIE:50%, SEE:50%	

((Mandatory Learning Course: **Common to All Branches)**

(A Bridge course for Diploma qualified students of IV Sem. B. E.)

Course Content

UNIT –I

Linear Algebra: Introduction - Rank of matrix by elementary row operations - Echelon form of a matrix. Consistency of system of linear equations - Gauss elimination method. Gauss-Jordan and LU decomposition methods. Eigen values and eigen vectors of a square matrix. Application of Cayley-Hamilton theorem(without proof) to compute the inverse of a matrix-Examples. **10 Hrs**

UNIT –II

Higher order ODE's: Linear differential equations of second and higher order equations with constant coefficients. Homogeneous /non-homogeneous equations. Inverse differential operators. Solutions of initial value problems. Method of undetermined coefficients and variation of parameters. Solution of Cauchy's homogeneous linear equation and Legendre's linear differential equation. **14 Hrs**

UNIT –III

Multiple Integrals: Double and triple integrals-region of integration. Evaluation of double integrals by change of order of integration.

Vector Integration : Vector Integration :Integration of vector functions. Concept of a line integrals, surface and volume integrals. Green's, Stokes's and Gauss theorems (without proof) problems. Orthogonal curvilinear coordinates. **10 Hrs**

UNIT –IV

Laplace transforms: Laplace transforms of elementary functions. Transforms of derivatives and integrals**,** transforms of periodic function and unit step function-Problems only. Inverse Laplace transforms: Definition of inverse Laplace transforms. Evaluation of Inverse transforms by standard methods. Application to solutions of Linear differential equations and simultaneous differential equations. **12 Hrs**

UNIT –V

Probability: Introduction. Sample space and events. Axioms of probability. Addition and multiplication theorems. Conditional probability – illustrative examples. Bayes's theorem-examples. **06 Hrs**

Text Book:

1. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, New Delhi,42nd Ed. 2012.

References:

1.E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 6th Ed., 2007
2.N.P.Bali and Manish Goyal: Engineering Mathematics, Laxmi Publishers,7th Ed., 2007.