SYLLABUS

(With effect from 2018 - 19 Academic year)

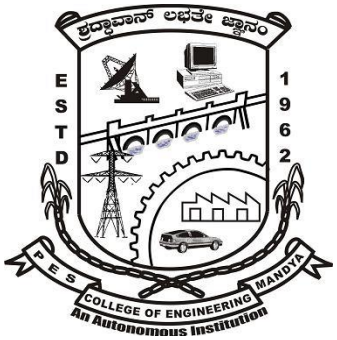
ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕವರ್ಷ 2018–19)

III & IV SEMESTER

BACHELOR DEGREE
IN
MECHANICAL 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)

Ph : 08232- 220043, Fax : 08232 – 222075,Web : www.pescemandya.org

PREFACE

PES College of Engineering, Mandya, started in the year 1962, has become autonomous institute in the academic year 2008-09. Since, then it has been doing the academics and assessment activities successfully. The college is running eight undergraduate and eight Postgraduate programs including MBA and MCA which are affiliated to VTU, Belagavi.

India has recently become a Permanent Member of 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. The implementation of Outcome Based Education (OBE) has been the core issue for enabling the equivalence and of Indian degrees and their mobility across the various countries.

Our Higher Educational Institution has adopted the Choice Based Credit System (CBCS) based semester structure with OBE scheme and grading system. Which provides the flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. There lies a shift in thinking, teaching and learning process moving towards Students Centric from Teachers Centric education which enhances the knowledge, skills & moral values of each student.

Choice Based Credit System (CBCS) provides the options for the students to select from the number of prescribed 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 for learning which enables integration of concepts, theories, techniques. These are greatly enhances the skill/employability of students.

In order to increase the Industry/Corporate readiness, many Soft Skills, self learning components and Personality Development modules have been added to the existing curriculum. In order to enhance creativity and innovation Mini Project and Industrial visit & Interaction are made mandatory for all undergraduate programs.

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

Dr. Nagarathna
Dean (Academic)
Professor,
Dept. of Electrical & Electronics Engg.

PES College of Engineering

Vision

"*A* leading institution imparting quality engineering and management education developing creative and socially responsible professionals"

Mission

Mission of P E S College of Engineering is to,

- 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.

About the Department of Mechanical Engineering

The department of Mechanical Engineering was established in the year 1962 during the origination of the institute. The department was granted academic autonomy in the year 2009.
The department presently offers B.E in Mechanical Engineering, M Tech in Computer Integrated Manufacturing (CIM), M Tech in Machine Design, M.Sc., (Engg.) by research and research leading to Ph.D. The present intake capacity of the department is 120 for BE, 18 for M Tech CIM and 24 for M Tech Machine Design. The department has a faculty-student ratio of 1:15 for UG courses and 1:12 for PG courses. The department has well established laboratories to meet the academic requirements of UG and PG programmes and a skilled technical faculty to train the students. The department has its own library which has a collection of about 3861 reference books.
The department has been NBA accreditated for 3Years in 2017.
The department regularly organizes industrial visits, technical lectures by experts from industries and institutes in contemporary areas to bridge the gap between syllabi and current developments. The students are encouraged to undergo industrial training as well as to take up industry oriented projects during their academic course. Mechanical Engineering Association, formed by the students and faculty of the department regularly organizes cocurricular and extracurricular activities for the students.

Department Vision

"Be a department well recognized for its ability to develop competent mechanical engineers capable of working in global environment"

Department Mission

The Mission of the Department of Mechanical Engineering is to:

- Provide quality education by competent faculty.
- Provide adequate infrastructure and learning ambience for the development of essential technical skills.
- Inculcate a sense of higher education and research orientation.
- Foster industry interaction.

Program Educational Objectives (PEOs)

The Department of Mechanical Engineering has formulated the following programme educational objectives for the under-graduate program in Mechanical Engineering:

The Mechanical Engineering graduates will be able to:

PEO1: Use the fundamentals of basic science, mathematics and mechanical engineering, to pursue their career as engineers as well as to lead and manage teams in global organizations.

PEO2: Pursue advanced education, research and development and engage in the process of life-long learning.

PEO3: Become entrepreneurs in a responsible, professional and ethical manner to serve the society.

Program Outcomes (POs)

Engineering Graduates will be able to:

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, review 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, and 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. (ME)**

Sl. No.	Course Code	Course Title	Teaching Dept.	Hrs/Week			Total Credit	Examination Marks		
				L	T	P		CIE	SEE	Total
1.	P18MA31	Transform calculus, fouries and numerical techniques	Maths	4	-	-	4	50	50	100
2.	P18ME32	Material Science & Metallurgy	Mechanical	2	2	-	3	50	50	100
3.	P18ME33	Fluid Mechanics	Mechanical	2	2	-	3	50	50	100
4.	P18ME34	Manufacturing Process-I	Mechanical	2	2	-	3	50	50	100
5.	P18ME35	Basic Thermodynamics	Mechanical	2	2	-	3	50	50	100
6.	P18ME36	Computer Aided Machine Drawing	Mechanical	-	-	6	3	50	50	100
7.	P18MEL37	Fluids Measurement Lab	Mechanical	-	-	3	1.5	50	50	100
8.	P18MEL38	Foundry & Forging Lab	Mechanical	-	-	3	1.5	50	50	100
9	P18HU39	*Aptitude and Reasoning Development - BEGINNER (ARDB)	HS&M	2	-	-	-	(50)	--	--
10	P18HUDIP310	*Comprehensive Communication Development(CCD)	HS & M	2	-	-	[2]	[50]	[50]	[100]
11	P18HUDIP311	* Indian Constitution, Human Rights & Professional Ethics(CHRPF)	Human& Science	2	-	-	-	--	---	---
12	P18MADIP31	*Additional Mathematics-I	Maths	4	-	-	-	--	---	---
Total							22[24]	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 completion of VI- Semester**

*** ARDB: All students shall have to pass this mandatory learning courses before completion of VI- Semester**

Scheme of Teaching and Examination **IV Semester B.E. (ME)**

Sl. No.	Course Code	Course Title	Teaching Dept.	Hrs/Week			Total Credit	Examination Marks		
				L	T	P		CIE	SEE	Total
1.	P18MA41	Complex analysis, statistics, probability and numerical techniques	Maths	4	-	-	4	50	50	100
2.	P18ME42	Applied Thermodynamics	Mechanical	2	2	-	3	50	50	100
3.	P18ME43	Mechanical Measurements & Metrology	Mechanical	2	2	-	3	50	50	100
4.	P18ME44	Mechanics of Materials	Mechanical	2	2	-	3	50	50	100
5.	P18ME45	Kinematics of Machinery	Mechanical	2	2	-	3	50	50	100
6.	P18ME46	Manufacturing Process –II	Mechanical	2	2	-	3	50	50	100
7.	P18MEL47	Metrology & Measurements Laboratory	Mechanical	-	-	3	1.5	50	50	100
8.	P18MEL48	Basic Material Testing Laboratory	Mechanical	-	-	3	1.5	50	50	100
9	P18HU49	Aptitude and Reasoning Development – Intermediate (ARDI)	HS&M	2	-	-	1	50	50	100
10	P18EV**DIP**50	*Environmental Studies	ENV	2	-	-	-	--	--	--
11	P18MA**DIP**41	*Additional Maths-II	Maths	4	-	-	-	--	--	--
Total							**23**	**450**	**450**	**900**

*** Additional Mathematics-II & Environmental Studies: Lateral entry students shall have to pass these mandatory learning courses before completion of VI- Semester**

$^{+}$ Common to BE (AU, CV, ME and I&PE)	$^{++}$ Common to BE (CS, EC, E&E and IS&E)

Course Title: TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES			
Course Code: P18MA31	Semester: III	L:T:P:H: 4:0:0:4	Credits: 4-0-0
Contact Period-Lecturer: 52Hrs. Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

(Common to All Branches)

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.

Self-Study Component: 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 (⅓)$^{rd.}$ rule, Simpson's (⅜)th rule, Boole's rule and Weddle's rule (All rules without proof)-Illustrative problems.

Self-Study Component: Derive Newton- Cotes quadrature formula.

10 Hrs.

UNIT-III

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

Self-Study Component: Derivations of Euler's formulae

11 Hrs.

UNIT-IV

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

Difference equations and Z-transforms: Definition, Z-transform of standard functions, 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.

Self-Study Component: Convolution theorem, Parseval's identities.related problems.

10 Hrs.

UNIT-V

Partial differential equations (PDE's):

Formation of PDE by eliminating orbitrary constants and functions. Solution of non-homogeneous PDE by the method of 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.

Self-Study Component: Finding the solution of non-linear equations of first order: Char pit'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

Course Articulation Matrix

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

Sem: 3	Course code : P18MAT31	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**	-	-	-	-	-	-	-	-	-	-

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

Course Title: **Material Science and Metallurgy**			
Course Code: **P18ME32**	Semester: III	L-T-P: 2-2-0	Credits: 03
Contact Period - Lecture: 52Hrs. Exam: 3Hrs		Weightage: CIE: 50 %;SEE: 50%	

Course Objectives:

This course aims to facilitate the students to acquire basic knowledge about lattice arrangement of atoms in materials, their mechanical behavior, properties, characterization, different advanced heat treatment processes and phase diagrams. Finally it helps students to expose to information on corrosion, non ferrous materials and environmental issues.

Course Content

UNIT-I

Structure of Crystalline Solids: Fundamental concepts of unit cell, space lattice, Bravaias lattice, Unit cells for cubic structure and HCP, study of stacking of layers of atoms in cubic structures and HCP, Calculation of atomic radius, co-ordination number and atomic packing factors for different cubic structures. Crystal imperfections - point, line, surface and volume defects. Diffusion Mechanisms and Fick's laws of diffusion. **11 Hrs**

Self-study component: Difference between Amorphous and crystalline solids

UNIT-II

Mechanical characteristics of metals: Tensile properties, true stress and true strain, Hardness, Rockwell, Vickers and Brinell hardness testing, plastic deformation - slip and twinning. Fracture type, stages in Cup & Cone fracture, fracture toughness, Griffith's criterion. Fatigue test, S-N curves, factors affecting fatigue life and protection methods. The creep curves, Mechanism of creep. **10 Hrs**

Self-study component: Creep resistant materials

UNIT-III

Solid Solution and Phase Diagrams: Solid solutions, Rules governing formation of solid solutions, Phase diagram- Basic terms, phase rule, cooling curves, construction of Phase diagrams, interpretation of equilibrium diagrams, Types of Phase diagrams, 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. **11 Hrs**

Self-study component: Effect of alloying elements on CCT diagram

UNIT-IV

Heat Treatment: Annealing and its types, normalizing, Hardening, tempering, martempering, austempering, surface hardening: case hardening, carburizing, cyaniding, nitriding Induction hardening, hardenabilty, Jominy end-quench test. **10 Hrs**

Self-study component: Age hardening of Al & Cu alloys

UNIT-V

Engineering Alloys: Properties, composition and uses of low carbon, mild medium & high carbon steels. Steels designation & AISI –SAE designation. Cast irons, gray CI, white CI, malleable CI, SG iron. Microstructures of cast irons. Light alloys: Al, Mg & Titanium alloys. Copper & its alloys: brasses & bronzes.

Composite materials: Introduction, Classification, Fabrication Methods, Characteristics of

each type. **10 Hrs**

Self study component: Application of titanium alloys and Composite materials.

Text Books

1. Willian D. Callister Jr., **"Materials Science and Engineering – an Introduction"**, John Wiley India Pvt.Ltd, New Delhi, 6th Edition, 2006, ISBN: 978-0471736967

2. Donald R. Askeland, Pradeep, **"Essentials of Materials For Science and Engineering"**, CL Engineering,2nd Edition, 2006, ISBN: 978-0495244462

Reference Books

1.James F. Shackel ford, **"Introduction to Material Science for Engineering",** 6th edition Pearson, Prentice Hall, New Jersy, 2006.

2. Raghavan, **"Physical Metallurgy, Principles & Practices",** PHI 2nd Edition, New Delhi, 2006, ISBN: 978-8120330129

3. Smith, **"Foundations of Materials Science and Engineering"** 3rd Edition McGraw Hill, 1997

Course Outcomes

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

1.Explain the internal Structure of Crystalline Solid, Stacking of layers, Coordination Number and Atomic Packing Factor for different crystal structure, Crystal imperfections and diffusion.

2.Explain the concept of Stress and strain, Hardness and plastic deformation.

3.Analyze phase diagram and Iron Carbon Equilibrium diagrams.

4.Explain heat treatment process to improve the physical and mechanical properties of different types of engineering materials.

5.Explain the concept of corrosion and different methods of prevention of corrosion.

6.Explain microstructures and different types of alloys.

Course Articulation Matrix

Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Explain** the internal Structure of Crystalline Solid, Stacking of layers, Coordination Number and Atomic Packing Factor for different crystal structure, Crystal imperfections and diffusion.	**3**	**2**					**1**						**1**	**-**
CO2	**Explain** the concept of stress and strain, Hardness and plastic deformation.	**3**	**3**	**2**										**1**	**-**
CO3	**Analyze** phase diagram and Iron Carbon Equilibrium diagrams.	**3**	**2**		**2**									**1**	**-**
CO4	**Explain** heat treatment process to improve the physical and mechanical properties of different types of engineering materials.	**3**		**2**		**2**	**1**							**1**	**-**
CO5	**Explain** microstructures and different types of alloys. **Explain** fabrication methods of Composite materials	**3**		**1**			**2**							**1**	**1**

Course Title: **Fluid Mechanics**			
Course Code: **P18ME33**	Semester: III	L-T-P: 2-2-0	Credits: 03
Contact Period - Lecture: 52Hrs.; Exam:3Hrs.		Weightage: CIE: 50 %; SEE: 50%	

Course Objectives:

The course aims to cover the basic principles and equations of fluid mechanics and their applications to the various engineering fields involving fluid flow problems so as to motivate the students to use fluid mechanics in engineering practice.

Course Content

UNIT-I

Properties of fluids: Introduction, properties of fluids, viscosity, Newton's law of viscosity. Surface tension, capillarity, vapor pressure and cavitations. Pascal's law, Fluid pressure at a point, pressure variation in a static fluid, absolute, gauge, atmospheric & vacuum pressures. **11Hrs**

Self study component: Bourdon's tube Pressure gauge and Bellows Pressure gauge

UNIT-II

Fluid statics: Simple manometers and differential manometers. Total pressure, centre of pressure in vertical and inclined plane surfaces and curved surfaces submerged in liquid. Buoyancy, Buoyant force, and centre of buoyancy. Meta centre and metacentric height (analytical method only). Stability of submerged and floating bodies. **10Hrs**

Self study component: Experimental method of finding metacentric height

UNIT-III

Fluid kinematics: Types of Fluid flow, continuity equation in three dimensions (Cartesian co-ordinate system only) and velocity and acceleration, velocity potential function, stream function and flow net.

Fluid Dynamics: Euler's equation of motion, Bernoulli's equation derived from fundamental principles & Euler's equation, Bernoulli's equation for real fluids. Fluid Flow measurements: Venturi meter, Orifice meter. **10Hrs**

Self study component: Flow measurement using Pitot tube and its types

UNIT-IV

Flow past immersed bodies: Drag, lift, expression for lift and drag, pressure drag and friction drag, boundary layer concept. Displacement thickness, momentum thickness and energy thickness. **Flow Through Pipes:** Frictional losses in pipe flow, Darcy and Chezy equations for loss of head due to friction in pipes, hydraulic gradient & total energy line. **10Hrs**

Self study component: Minor losses in flow through pipes

UNIT-V

Laminar flow and viscous effects: Reynold's number, critical Reynold's number, laminar flow through a round pipe- Hagen-Poisuille's equation, laminar flow between parallel stationery plates**.**

Dimensional Analysis: Introduction, derived quantities, Dimensions of physical quantities, dimensional homogeneity-Buckingham's π theorem, the Rayleigh's method. **11Hrs**

Self study component: dimensionless numbers and its significance

Text Books

1.K. W. Bedford, Victor Streeter, E. Benjamin Wylie "Fluid Mechanics" Tata Mcgraw Hill Education Private Limited, 9th edition, 1997, ISBN: 9780070625372

2.Dr. R.K.Bansal, "**Fluid mechanics and hydraulic machines"** Laxmi publications Ltd., New Delhi. 9th edition, 2015, ISBN: 9788131808153.

Reference Books

1.Dr. Jagadish Lal **"Fluid Mechanics and Hydraulics"** Metropolitan Book Co. Pvt. Ltd, New Delhi, 2002, ISBN: 9788120002722
2.Dr.K.L.Kumar, "Engineering Fluid Mechanics" S Chand Lltd., 2010, ISBN: 9788121901000
3.Dr.R.J.Garde and Dr.A.J.Mirajgaonkar "Engineering Fluid Mechanics" ScitechPublications (India) Chennai,2010, ISBN: 9788188429011.
4.Frank M.White "Fluid Mechanics" Tata Mcgraw Hill Education Private Limited, 7th edition, 2011, ISBN: 9780071333122

Course Outcomes

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

1. **Explain** fluid properties like density, weight density, specific volume, specific gravity, viscosity and surface tension. **Solve** problems on viscosity and surface tension.
2. **Derive** Pascal's law and fundamental law of hydrostatics and **Explain** buoyancy and centre of buoyancy.
3. **Describe** the types of fluid flow and **solve** problems on continuity equation, Euler's equation of motion and Bernoulli's equation.
4. **Explain** boundary layer concept and **define** hydraulic gradient line and total energy line.
5. **Derive** Hagen-Poiseuille equation and **apply** dimensional analysis technique to obtain dimensionless relations.

Course Articulation Matrix

Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Explain** fluid properties like density, weight density, specific volume, specific gravity, viscosity and surface tension. **Solve** problems on viscosity and surface tension.	2	2		2									-	-
CO2	**Derive** Pascal's law and fundamental law of hydrostatics and **Explain** buoyancy and centre of buoyancy.	2	2											-	-
CO3	**Describe** the types of fluid flow and **solve** problems on continuity equation, Euler's equation of motion and Bernoulli's equation.	2	2		2									-	-
CO4	**Explain** boundary layer concept and **define** hydraulic gradient line and total energy line.	2	2											-	-
CO5	**Derive** Hagen-Poiseuille equation and **apply** dimensional analysis technique to obtain dimensionless relations.	2	2		2									-	-

Course Title: **Manufacturing Process - I**			
Course Code: **P18ME34**	Semester: III	L-T-P: 2-2-0	Credits: 03
Contact Period - Lecture: 52Hrs. Exam: 3Hrs.		Weightage: CIE: 50 %; SEE: 50%	

Course Objectives: This course aims to facilitate the students to acquire basic knowledge about Casting, Welding process and metal cutting theory which are relevant to manufacturing of engineering components.

Course Content

UNIT-I

Introduction: Concept of Manufacturing process, **Casting process**: Introduction, Steps involved, Varieties of components produced by casting process, Advantages & Limitations of casting process. Introduction to furnace, Classification of furnaces.

Patterns: Definition, functions, Materials used for pattern, various pattern allowances and their importance. Classification of patterns. Binder: Definition, Types of binders used in moulding. **12 Hrs**

Self study component: Need of additives, Types of additives

UNIT-II

Sand Moulding: Types of sand moulds, ingredients of moulding sand and Properties, core sands, ingredients properties, Core making, Core baking – Dielectric baking of cores, 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.

Special Moulding Process : CO_2 moulding, Shell moulding, Investment casting, permanent mould casting, Gravity die-casting, Pressure die casting, centrifugal casting, Injection moulding, Squeeze Casting. **10 Hrs**

Self study component: Thixocasting, Slush casting and continuous casting processes.

UNIT-III

Special Types of Welding: Resistance welding - principles, Seam welding, Thermit welding, Spot welding, projection welding, Friction welding, Explosive welding, and Brazing-Methods of Brazing.

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. **10 Hrs**

Self study component: Welding defects: causes, detection and remedy.

UNIT-IV

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 Heat generation in metal cutting, factors affecting heat generation, measurement of tool tip temperature. **10 Hrs**

Self study component: Cutting Fluids: Desired properties, types and selection

UNIT-V

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.

Mechanisms of machines : Turret Lathe Mechanism, Calculation of change of gears in thread cutting, Driving Mechanism of shaper, Simple and compound indexing calculations, specification of grinding wheel, selection of grinding wheel, balancing of grinding wheel.

10 Hrs

Self study component: Super Finishing, Lapping, and honing

Text Books

1. Serope Kalpakjian & Steven R Schmid, "Manufacturing Engineering and Technology", Pearson Education Asia, 4th Edition, 2002, ISBN: 9788177581706
2. Dr.K.Radhakrishna, "Manufacturing Process-I", 5th Ed ,Sapna Book House, 2006, ISBN: 8128002074

Reference Books

1. P.N.Rao, **"Manufacturing & Technology: Foundry Forming and Welding"**,Tata McGraw Hill, 2nd Edition, 2013, ISBN: 9789383286614
3. Roy A Lindberg, "**Process and Materials of Manufacturin**g" Prentice Hall, 4th Edition, 1998, ISBN: 9780205118175

Course Outcomes

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

1. **Explain** the steps involved in casting processes
2. **Distinguish** between various casting processes
3. **Explain** special types of welding processes.
4. Merchants circle diagram and
5. Tool life, Mechanism of machines.

Course Articulation Matrix

Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Explain** the steps involved in casting processes	**2**	**1**	**1**										**-**	**-**
CO2	**Distinguish** between various moulding processes	**2**	**1**	**1**										**-**	**-**
CO3	**Explain** special types of welding processes.	**2**	**1**	**1**										**-**	**1**
CO4	**Analyze** shear angle using Merchants circle diagram **Explain** various types of cutting tool materials	**3**	**2**	**1**										**-**	**1**
CO5	**Estimate** Tool life and **Describe** Mechanism of machines.	**2**	**2**	**1**										**-**	**2**

Course Title: Basic Thermodynamics			
Course Code: **P18ME35**	Semester: III	L-T-P: 2-2-0	Credits: 03
Contact Period - Lecture: 52Hrs. Exam: 3Hrs.	Weightage: CIE: 50 %;		SEE: 50%

Course Objectives: The course aims at to cover the basic principles of thermodynamics, to give students a feel for how thermodynamics is applied in engineering practice and to develop an intuitive understanding of thermodynamics by emphasizing the physics and physical arguments.

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 examples to illustrate the definition of work. Zeroth law of thermodynamics, Concept of Temperature with simple numerical problems on measurement of temperature.

Thermodynamic definition of work, sign convention, .Work done at the system boundary, process equation and expressions for work done in different processes. Definition of heat and its sign convention. Examples to illustrate the definition of work and heat Comparison of work and heat. Simple numerical problems on work and heat transfer only. **11 Hrs**

Self study component: Types of temperature scales, international scale of temperature and design of temperature scales. Other forms of work.

UNIT-II

First Law of Thermodynamics: Statement of the First law of thermodynamics for a closed system undergoing a cyclic process. First law of thermodynamics for a change of state of the system and concept of energy. Energy as a property of the system and its significance. Definition and significance of 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. Simple numerical problems on systems undergoing steady flow process. **10 Hrs**

Self study component: Application of Steady flow energy equation for nozzles, heat exchangers, compressors and throttling device.

UNIT-III

Pure substances: Definition of pure substance, two-property rule applied to pure substance. Temperature-Volume diagram, definitions of Sub-cooled liquid, saturated liquid, mixture, saturated vapor and superheated vapor. Pressure-Temperature diagram. Definitions of triple point and critical point. Enthalpy of changes of a pure substance, temperature- Enthalpy diagram, definition of sensible heat, latent heat and super heat. Two phase mixture, quality of steam and definition of Dryness fraction. Measurement of dryness fraction using bucket calorimeter, throttling calorimeter, separating calorimeter and throttling and separating calorimeter. Simple problems on measurement of dryness fraction using Steam tables. **10 Hrs**

Self study component: P-V-T surfaces for water.

UNIT-IV

Second Law of Thermodynamics: Thermal reservoir. Source and sink. Heat engine, heat pump and refrigerator. Efficiency and coefficient of performance. Kelvin – Planck and Clausius statement of the Second law of thermodynamics and equivalence of the two Statements.. Reversible and Irreversible processes. Factors that makes a process irreversible. Reversible heat engine - Carnot Cycle and expression for efficiency of Carnot cycle. Simple numerical problems on heat engines and heat pumps. **10 Hrs**

Self study component: Explanation and Definition of perpetual motion machines. Working of a perpetual motion machine of II kind with example.

UNIT-V

Entropy: Clausius Inequality: Statement, and proof. Entropy: Definition, entropy as a property of the system. Principle of increase of entropy. Entropy as a quantitative test for irreversibility. Expression for entropy using T-ds relations, Calculation of entropy changes in different thermodynamic process. Characteristic equation of gases, ideal gas, equation of state, internal energy and enthalpy as a function of temperature only. Universal and particular gas constants and specific heats. Evaluation of heat, work, change in internal energy, enthalpy and entropy in various processes. **11 Hrs**

Self study component: Dalton's law, Gibbs law and Amagots law for ideal gases and gas mixtures.

Text Books

1. P .K. Nag, **"Basic and Applied Thermodynamics"** Tata McGraw Hill, 3rd Edition, 2006, ISBN: 9780070260627
2. R K Rajput, "**Engineering Thermodynamics"** Laxmi Publications Pvt Ltd, 3rd Edition, 2011, ISBN: 9789380298405
3. Yunus A. Cenegal, "**Thermodynamics – An engineering approach"** Tata McGraw Hill, Featured Edition, 2001, ISBN: 9780072383324

Reference Books

1. Mahesh M Rathore, "**Thermal Engineering**" McGraw Hill Pvt Ltd., 1st Edition, New Delhi, 2010, ISBN: 9780070681132Spalding and Cole, "**Engineering Thermodynamics"** ELBS Publications, 1985, ISBN: 9780713133141
2. Van and Wylen, "**Fundamentals of Classical Thermodynamics"** Wiley Eastern limited, 2nd Edition, 1976, ISBN: 9780471902294
3. Domkundwar, Kothandaraman "**A course in Thermal Engineering**" Dhanpat Rai & Co., New Delhi, 2004, ISBN: 9788177000214

Course Outcomes

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

1. **Understand** the basic concepts and definitions used in engineering thermodynamics.
2. **Apply** the first laws of thermodynamics and the concepts of thermodynamics to basic energy systems.
3. **Understand** the properties of pure substances.
4. **Understanding** of the second law of thermodynamics and analysis in different applications
5. **Calculate** entropy for various simple real life systems

Course Articulation Matrix															
Course Outcomes		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Understand** the basic concepts and definitions used in engineering thermodynamics	**2**		**2**										**-**	**-**
CO2	**Apply** the first laws of thermodynamics and the concepts of thermodynamics to basic energy systems..	**2**	**2**	**2**	**2**									**1**	**-**
CO3	**Understand** the properties of pure substances.	**2**	**2**	**2**										**-**	**-**
CO4	**Understanding** of the second law of thermodynamics and analysis in different applications	**2**	**2**	**2**	**2**									**-**	**-**
CO5	**Calculate** entropy for various simple real life systems	**2**	**2**	**1**										**1**	**-**

Course Title: **Computer Aided Machine Drawing**			
Course Code: **P18ME36**	Semester: III	L-T-P: 0-0-6	Credits: 03
Contact Period - Lecture: 52Hrs. Exam: 3Hrs.		Weightage: CIE: 50 %;SEE: 50%	

Course Objectives: The course aims at empowering the students with drafting skills and strengthens their ability to draw, read and interpret machine part/assembly using computer and relevant software and following standards codes and norms.

Course Content

UNIT-I

Introduction: Review of basic sketching commands and navigational commands.

Sections Of Solids: Sections of Pyramids, Prisms, Cube, Tetrahedron, Cone and Cylinder 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 with and without section. (Bureau of Indian standards conventions are to be followed for the drawings), Line conventions. **12 Hrs**

UNIT-II

Thread Forms: Thread terminology, sectional view of threads. ISO Metric (Internal & External), BSW (Internal & External), square and Acme threads, Buttress thread, Sellers thread, American Standard thread.

Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) simple assembly using stud bolts with nut and lock nut.

12 Hrs

UNIT-III

Riveted Joints: Single and Double riveted lap joints, butt joints with single/double cover straps (chain and Zigzag, using snap head rivets). **12 Hrs**

UNIT-IV

Keys & Joints: Study of keys: Parallel key, Taper key, feather key, Gibhead key and Woodruff key.

Joints: cotter joint (socket and spigot), knuckle joint (pin joint), Universal joint.

Couplings: Protected type flanged coupling, pin (bush) type flexible coupling, Muff coupling. **15 Hrs**

UNIT-V

Assembly Drawings

Solids of Protrusion, Assembly drawing of following machine parts (3D parts to be created and assemble and then getting 2D drawing with required views, including part drawing).

Introduction to geometrical dimensioning and tolerance.

1. Screw Jack
2. I.C. Engine Connecting Rod
3. Machine Vice
4. Plummer Block
5. Fuel Injector **27 Hrs**

Text Books

1. N.D. Bhat and V.M.Panchal, "**Machine Drawing"**, Charotar Publishing Hous, 46th Edition, 2011, ISBN: 9789380358390

2. N. Siddeshwar, P. Kannaiah and V.V.S. Sastri, "**Machine Drawing"** published by Tata Mc. GrawHill, 2010, ISBN: 9780074603376
3. Tryambaka Murthy, **"Machine Drawing",** CBS Publications, 2nd Edition, 2008, ISBN: 9788123916590

Reference Books

1. K.R. Gopala Krishna, "**Machine Drawing"**, Subhash Publication, 1st Edition, 1984.

Course Outcomes

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

1. **Solve** problems on sections of regular solids.
2. **Convert** pictorial views to orthographic views.
3. **Draw** 2D views of simple machine elements
4. **Assemble** the components of mechanical systems in 3D environment.

Course Articulation Matrix

Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Solve** problems on sections of solids.			**3**		**3**					**1**			**-**	**-**
CO2	**Convert** pictorial views to orthographic views.			**3**		**3**					**1**			**-**	**-**
CO3	**Draw** 2D views of simple machine elements			**3**		**3**					**1**			**-**	**-**
CO4	**Assemble** the components of mechanical systems in 3D environment.			**3**		**3**					**1**			**1**	**-**

Course Title: **Fluids Measurement Laboratory**			
Course Code: **P18MEL37**	Semester: III	L-T-P: 0-0-3	Credits: 1.5
Contact Period - Lecture: 52Hrs. Exam: 3Hrs.		Weightage: CIE: 50 %; SEE: 50%	

Course Objectives: The course aims at enabling the students to understand the basic measurement techniques of fluid flow, fuels and lubricants properties.

Course Content

PART-A

Exp-1
Calibration of venturi meter and determination of its co-efficient of discharge **3Hrs**

Exp-2
Calibration of orifice meter and determination of its co-efficient of discharge **3Hrs**

Exp-3
Calibration of V-Notch for flow through a channel. **3Hrs**

Exp-4
Determination of coefficient of friction in flow through pipes. **3Hrs**

Exp-5
Determination of vane efficiency (Coefficient of impact) for different vanes. **3Hrs**

PART-B

Exp-6
Determination of Viscosity of lubricating oil using Redwoods Viscometer. **3Hrs**

Exp-7
Determination of Viscosity of lubricating oil using Saybolts and Torsion Viscometers. **3Hrs**

Exp-8
Determination of Calorific value of solid fuel using Lewis Thomson calorimeter. **3Hrs**

Exp-9
Determination of Calorific value of gaseous fuels using Junkers Gas calorimeter. **3Hrs**

Seminar **6Hrs**

Test **3Hrs**

Reference Books

1. Dr. Jagadish Lal **"Fluid Mechanics and Hydraulics"** Metropolitan Book Co. Pvt. Ltd, New Delhi, 2002, ISBN: 9788120002722
2. Dr. R.K.Bansal, "**Fluid mechanics and hydraulic machines"** Laxmi publications Ltd., New Delhi. 9th edition, 2015, ISBN: 9788131808153.
3. P .K. Nag, **"Basic and Applied Thermodynamics"** Tata McGraw Hill, 3rd Edition, 2006, ISBN: 9780070260627

Course Outcomes

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

1. **Calibrate** venturimeter, orificemeter and V-notch.
2. **Determine** friction coefficient for fluid flow in pipes.
3. **Determine** the efficiencies of vertical, inclined and curved vanes.
4. **Determine** Flash point, Fire point and viscosity of lubricating oil.
5. **Determine** Calorific value of solid and gaseous fuels.

Course Articulation Matrix

Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Calibrate** venturimeter, orificemeter and V-notch.	3	1		3						2			-	-
CO2	**Determine** friction coefficient for fluid flow in pipes.	3	1	2	3						2			-	-
CO3	**Determine** the efficiencies of vertical, inclined and curved vanes.	1	1		3						2			-	-
CO4	**Determine** properties like Flash point, Fire point and Viscosity of lubricating oil.	1	2	2	3						2			-	**1**
CO5	**Estimate** Calorific value of solid and gaseous fuels	1	2	2	3						2			-	-

Course Title: **Foundry and Forging Laboratory**			
Course Code: **P18MEL38**	Semester: III	L-T-P: 0-0-3	Credits: 1.5
Contact Period - Lecture: 52Hrs. Exam: 3Hrs.		Weightage: CIE: 50 %;	SEE: 50%

Course Objectives: The course aims at enabling the students to have practical knowledge about preparation of components through sand casting and forging processes.

Course Content

PART-A

Use of foundry tools and equipments. **3Hrs**

Exp-1

Preparation of moulds using two boxes. Use of patterns: split pattern, match plate pattern and cores. Mould cavity volume calculations. **6Hrs**

Exp-2

Preparation of casting: Aluminium or cast iron (demonstration only). **6Hrs**

PART-B

Use of forging tools and equipments. **3Hrs**

Exp-3

Preparing minimum three models involving upsetting, drawing and bending operations, along with length and volume calculations. **12Hrs**

Seminar **3Hrs**

Test **3Hrs**

Reference Books

1.Serope Kalpakjian & Steven R Schmid, **"Manufacturing Engineering and Technology",** Pearson Education Asia, 7th edition, 2013, ISBN: 978-0133128741.

2. P. N. Rao, **"Manufacturing Technology: Foundry Forming and Welding"** 2nd Ed., Tata McGraw Hill, 2003.

Course Outcomes

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

1.**Prepare** casting moulds using foundry sand.

2.**Prepare** simple cast components using Aluminium/Cast Iron.

3.**Calculate** the material requirement for forging.

4.**Prepare** simple forged components.

Course Articulation Matrix

Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Prepare** casting moulds using foundry sand.			3	1	1								-	-
CO2	**Prepare** simple cast components using Aluminium/Cast Iron.			3	3	2	1			1				-	-
CO3	**Calculate** the material requirement for forging.	1		3	1					1				-	-
CO4	**Prepare** simple forged components.			2	1	1				1				-	-

Course Title: **Aptitude and Reasoning Development - BEGINNER. (ARDB)**			
Course Code: **P18HU39**	Semester: III	L-T-P-H: 0-0-2-2	Credits: **NA**
Contact Period - Lecture: 32Hrs.; Exam:3Hrs.		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.

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

Course Title: **Additional Mathematics-I**			
Course Code : **P18MADIP31**	Semester : 3	L-T-P-H: 4-0-0-4	Credits: **0**
Contact Period: Lecture: 52 Hr.		Weightage: CIE (max: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,

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

Self-study components: De-Moivre's theorem (without proof). Roots of complex number – Simple problems. **12Hrs**

UNIT-II

Differential Calculus: 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.

Self-study components: Review of successive differentiation. Formulae for n^{th} derivatives of standard functions- Liebnitz's theorem (without proof). 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. Applications of integration to area, length of a given curve, volume and surface area of solids of revolution.

Self-study components: Differentiation under integral sign (Integrals with constants limits)-Simple problems. **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).

Self-study components: 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.

Self-study components: 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 Books

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

Reference Books

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.

Course Title: COMPLEX ANALYSIS, STATISTICS, PROBABILITY AND NUMERICAL TECHNIQUES			
Course Code: P18MA41	Semester: IV	L:T:P:H: 4:0:0:4	Credits: 4-0-0
Contact Period-Lecturer: 52Hrs. Exam: 3Hrs		Weightage:CIE:50%; SEE:50%	

(Common to all Branches)

UNIT-I

Numerical Methods-II: Solution of algebraic and transcendental equations: Bisection method, Regula-Falsi & 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 and first degree – Introduction. Taylor's series method. Modified Euler's method, Runge - Kutta method of fourth order, Milne's and Adams-Bashforth predictor & corrector methods (All formulae without proof). Illustrative examples only.

Self-Study Component: Solution of second order ordinary differential equations using Runge-Kutta methods. Solution of first order simultaneous differential equations. **10 Hrs.**

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

Self-Study Component: Basics of Series solutions of ODE's; analytic, singular point and basic recurrence relations. **10 Hrs.**

UNIT-III

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

Self-Study Component: Derivation of Cauchy- Riemann equation in Cartesian and polar form. **11 Hrs.**

UNIT-IV

Complex integration: complex line integrals. Cauchy theorem, Cauchy integral formula. Taylor's and Laurent's series (Statements only) and illustrative examples. Singularities, poles and residues. Cauchy residue theorem (statement only). Illustrative examples. 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* $y = ax^2 + bx + c.$ Correlation and **regression**.

Self-Study Component: Derivation of Cauchy theorem, Cauchy integral formula and Cauchy's residue theorem. Fit an equation of the **curves** of the type : $y = ae^{bx}$, **11 Hrs.**

UNIT – V

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.

Joint probability distributions and Markov chains: Concept of joint probability. Joint probability Distributions of discrete random variables. Expectation, Covariance, correlation coefficient – illustrative Examples. Continuous joint probability distributions. Probability vectors, stochastic matrices. Fixed point and regular stochastic matrices.

Self-Study Component Basic definitions of probability and problems up to Bayes' theorem. Derivation of Mean and SD of Binomial &Poisson distribution**.**

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. **T. Veerarajan:** Engineering Mathematics, Tata McGraw-Hill Pub., 2003.

2. Introductory Methods of Numerical Analysis: - S.S.Sastry, PHI, 3rd Ed.2000.

3. Linear Algebra and its applications: - David C.Lay, Pearson Education Ltd., 3rd Edition, 2003.

4. Seymour Lipschutz: Probability:-, Schaum's outline series, McGraw-Hill Pub., 2nd Ed, 2002.

5. Higher Engineering Mathematics: - B.V. RAMANA, McGraw Hill Education, 2007

Course Articulation Matrix

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

Sem: 4		**Course code : P18MAES41**	**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**	-	-	-	-	-	-	-	-	-	-

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

Course Title: **Applied Thermodynamics**			
Course Code: **P18ME42**	Semester: IV	L-T-P: 2-2-0	Credits: 03
Contact Period - Lecture: 52Hrs. Exam: 3Hrs.		Weightage: CIE: 50 %;	SEE: 50%

Course Objectives: Applied thermodynamics is a continuation course of Basic Thermodynamics with emphasis on the analysis of gas power and refrigeration cycles and the application of basic principles to engineering problems with systems involving compressors, refrigeration and I C engines.

Course Content

UNIT-I

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. Brayton cycle for gas turbine power plants. Deviations of practical gas turbine cycles from ideal cycles. Variations of Brayton cycle like Inter-cooling, , reheating and Regeneration. **11 Hrs**

Self study component: P-V and T-S diagrams, description, expression for efficiencies of Duel cycle, Sterling cycle, Atkinson cycle, Lenoir cycle and Ericson cycle.

UNIT-II

VAPOUR POWER CYCLES: Carnot vapor power cycle and its performance. Simple Rankine cycle, description, T-S diagram and Expression for efficiency. Comparison of Carnot and Rankine cycles. Effects of maximum pressure exhaust pressure and maximum temperature on the performance of simple Rankine cycle. Deviation of simple Rankine cycle from ideal cycles Analysis of Reheat Cycle, Ideal regenerative cycle, and practical regenerative cycles with open and closed type feed water heaters. **11 Hrs**

Self study component: Ideal cycles for jet propulsion, maximum work and propulsion efficiency for a turbo jet cycle. Turbo jet, Ram jet and turbo prop engines.

UNIT-III

RECIPROCATING AIR COMPRESSORS: Working of single stage reciprocating air compressors, Work input using PV diagram and steady flow analysis. Effect of clearance volume and volumetric efficiency, isothermal and mechanical efficiencies, Multistage compression, advantages of multistage compression. Expression for optimum intermediate pressure. Imperfect inter cooling. Expression for intermediate pressure in Imperfect intercooling**.** **10 Hrs**

Self study component: Brief explanation of rotary compressors, fans and Blowers.

UNIT-IV

REFRIGERATION: Introduction, Units of refrigeration and COP. T-S and P-H diagrams for Mechanical vapor compression refrigeration systems. Sub-cooling and super-heating of vapor in vapor compression refrigeration systems, description, analysis mechanical refrigeration, and refrigeration effect, capacity, power required to drive the compressor and Simple numerical problems on vapor compression refrigeration systems. Refrigerants for vapor compression systems and Properties of refrigerants. Air refrigeration, principle of absorption refrigeration, COP of an absorption refrigeration system Steam jet refrigeration, **10 Hrs**

Self study component: Psychometric Chart and Psychometric Process like Sensible heating or cooling, cooling and dehumidification, Summer and winter air conditioning.

UNIT-V

TESTING OF I.C. ENGINES: Testing of two-stroke and four strokes SI and CI engines. Performance Factors, Basic testing factors and basic measurements for engine performance. Indicated Power, Friction Power: William's line method, Morse Test, and Motoring test. Brake Power: principle of Dynamometer, mechanical, Hydraulic and eddy current dynamometers. Fuel consumption: volumetric type. Air consumption: Air Box Method to determine air consumption. Heat balance sheet and related numerical problems. **10 Hrs**

Self-study component: Combustion in I C engines, delay period and factors affecting delay period. Diesel knock and methods of controlling diesel knock.

Text Books

1. P .K. Nag **"Basic and Applied Thermodynamics"** Tata McGraw Hill, 2nd Edition 2009, ISBN: 9780070151314.
2. R K Rajput "**Engineering Thermodynamics"** Laxmi Publications, 4th Edition, ISBN: 9788131800584.
3. Gordon J. Van Wylen "**Fundamentals of Classical Thermodynamics"** John Wiley & Sons Canada, Limited, 3rd edition, 1988,ISBN : 9780471610762

Reference Books

4. D B Spalding and E H Cole "**Engineering Thermodynamics"** Arnold 1973, 3 edition, ISBN : 9780713132991.
5. Yunus A. Çengel, Michael A. Boles "**Thermodynamics – An engineering approach"** Tata McGraw Hill, 6th edition, 2007, ISBN : 9780073305370.
6. S Domkundwar, C P Kothandaraman and V Domkundwar "**A course in Thermal Engineering**",Dhanpat Rai & Co, 2004, ISBN: 9788177000214.
7. M.L.Mathur and R.P.Sharma "**Internal Combustion Engines**", Dhanpat Rai & Co, 2010, ISBN: 9788189928469.
8. Mahesh M Rathore "Thermal Engineering" Tata McGraw Hill, 1st edition, ISBN: 9780070681132
9. V Ganesan "Internal Combustion Engines" Tata McGraw Hill, 4th edition, 2012, ISBN : 9781259006197

Course Outcomes

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

1. **Explain** the concept of air standard cycle and vapor power cycle
2. **Explain** and **calculate** the performance characteristics of reciprocating air compressor.
3. **Explain** the different types of refrigerating systems and **Apply** the knowledge of P-H chart.
4. **Calculate** the performance characteristics of I.C. Engines

Course Articulation Matrix															
Course Outcomes		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Explain** the concept of air standard cycle and vapor power cycle	**2**	**2**		**2**									-	-
CO2	**Explain** and **calculate** the performance characteristics of reciprocating air compressor.	**2**	**2**		**2**	**2**								-	-
CO3	**Explain** the different types of refrigerating systems and and **Apply** the knowledge of P-H chart.	**2**	**2**		**2**	**2**								-	-
CO4	**Calculate** the performance characteristics of I.C. Engines	**2**	**2**		**3**	**2**								-	-

Course Title: **Mechanical Measurements & Metrology**			
Course Code: **P18ME43**	Semester: IV	L-T-P: 2-2-0	Credits: 03
Contact Period - Lecture: 52Hrs. Exam: 3Hrs.	Weightage: CIE: 50 %;		SEE: 50%

Course Objectives: The course aims at enabling the students to understand the basic concepts of Measurement and Metrology and strengthening their knowledge about advancements in **s**ystem of Limits, Fits, Tolerances and Gauging of mechanical elements which are commonly used in industries.

Course Content

UNIT-I

Basic Concepts of Measurement and Metrology: Definition and significance of measurement, Generalized measurement system, Performance characteristics of measuring instruments (Only static characteristics), Inaccuracy of Measurements, Definition and objectives of metrology. Standards, Subdivision of standards, Line and end standard, Imperial standard yard, Wave length standard, International Prototype meter, Transfer from line to end standard. Calibration of end bars, Slip gauges, Wringing phenomena, Numerical problems on building of slip gauges. **10 Hrs**

Self study component: Identification of standards and their applications

UNIT-II

System of Limits, Fits, Tolerances and Gauging: Definition of tolerance, specification in assembly, Principle of inter changeability and selective assembly. Concept of limits of size and tolerances, Compound tolerances, accumulation of tolerances. Definition of fits, types of fits. Hole basis system and shaft basis system, Geometric dimensioning and tolerancing.

Classification of gauges, Basic concept of design of gauges (Taylor's principles), wear allowance on gauges. Types of gauges -plain plug gauge, ring gauge, snap gauge, gauge materials. Gauge Design and numerical problems. **10 Hrs**

Self study component: Limit gauges for tapers.

UNIT-III

Comparators: Characteristics and classification of comparators. Mechanical comparators-Johnson Mikrokator, Sigma Comparators, Optical Comparators -principles, Zeiss ultra optimeter, Electric and Electronic Comparators, LVDT, Pneumatic Comparators, Solex Comparator. Back Pressure gauges,

Surface roughness and Metrology of Screw Thread: Surface roughness terminology, Methods of measuring surface roughness, Taylor-Hobson Talysurf, Analysis of surface traces, Measurement of basic elements of thread, worked examples. **12 Hrs**

Self study component: Screw threads: 2-wire and 3-wire methods.

UNIT-IV

Transducers: Introduction, Transfer efficiency, Loading effect, Primary and Secondary transducers, classification of transducers with examples. Advantages of each type transducers.

Signal Conditioning: Mechanical systems, Electrical intermediate modifying devices, Input circuitry-simple current sensitive circuit, Electronic amplifiers, Filters, Types of filters, telemetry. **10 Hrs**

Self study component: Applications of Transducers.

UNIT-V

Strain Measurement: Methods of strain measurement, Strain gauges, Preparation and mounting of strain gauges, Gauge factor.

Measurement of Force: Introduction, Proving ring

Measurement of Torque: Introduction, Hydraulic dynamometer.

Measurement of Pressure: Introduction, Use of elastic members, Bridgeman gauge, Mc Leod gauge, Pirani Gauge

Temperature Measurement: Resistance thermometers, Thermocouple, Laws of thermocouple, Thermocouple materials. **10 Hrs**

Self study component: Pyrometers, Optical pyrometers.

Text Books

1. R.K.Jain **"Engineering Metrology"** Khanna Publishers, Delhi, 20th edition, 2004, ISBN: 9788174091536.
2. Thomas G. Beckwith, Roy D. Marangoni & John H. Lienhard "Mechanical Measurements" Pearson Prentice Hall, 6th edition, 2007, ISBN : 9780201847659

Reference Books

1. I.C.Gupta **"Engineering Metrology"** Dhanpat Rai Publications, 7th edition, 2012, ISBN: 9788189928452.
2. Alsutko & Jerry Faulk **"Industrial Instrumentation"** Delmar cengage learning, 1996, ISBN: 9780827361256.
3. R.S.Sirohi and H.C.RadhaKrishna **"Mechanical Measurements"** New Age International, Revised 3rd edition, 2013, ISBN: 9788122403831.
4. Doblin **"Measurement Systems"** Tata McGraw Hill, 6th edition, 2012, ISBN: 9780070699687.

Course Outcomes

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

1. **Explain** measurement, metrology, various standards of measurements and elements of measurement systems.
2. **Calculate** tolerances and **design** plug and ring gauges.
3. **Explain** different types of comparators, angle measuring devices and **derive** expressions for finding effective diameter of screw threads.
4. **Explain** sensor transducers, signal conditioning and terminating devices with associated parameters.
5. **Explain** basic principles and devices involved in measuring strain, force, torque, pressure and temperature.

Course Articulation Matrix															
Course Outcomes		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Explain** measurement, metrology, various standards of measurements and elements of measurement systems.	**1**	**2**		**2**									**-**	**1**
CO2	**Calculate** tolerances and **design** plug and ring guages	**2**	**1**											**-**	**1**
CO3	**Explain** different types of comparators, angle measuring devices and **derive** expressions for finding effective diameter of screw threads.	**1**	**2**		**1**									**-**	**1**
CO4	**Explain** sensor transducers, signal conditioning and terminating devices with associated parameters.	**1**	**1**		**2**									**-**	**1**
CO5	**Explain** basic principles and devices involved in measuring strain, force, torque, pressure and temperature.	**1**	**2**		**3**									**-**	**1**

Course Title: **Mechanics of Materials**			
Course Code: **P18ME44**	Semester: IV	L-T-P: 2-2-0	Credits: 03
Contact Period - Lecture: 52Hrs. Exam: 3Hrs.		Weightage: CIE: 50 %;	SEE: 50%

Course Objectives: The course aims at enabling the students to understand the basic concepts of stress, strain and deformation of mechanical elements subjected to axial, bending and torsional loading.

Course Content

UNIT-I

Simple stresses and strains: Stress, types, Saint Venant's principle, stress-strain curve for mild steel, working stress, proof stress, factor of safety, Hooke's law, modulus of elasticity, strain energy, 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. **10 Hrs**

Self study component: Strain energy due to gradually applied normal load; Strain energy due to gradually applied shear load

UNIT-II

Compound bars: Stress analysis of composite bars. Thermal stresses in uniform and compound bars**. Compound stresses**: Principal planes and stresses, plane of maximum shear stress in general 2D system. Mohr's circle diagram. **10 Hrs**

Self study component: Strain on inclined plane due to (i) normal stress in x direction (ii) normal stress in y direction (iii) shear stress in x-y direction; Mohr's circle for strain, Principal strain.

UNIT-III

Shear force and Bending Moment: Types of beams, loads and supports. SF and BM, sign conventions, relationship between load intensity, shear force and bending moment. SFD and BMD for different beams subjected to concentrated loads, Uniformly Distributed Load and Uniformly Varying Load. Shear force and Bending moment diagrams due to inclined loads **10 Hrs**

Self study component: Loading and Bending moment diagram from shear force diagram

UNIT-IV

Bending and shear stresses in Beams: Theory of simple bending, assumptions in simple bending, relationship between bending stresses and radius of curvature, Flexural strength (Modulus of rupture), Flexural Modulus, 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. (Moment of Inertia to be provided for numerical problems).

Deflection of Beams: Introduction, Differential equation of deflection; Flexural rigidity, Macaulay's method for simply supported beams with point load and UDL. **12 Hrs**

Self study component: Beam of uniform strength-uniform beam of rectangular section replaced by (i) Beam of constant depth (ii) Beam of constant width.

UNIT-V

Torsional stresses: Introduction to torsion, pure torsion, assumptions, derivation of torsion equation, polar modulus, torsional rigidity, and torque transmitted by solid and hollow circular shafts. Shafts in series & parallel, strain energy in torsion.

Columns: Introduction to Columns, Euler theory for axially loaded elastic long columns, Euler equation for columns with (i) both ends hinged (ii) one end fixed and other end free, (iii) both ends fixed, Limitations of Euler's theory, Rankine's formula.

10 Hrs

Self study component: Frames: Types of frames, Analysis of simply supported perfect frames using method of joints, method of sections subjected to horizontal and vertical loads.

Text Books

1.S. S. Bhavikatti "**Strength of Materials**" Vikas Publication House-Pvt Ltd 2nd edition, 2000, ISBN: 8125901647
2.S.S. Rattan **"Strength of Materials"** Tata McGraw-Hill, New Delhi, 2nd Edition, 2011, ISBN: 9780071072564
3.James M. Gere, Stephen P. Timoshenko, **"Mechanics of Materials"** CBS Publishers and Distributers Delhi.

Reference Books

4.W.A. Nash **"Strength of Materials "**Schaum's Outline Series, 4th Edition, 2007, ISBN: 9780070466173
5.Dr. R. K. Bansal **"Strength of Materials"** Laxmi Publication, New Delhi, 5th Edition, 2007, ISBN: 9788131808146
6.Ferdinand P Beer, E Russell Johnston, JR., John T DeWolf adapted by N Shivaprasad & S Krishnamurthy **" Mechanics of Materials"** Tata McGraw-Hill
7.Dr. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, **"Mechanics of Materials"** Laxmi Publications, New Delhi. 2002

Course Outcomes

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

1. **Classify** different types of stresses, strain and deformations induced in the mechanical components due to external loads.
2. **Estimate** thermal stresses; **calculate** principal stresses in simple 2D elements.
3. **Draw** Shear Force Diagrams and Bending Moment Diagrams for uniform beams for different types of loads and support conditions.
4. **Compute** and **analyze** bending and shear stresses and deflections induced in beams.
5. **Estimate** torsional stresses in circular shafts; **Analyze** columns under buckling load; **Analyze** perfect frames under loads.

Course Articulation Matrix															
Course Outcomes		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Classify** different types of stresses, strain and deformations induced in the mechanical components due to external loads.	**2**	**1**											**-**	**-**
CO2	**Estimate** thermal stresses; **calculate** principal stresses in simple 2D elements.	**2**	**2**											**-**	**-**
CO3	**Draw** Shear Force Diagrams and Bending Moment Diagrams for uniform beams for different types of loads and support conditions.	**2**	**2**											**-**	**-**
CO4	**Compute** and **analyze** bending and shear stresses and deflections induced in beams.	**2**	**2**											**-**	**-**
CO5	**Estimate** torsional stresses in circular shafts; **Analyze** columns under buckling load and **analyze** perfect frames.	**2**	**2**											**1**	**1**

Course Title: **Kinematics of Machinery**			
Course Code: **P18ME45**	Semester: IV	L-T-P: 2-2-0	Credits: 03
Contact Period - Lecture: 52Hrs. Exam: 3Hrs.		Weightage: CIE: 50 %;SEE: 50%	

Course Objectives: The course aims at exposing students to the working principles of simple planar mechanisms and enabling them to understand the basic concepts of kinematic analysis of simple planar mechanisms.

Course Content

UNIT-I

Introduction to Mechanisms: Introduction, Rigid and Resistant bodies, kinematic pairs, degrees of freedom, Grubler's criterion, Kinematic chain, mechanism, machine and structure. Mobility of Mechanisms, Inversions of mechanisms: Four bar chain, Single slider crank chain and Double slider crank chain.

Simple Mechanisms: Quick return motion mechanisms-Whitworth mechanisms, Crank and slotted lever mechanisms. Intermittent motion mechanisms- Geneva mechanism, Ratchet and pawl mechanism. Peaucelliar's Straight line mechanism, Toggle mechanism, Pantograph, Ackerman steering mechanism, Davis steering gear mechanism. **10 Hrs**

Self study component: Working principle and application of Universal joint (Hook joint).

UNIT-II

Velocity analysis of mechanisms: Introduction, vectors, addition and subtraction of vectors, absolute and relative motions, motion of a link, velocity analysis of a link by relative velocity method, velocity analysis of four-bar mechanism, slider-crank mechanism and crank and slotted lever mechanism by relative velocity method. Instantaneous centre, number of I-centres, Kennedy's theorem, locating I-centres, velocity analysis of four bar and slider crank mechanisms by I-centre method.

Acceleration analysis of mechanisms: Radial and tangential components of acceleration, Angular acceleration, Acceleration analysis of a link by relative acceleration method, Acceleration analysis of four bar mechanisms and slider-crank mechanisms by relative acceleration method. **12 Hrs**

Self study component: Coriolis Component of Acceleration.

UNIT-III

Gears: 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 and under cutting. Methods of avoiding interference and Back lash. Numerical problems. **10 Hrs**

Self study component: Application and limitations of different types of gears.

UNIT-IV

Gear trains: Simple gear trains, Compound gear trains, Reverted gear trains, Epicyclic gear trains, Tabular method of finding velocity ratio of epicyclic gear trains. Estimation of Tooth load and torque in epicyclic gear trains.

Belt drive: Introduction, classification, **(derivation of length of belt not included)** velocity ratio, effect of slip, ratio of belt tensions, effect of centrifugal tension, power transmitted, effect of initial belt tension. V-belts – ratio of belt tensions, power transmitted. Numerical problems. **10 Hrs**

Self study component: Working principle of Automobile differential gear. Comparison of chain drive, belt drive and rope drive.

UNIT-V

Cams: Types of cams, types of followers, Types of follower motion - SHM, Uniform velocity, uniform acceleration and retardation and Cycloidal motion. Displacement, Velocity and acceleration of follower for different types of motion; Displacement diagram for follower motion, Construction of cam profiles - Disc cam with reciprocating follower having knife-edge, roller and flat –faced follower. **10 Hrs**

Self study component: Applications of different types of cams.

Text Books

1.S.S. Rattan **"Theory of Machines"** Tata McGraw-Hill, New Delhi, 4th edition, 2015, ISBN: 9789351343479.

2.J.V. Shigley, J.J.Uickers, G R Pennock "**Theory of Machines & Mechanisms"** Oxford University Press, 4th edition 201, ISBN: 9780195371239.

Reference Books

1.Sadhu Singh "**Theory of Machines"** Person Eduction (Singapore) Pvt. Ltd Indian Branch, New Delhi, 2nd Edition, 2006, ISBN: 9788177581270

2.R.S.Khurmi and J.K.Gupta "**Theory of Machines"** S.Chand and Co., 2005, ISBN: 9788121925242.

3.P.L. Ballaney "**Theory of Machines and Mechanisms"** Khanna Publishers, delhi, 24th edition, 2005, ISBN: 9788174091222.

4.R.K. Bansal "**Theory of Machines-1"** Laxmi Publications. 1st edition, 2013, ISBN:9788131809846.

5.J.B.K.Das and P I Shrinivasa Murthy "**Theory of Machines-1"** Sapna book house, ISBN: 9788128001451.

Course Outcomes

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

1. **Identify** various mechanisms, **determine** their degrees of freedom; **describe** various inversions of four bar chain, single and double slider crank chain.
2. **Analyze** velocity of four bar and slider-crank mechanisms by relative velocity method and Instantaneous centre method. **Analyze** acceleration of four bar and slider-crank mechanisms by relative acceleration method.
3. **Classify** different types of gears; **Explain** Spur Gear terminology, law of gearing, interference and Back lash. **Derive** expressions for Path of contact, arc of contact and contact ratio. **Solve** numerical problems related to gears.
4. **Describe** Simple, Compound and Epicyclic gear trains; **Determine** velocity ratio, tooth load and torque in epicyclic gear trains. **Explain** and **calculate** ratio of belt tensions; **Estimate** power transmitted by belt drive; **Analyze** effect of slip, initial and centrifugal belt tension on performance of belt drive.
5. **Explain** cam and follower types; **Explain** different follower Motions; **Construct** cam profiles for different types of follower motions.

Course Articulation Matrix

Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Identify** various mechanisms, **determine** their degrees of freedom; **describe** various inversions of four bar chain, single and double slider crank chain.	**2**	**1**											-	-
CO2	**Analyze** velocity of four bar and slider-crank mechanisms by relative velocity method and Instantaneous centre method. **Analyze** acceleration of four bar and slider-crank mechanisms by relative acceleration method.	**2**	**1**								**2**			-	-
CO3	**Classify** different types of gears; **Explain** Spur Gear terminology, law of gearing, interference and Back lash. **Derive** expressions for Path of contact, arc of contact and contact ratio. **Solve** numerical problems related to gears.	**2**	**2**	**2**										-	-
CO4	**Describe** Simple, Compound and Epicyclic gear trains; **Determine** velocity ratio, tooth load and torque in epicyclic gear trains. **Explain** and **calculate** ratio of belt tensions; **Estimate** power transmitted by belt drive; **Analyze** effect of slip, initial and centrifugal belt tension on performance of belt drive.	**2**	**2**	**2**										-	-
CO5	**Explain** cam and follower types; **Explain** different follower Motions; **Construct** cam profiles for different types of follower motions.	**2**	**2**	**2**							**2**			-	-

Course Title: **Manufacturing Process - II**			
Course Code: **P18ME46**	Semester: IV	L-T-P: 2-2-0	Credits: 03
Contact Period - Lecture: 52Hrs. Exam: 3Hrs.		Weightage: CIE: 50 %;SEE: 50%	

Course Objectives: This course enables the student to understand basic manufacturing processes like forging, rolling, sheet metal forming and powder metallurgy.

Course Content

UNIT-I

INTRODUCTION TO METAL WORKING: Classification of metal working processes, characteristics of wrought products, advantages and limitations of metal working processes. Concepts of true stress, true strain, biaxial & triaxial stresses. Determination of flow stress. Principal stresses, Tresca & Von-**Mises** yield criteria, concepts of plane stress & plane strain. Temperature, strain rate, friction and lubrication, hydrostatic pressure in metalworking, Deformation zone geometry, workability of materials. **12 Hrs**

Self study component: Residual stresses in wrought products

UNIT-II

FORGING & ROLLING: classification of forging processes. Forging machines & equipment. Expressions for forging pressures & load in open die forging and closed die forging by slab analysis, concepts of friction hill and factors affecting it, Die-design parameters. Material flow lines in forging. Forging defects, Residual stresses in forging. Simple problems. Classification of Rolling processes. Types of rolling mills, expression for Rolling load. Roll separating force. Frictional losses in bearing, power required rolling, Effects of front & back tensions, frictions, friction hill. Defects in rolled products. Numericals. **10 Hrs**

Self study component: Safety issues in forging and rolling operations

UNIT-III

EXTRUSION & WIRE DRAWING: Types, Application, Variables in extrusion, Extrusion dies. Relationship between speed of extrusion and extrusion pressure. Special extrusion processes: Impact extrusion, hydrostatic extrusion, extrusion of brittle metals, Seamless Tube extrusion, Closed cavity extrusion, Powder extrusion. Metal flow pattern in extrusion with and without lubrication. Defects in extruded products. Analysis for extrusion force problems. Introduction to wire drawing, Drawing ratio, Steps in drawing operation Work done in homogenous deformation. Work formula for wire drawing. Max. Possible reduction of area per pass. Drawing equipment & dies, Drawing speed Vs wire diameter. Drawing stress Vs strain. Expression for drawing load by slab analysis. Power requirement. Redundant work and its estimation, optimal cone angle & dead zone formation, drawing variables, Numericals. **10 Hrs**

Self study component: Tube drawing process and classification of tube drawing

UNIT-IV

SHEET & METAL FORMING: Forming methods, dies & punches, progressive die, compound die and combination die. Rubber forming. Open back inclinable press (OBI press), piercing, blanking, bending, deep drawing, LDR in drawing, Forming limit criterion, defects of drawn products, stretch forming. Roll bending & contouring, Sheet metal drawing process, types. Deep drawing, stresses in deep drawing, Numericals. **10 Hrs**

Self study component: Safety aspects in forming operations.

UNIT-V

POWDER METALLURGY: Basic steps in Powder metallurgy brief description of methods of production of metal powders, Characteristics of powder. Conditioning and blending powders, Compaction and sintering. Sintering types, Mechanism of Sintering, Effect of sintering on structure and dimensional changes. Sintering furnaces, post sintering operations. Application of powder metallurgy components, advantages and limitations.

PROCESSING OF PLASTICS AND CERAMICS: Introduction, types of plastics, Processing of rubber, elastomers and ceramics. **10 Hrs**

Self study component: Health and safety issues in processing of plastics and rubber.

Text Books

1.George E. Dieter, "**Mechanical Metallurgy,"** Tata Mc Graw Hill Education, 3rd Edition, 2013, ISBN**:** 9781259064791.

2.Serope Kalpakjian & Stevan R. Schmid, **"Manufacturing Engineering and Technology,"** Pearson Education; 4th Edition, 2014, ISBN: 978-9332535800

Reference Books

1.J.T. Black, Ronald A. Kohser, "**Materials and Processes in manufacturing,"** Wiley, 11th Edition, 2011, ISBN: 978-0470924679.

2.G. W. Rowe, "**Principles of Industrial metal working process,"** CBS Publisher, 1st Edition, 2005, ISBN: 978-8123904283

3.Amitabha Ghosh and Asok Kumar Mallik, "**Manufacturing Science,"** East-West press Pvt. Ltd., 2010, ISBN: 978-8176710633

4. Sadhu Singh, **Theory of Plasticity & Metal Forming Processes,"** Khanna Publishers, 2003, ISBN: 978-8174090508

Course Outcomes

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

1.**Describe** different metal working processes and its applications.
2.**Illustrate** metal working processes
3.**Analyse** stresses and strain rate in metal working processes
4.**Explain** powder **metallurgy** process.
5.**Discuss** processing of plastics and ceramics.

Course Articulation Matrix

Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Describe** different metal working processes and its applications.	**3**	**2**	**1**									**1**	-	-
CO2	**Illustrate** metal working processes	**3**	**2**	**1**									**1**	-	-
CO3	**Analyse** stresses and strain rate in metal working processes	**3**	**2**	**1**									**1**	-	-
CO4	**Explain** powder metallurgy process.	**3**	**2**	**1**									**1**	-	-
CO5	**Discuss** processing of plastics and ceramics.	**3**	**2**	**1**									**1**	-	-

Course Title: **Metrology & Measurements laboratory**			
Course Code: **P18MEL47**	Semester: IV	L-T-P: 0-0-3	Credits: 1.5
Contact Period - Lecture: 36Hrs. Exam: 3Hrs.		Weightage: CIE: 50 %;SEE: 50%	

Course Objectives: The course aims at making students familiar with different measurement equipments and use of this in industry for quality inspection and safety.

Course Content

PART-A

Exp-1
Calibration of LVDT **3 Hrs**

Exp-2
Calibration of Load Cell **3 Hrs**

Exp-3
Use of Planimeter **3 Hrs**

Exp-4
Measurements of alignment using Autocollimator / roller set **3 Hrs**

PART-B

Exp-5
Measurements of angle using Sine Center / Sine bar / Bevel protractor **3 Hrs**

Exp-6
Measurements of Screw thread Parameters using two wire and three-wire method. **3 Hrs**

Exp-7
Measurements using Profile Projector / Toolmaker's Microscope **3 Hrs**

Exp-8
Measurements of cutting tool forces using
a) Lathe tool Dynamometer
b) Drill tool Dynamometer **3 Hrs**

Exp-9
Measurements of Surface roughness using Tally surf/mechanical Comparator. **3 Hrs**

Seminar **3 Hrs**

Test **3 Hrs**

Reference Books

1.R. K. Jain, "**Engineering Metrology,"** 21st Edition, Khanna Publishers, ISBN: 978-817409153X
2.R. S. Sirohi and H. C. Radha Krishna, **"Mechanical Measurements,"** 3rd Edition, 1991, New Age International, ISBN: 978-8122403831.

Course Outcomes

After learning all the units of the course, the student is able to;
1.**Demonstrate** calibration of pressure gauge, thermocouple and LVDT
2.**Use** Vernier/Micrometer and Sine Center / Sine bar / bevel protractor for measurement of linear dimension and angular.
3.**Measure** the thread parameters using two wire or three-wire method.
4.**Use** tool makers microscope / profile projector for measurement of the thread parameters

and tool wear

5.**Use** Tally surf/mechanical Comparator to Measure Surface roughness

Course Articulation Matrix

Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Demonstrate** calibration of pressure gauge, thermocouple and LVDT	**3**		**2**	**3**			**1**						**-**	**-**
CO2	**Use** Vernier/Micrometer and Sine Center / Sine bar / bevel protractor for measurement of linear dimension and angular.	**3**			**3**									**-**	**1**
CO3	**Measure** the thread parameters using two wire or three-wire methods.	**3**			**3**									**-**	**-**
CO4	**Use** tool makers microscope / profile projector for measurement of the thread parameters and tool wear	**3**			**3**									**-**	**-**
CO5	**Use** Tally surf/mechanical Comparator to Measure Surface roughness	**3**	**3**		**3**		**3**							**-**	**1**

Course Title: **Basic Material Testing Laboratory**			
Course Code: **P18MEL48**	Semester: IV	L-T-P: 0-0-3	Credits: 1.5
Contact Period - Lecture: 36Hrs. Exam: 3Hrs.		Weightage: CIE: 50 %; SEE: 50%	

Course Objectives: To learn how to characterize and determine the basic mechanical properties and behaviors of engineering materials and to introduce variety of material testing equipments and techniques.

Course Content

PART-A

Exp-1

Tensile, Compression, Shear and Torsion tests on mild steel specimens using a Universal Testing Machine **6 Hrs**

Exp-2: Bending Test on mild steel, wooden specimens. **3 Hrs**

Exp-3

Preparation of specimen for metallographic examination of different engineering materials. Identification of microstructures of plain carbon steel, tool steel, grey CI, SG iron, Brass, Bronze and composites. **6 Hrs**

PART-B

Exp-4

Impact Tests: Izod and Charpy tests on mild steel specimens. **3 Hrs**

Exp-5

Hardness tests: Brinnell, Rockwell and Vickers's Hardness tests. **3 Hrs**

Exp-6

Heat treatment: Annealing, Normalizing, Hardening and Tempering of Ferrous alloys and study their Rock well's hardness. **6 Hrs**

Exp-7

Fatigue test- 4 point bending (Demonstration only) **3 Hrs**

Seminar **3 Hrs**

Test **3 Hrs**

Reference Books

1. William D. Callister and David G. Rethwisch, "**Materials Science and Engineering"** Wiley India Pvt. Ltd, 9th edition, 2014, ISBN: 978-1118319222.
2. Sidney Avner, "I**ntroduction to Physical Metallurgy"** Tata McGraw Hill Education Private Ltd., 2nd edition, 1997, ISBN: 978-0074630068.

Course Outcomes

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

1. **Determine** the mechanical properties of material specimen.
2. **Prepare** material specimen for metallographic studies and **recognize** the micro structural features of material.
3. **Demonstrate** heat treatment of metal specimens.
4. **Demonstrate** 4 point bending fatigue test.

Course Articulation Matrix															
Course Outcomes		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Determine** the mechanical properties of material specimen.		**3**	**3**	**3**	**2**				**2**				-	-
CO2	**Prepare** material specimen for metallographic studies and **recognize** the micro structural features of material.				**3**	**3**				**2**				-	-
CO3	**Demonstrate** heat treatment of metal specimens.				**2**		**2**			**2**				-	-
CO4	**Demonstrate** 4 point bending fatigue test.		**3**		**3**	**2**	**2**			**2**				-	-

Course Title: **Aptitude and Reasoning Development - INTERMEDIATE (ARDI)**			
Course Code: **P18HU49**	Semester: IV	L-T-P-H: 0-0-2-2	Credits: 01
Contact Period - Lecture: 32Hrs. ; Exam:3Hrs.	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.

Self-study Component- 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. **8Hrs**

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 solv e 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 r 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

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.
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.
3. Apply the concept of L.C.M in the module time and work to solve the problems with comprehension.
4. Analyze the concepts in Co-ordinate geometry by spatial visualization.
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.
6. Determine the solutions for complicated problems of set theory using the concept of venn diagram.

Course Title: **Additional Mathematics-II**			
Course Code: **P18MADIP41**	Semester: IV	L-T-P-H: 4-0-0-4	Credits: **0**
Contact Period - Lecture: 52Hrs. Exam: 3Hrs.	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

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..

Self-study Components: 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. and variation of parameters. Solution of Cauchy's homogeneous linear equation and Legendre's linear differential equation.

Self-study Components: Method of undetermined coefficients **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.

Self-study Components: 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.

Self-study Components: 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 Books

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

Reference Books

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