SYLLABUS

With effect from 2017-2018
Outcome Based Education and Choice Based Credit System

ಪಠ್ಯಕ್ರಮ

ಶೈಕ್ಷಣಿಕವರ್ಷ 2017–18
ಫಲಿತಾಂಶ ಆಧಾರಿತ ಶಿಕ್ಷಣ ಹಾಗೂ ಐಚ್ಛಿಕ ವಿಷಯಾಧಾರಿತ ಗಳಿಕೆ ಪದ್ಧತಿ

III and IV Semester

BACHELOR DEGREE
IN
INDUSTRIAL & PRODUCTION ENGINEERING

P.E.S. College of Engineering

Mandya - 571 401, Karnataka
(An Autonomous Institution under VTU, Belagavi)

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

ಮಂಡ್ಯ–571 401, ಕರ್ನಾಟಕ
(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

Preface

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

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

Our Higher Educational Institution has adopted the Choice Based Credit System (*CBCS) based semester structure with OBE scheme and grading system.*

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

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

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

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

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

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

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Dean (Academic)
Professor,
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Vision and Mission of the Institution

Vision

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

Mission

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

DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

About The Department

The Department of Industrial & Production Engineering was started during the year 1982 with a mission to produce the students of good management skill to cater the need of the advanced and globalized market which demand quality management people. The program offered in the department is B.E. in Industrial & Production Engineering. The department has very well experienced qualified teaching faculty among which three doctoral degree holders one is submitting his thesis and two are pursuing Post graduate courses.

The department strives hard to bring out well qualified students through all the available sources of teaching audio visual, interactive methods in teaching-learning process. The department has well-equipped laboratories, latest software facilities, to prepare the students industry ready when they become graduates.

The curriculum is designed involving industry, academia personnel to meet the demands of the current scenario and updated constantly according to industrial needs. The department regularly organizes technical talks by inviting experts from various industries and institutes, organizes industrial visits to enhance the practical knowledge of the students.

Vision and Mission of the Department

- **VISION**

Contribute to achieve or pursue academic excellence for imparting quality education in I & P Engineering and to carry out the research activity on continuous basis to develop competent and social responsible engineers and managers.

- **MISSION**

1. To educate them in the fundamental concept, knowledge, skills in theory and practices.
2. To prepare them through skilled programmes for better Employment as engineers and managers or pursuit of advanced degrees in Industrial, Production and Mechanical Engineering fields.
3. To inculcate qualities of communication skills, professional personality and ethical values to make them the responsible and competent professionals.

Program Educational Objectives (PEO)

PEO1: Industrial and Production Engineering program will prepare graduates who will have the ability to apply the principles and techniques of traditional and modern quantitative, qualitative analysis, synthesis and effectively interpret, evaluate, select, and communicate the desired alternative in both manufacturing and service industries.

PEO2: Industrial and Production Engineering program will prepare its graduates who will possess the required engineering competence in industrial engineering, production engineering and managerial skills.

PEO3: Industrial and Production Engineering program will prepare graduates, who possess communication skills, professional personality and ethical

Program Outcomes

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. 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.

PO3. 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

PO4. 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.

PO5. 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.

PO6. 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.

PO7. 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.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. 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.

PO11. 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

PO12. 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.

Program Specific Outcomes (PSOs):

PSO 1: Industrial & Production Engineering graduates will be able to apply the knowledge acquired in the program about materials and finishing process.

PSO2: Industrial & Production Engineering graduates will be able design product based on Ergonomic Principles

SCHEME OF TEACHING AND EXAMINATION

III Semester B. E. (I&P E)

Sl No	Subject Code	Subject Title	Teaching Department	Credits	Teaching Hours / Week	Examination Duration / Marks		
					L : T : P: H	CIE	SEE	Total
1	P17MAT31	Engineering Mathematics - III	Maths	4	3:2:0:5	50	50	100
2	P17IP32	Mechanical Measurements & Metrology.	I&P E	4	4:0:0:4	50	50	100
3	P17IP33	Material Science and Metallurgy.	I&P E	4	4:0:0:4	50	50	100
4	P17IP34	Mechanics of Materials.	I&P E	4	4:1:0:5	50	50	100
5	P17IP35	Fluid Mechanics and Machinery.	I&P E	4	4:0:0:4	50	50	100
6	P17IP36	Manufacturing Technology – 1	I&P E	3	4:0:0:4	50	50	100
7	P17IPL37	Metrology Lab.	I&P E	1.5	0:0:3:3	50	50	100
8	P17IPL38	Foundry and Forging Lab.	I&P E	1.5	0:0:3:3	50	50	100
9	P17HUDIP39	Comprehensive Communication Development (CCD)	HS & M	[2]	2:0:0:2	[50]	[50]	[100]
10	P17HU39	**Aptitude and Reasoning Development – BEGINNER (ARDB)	HS & M	0	2:0:0:2	[50]	---	---
11	P17MADIP31	*Additional Maths – I	Maths	0	4:0:0:4	---	---	---
12	P17HMDIP310	*Indian Constitution. Human Rights & Professional Ethics	Human & Science	2	2:0:0:2	---	---	---
Total				**26 [28]**		**400 [450]**	**400 [450]**	**800 [900]**

***Additional Maths – 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.**

Note:-L : Lecture, **T :** Tutorial, **P :** Practical's, **CIE** : Continuous Internal Evaluation, **SEE :** Semester End Examination

SCHEME OF TEACHING AND EXAMINATION

IV Semester B. E. (I&P E)

Sl No	Subject Code	Subject Title	Teaching Department	Credits	Teaching Hours / Week	Examination Duration / Marks		
					L : T : P: H	CIE	SEE	Total
1	P17MAAC41*/ P17MAES41**	Engineering Mathematics - IV	Maths	4	3:2:0:5	50	50	100
2	P17IP42	CAD / CAM	I&P E	4	4:0:0:4	50	50	100
3	P17IP43	Engineering Thermodynamics	I&P E	4	4:1:0:5	50	50	100
4	P17IP44	Theory of Machines	I&P E	4	4:0:0:4	50	50	100
5	P17IP45	Manufacturing Technology – II	I&P E	4	4:0:0:4	50	50	100
6	P17IP46	Computer Aided Machine Drawing	I&P E	3	2:0:4:6	50	50	100
7	P17IPL47	Material Testing & Metallography Lab	I&P E	1.5	0:0:3:3	50	50	100
8	P17IPL48	Machine Shop Practice	I&P E	1.5	0:0:3:3	50	50	100
9	P17HU49	Aptitude and Reasoning Development – Intermediate (ARDI)	HS & M	1	2:0:0:2	50	50	100
10	P17MADIP41	*Additional Maths - II	Maths	0	4:0:0:4	---	---	---
11	P17EVDIP410	*Environmental Studies	Env	0	2:0:0:2	---	---	---
Total				**27**		**450**	**450**	**900**

***Additional Maths – 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 IPE)** ****Common to BE (CS, EC, E & E and IS & E)**

Note:-L : Lecture, **T :** Tutorial, **P :** Practical's, **CIE** : Continuous Internal Evaluation, **SEE :** Semester End Examination

Course Title: **Engineering Mathematics-III**			
Course Code: P17MAT31	Semester: III	L – T – P – H : 3– 2 – 0 – 5	Credits: 4
Contact Period - Lecture: 52Hrs.; Exam: 3Hrs.		Weightage: CIE: 50 %;	SEE: 50%

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

Course Learning Objectives (CLOs):
The course P17MA31 aims to:

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

Relevance of the course:

- Engineering Mathematics-III deals with the Numerical methods to solve interpolation and extrapolation problems in engineering field.
- In Fourier series analyze engineering problems arising in control theory and fluid flow phenomena using harmonic analysis
- Analyze the engineering problems arising in signals and systems, digital signal processing using Fourier transform techniques.
- Z-transforms & Z-transforms of standard functions to solve the specific problems by using properties of Z-transforms.
- Identify and solve difference equations arising in engineering applications using inverse Z– transforms techniques
- Partial Differential Equations (PDE's), order, degree and formation of PDE's and, to solve PDE's by various methods of solution.
- One – dimensional wave and heat equation and Laplace's equation and physical significance of their solutions to the problems selected from engineering field.

Course Content

UNIT-I

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

Central Differences: Gauss Forward and Backward difference formulae, Sterling's, and Bessel's formulae (All formulae without proof) – problems. **10 Hours**

Self-Study Component: *Problems using Everett's formula in Central differences.*

UNIT-II

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

Numerical Integration: Newton- Cotes quadrature formula, Trapezoidal rule, Simpson's $(\frac{1}{3})^{rd}$ rule, Simpson's $(\frac{3}{8})^{th}$ rule, Boole's rule and Weddle's rule (All rules without proof)- Illustrative problems. **10 Hours**

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

UNIT-III

Fourier Series: Periodic functions, Fourier series- Euler's formula, Dirichlet's conditions. Fourier series of discontinuous functions, Fourier series of even and odd functions. Change of interval- Fourier series of functions of arbitrary period. Half–range Fourier series expansions, Fourier series in complex form, Practical harmonic analysis- Illustrative examples from engineering field. **11 Hours**

Self-Study Component: *Derivations of Euler's formulae*

UNIT-IV

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

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

10 Hours

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

UNIT-V

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

Applications of PDE's: One- dimensional wave and heat equations (No derivation), and various possible solutions of these by the method of separation of variables. D'Alembert's solution of wave equation. Two dimensional Laplace's equation (No derivation)–various possible solutions. Solution of all these equations with specified boundary conditions (Boundary value problems). Illustrative examples from engineering field. **11 Hours**

Self-Study Component: *Finding the solution of non-linear equations of first order: Charpit's Method -simple problem.*

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 Outcomes

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

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

Course Articulation Matrix (CAM)													
Sl. No	**Course Outcome**	**Program outcome**											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	Apply forward, backward difference formulae and central differences formulae in solving interpolation- extrapolation problems in engineering field.	1	2										
CO2	Numerical differentiation and integration rules in solving engineering where the handling of numerical methods are inevitable	2	2										
CO3	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										
CO4	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										
CO5	Define Partial Differential Equations (PDE's),order, degree and formation of PDE's and, to solve PDE's by various methods of solution Explain one - dimensional wave and heat equation and Laplace's equation and physical significance of their solutions to the problems selected from engineering field.	2	3										

Course Title: **Mechanical Measurement and Metrology**			
Course Code: P17IP32	Semester: III	L-T-P-H: 4-0-0-4	Credits: 4
Contact Period - Lecture: 52 Hrs.; Exam:3Hrs.		Weightage: CIE: 50 %;	SEE: 50%

Prerequisites: Students should have the knowledge of basics of workshop practice, understanding of reading various instruments, like Scale, compass, inside and also outside calipers, Spirit level, Tri square, Micrometer, Vernier Caliper, etc.

Course Learning Objectives:

This course aims to:

1. Understand the students gain the knowledge in the field of mechanical measurement and Engineering Metrology.[L2]
2. Apply the fundamental concepts transducers.[L3]
3. Understand the basics concept of Mechanical Measurement.[L2]
4. Analyze the conception of Taylor principal for Go and No-Go Gauge design. [L4]
5. Demonstrate the operation principles, advantages, applications, limitations of the various comparators.[L3]
6. Apply the various flatness measurements technique and their application. [L3]
7. Analyze the different constructional feature of optical measuring instruments. [L4]

Relevance of the Course

The course aims at developing the concepts and understanding of basic measurement in Mechanical Measurements and Metrology. It helps in developing the student's skill in measurement techniques and implementation of ideas of measurement in various field of engineering application.

1.

Course Content

UNIT-I

The process of measurement: an overview: Introduction, Definition and Basic Concepts, Requirement, Significance, Fundamental Methods of measurement, generalized measuring System,

Sensors: Introduction, Primary and Secondary transducers, Variable-Resistance Transducer Elements, Sliding contact devices, Differential Transformer, Variable-Inductance Transducer, Variable-Reluctance Transducer and Piezo-Type Sensors. **10 Hours**

SSC: *Concept of sensor in Industrial application*

UNIT-II

Measurement of Force and Torque: Introduction, Measuring Methods.

Elastic Transducers: Calibration Adjustment, Proving Ring, Strain-Gauge Load cells, Temperature Sensitivity, Hydraulic and Pneumatic Systems, Prony Brake.

Torque Measurement: Mechanical and Hydraulic Dynamometers, Electric Dynamometers, Transmission Dynamometers. **10 Hours**

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

UNIT-III

General Measurement Concepts and Principles: Definition of accuracy and precision, estimating accuracy and precision, Line and End measurements, Subdivisions of Standards,

Different types of length standards: Imperial standard yard, International yard, International prototype meter, Light wave (optical) length standard, Limits, fits and tolerance, Hole basis system and shaft basis system (Simple problems). **10 Hours**

SSC: *Application of Time standard in measuring system*

UNIT-IV

Gauges: Classification of gauges, Brief concept of designing of gauges (Taylor's principle for Go and No-Go) wear allowance on gauges. Three basic types of gauges, Problems on designing of gauges.

Types of gauges: plain plug gauge, ring gauge, snap gauge, thread gauge, screw pitch gauge, feeler gauge, wire gauge, slip gauge**.**

Measurement and Checking using Different Instruments: Straightness, Flatness, Squareness, Sine bars- Sine center construction and working principle. **10 Hours**

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

UNIT-V

Comparators: Need for a comparator, Mechanical, Optical, Pneumatic, Electrical and Electronic Comparator- Construction, working principle, Applications, advantage, disadvantage of the various comparators.

Optical Measuring Instruments: Interference of light, Arrangement for producing interference pattern, Principal operation of Optical flats, Interference Patterns, Construction and Principle of Laser interferometer, Tool Maker's Microscope, Optical projectors, Autocollimators. **12 Hours**

SSC: *Application of optical flat in engineering field*

Text Book

1. Mechanical Measurements – Thomas G.Beckwith, Lewis Buck & Roy D.Marangoni, Narosa publishing House, New Delhi,1993
2. Metrology and measurement – Anand K Bewoor and V inay A Kulkararni The McGraw-Hill Company
3. Mechanical Measurements and Control - D.S.KUMAR, Metropolitan Publishers
4. I.C. Gupta, Engineering Metrology–Dhanpat Rai Publications(P) LTD, New Delhi, 2002

Reference Books:

1. K. J. Hume, “Engineering Metrology”, KalyaniPublis hers, Third Edition.
2. ASTME – Hand book of Industrial Metrology – PHI

Course Outcomes

After learning all the units of the course the students is able to

1. Explain the necessity of transducer in the field of mechanical measurement
2. Demonstrate the essential need of torque measurement in mechanical measurement
3. Determine the general measurement in the field of metrology
4. Demonstrate the essential need of gauges and Taylor’s principal in the field of metrology
5. Use of different types of comparators and interferometer.

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 necessity of transducer in the field of mechanical measurement	1		2		2								1	
CO2	Demonstrate the essential need of torque measurement in mechanical measurement	1	1			2									
CO3	Determine the general measurement in the field of metrology.	1	1			3							2		
CO4	Demonstrate the essential need of gauges and Taylor's principal in the field of metrology	1	1	2		2							1	1	
CO5	Use of different types of comparators and interferometer	1	1			2							1	1	

Course Title: **Material Science and Metallurgy**			
Course Code: P17IP33	Semester: III	L-T-P-H: 4-0-0-4	Credits: 4
Contact Period - Lecture: 52 Hrs.; Exam:3Hrs.		Weightage: CIE: 50 %;	SEE: 50%

Prerequisites: The students should have undergone the course on Elements of Mechanical Engineering.

Course Learning Objectives (CLOs):

The Course aims to:

1. Understand the concept of Unit cell, Space Lattice, Atomic Packing Factor, Coordination Number and different types of Crystal Imperfections, the concept of Mechanical Properties of the materials.[L2]
2. Apply the concept and mechanism of Fracture, Fatigue and Creep.[L2]
3. Construct and analyze the different types of Solid Solutions and Iron Carbon Equilibrium diagram.[L3]
4. Analyze and explain the different heat treatment techniques to improve the specific properties of the engineering materials.[L4]
5. Identify the composition, properties and application of ferrous and non-ferrous materials.[L3]

Relevance of the Course:

Material Science and Metallurgy is a basic subject which deals with the concept of,

- Internal Structure of the materials and their properties,
- Investigates the relationship between the Internal Structure and its properties,
- Different methods used for Testing the properties of materials,
- Different methods of failures of materials (Fracture, Fatigue and Creep),
- Preparation of Alloys and study of their compositions,
- Different Engineering materials,
- Synthesis of composites and application of composites.

Course Content

UNIT – I

Structure of Crystalline Solids : Fundamental concepts of Unit cell, Space lattice, Bravis Space lattice, Unit cells for cubic structure & HCP, study of stacking of layers of atoms in cubic structure & HCP, calculations of radius, Coordination Number and Atomic Packing Factor for different cubic structures. Crystal imperfections - Point, line, Surface & Volume defects. Diffusion, Diffusion Mechanism, Fick's laws of diffusion.

Concepts of Stress & Strain: Tensile properties, True Stress & Strain and Plastic deformation - Slip & Twinning. **11 Hours**

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

UNIT – II

Fracture, Fatigue &Creep:

Fracture: Types, Stages in Cup & Cone fracture.

Fatigue: Fatigue tests, S-N curves, Factors affecting fatigue life and protection methods.

Creep: The Creep curves, Mechanisms of Creep, Creep - resistant materials.

Solid Solutions and Phase Diagram: Solid solutions - Types, Rules governing the formation of solids solutions. Phase diagrams - Basic terms, phase rule, cooling curves, construction of phase diagrams, interpretation of equilibriums diagrams, Types of phase diagrams, Lever rule.

SSC: *Study of Peritectic and Monotectic System.* **11 Hours**

UNIT - III

Iron Carbon Equilibrium Diagram: Phases in the Fe-C System, Invariant reactions, critical temperatures, Microstructure 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 & hypereutectoid steels. **9 Hours**

SSC: *Effect of alloying elements on TTT diagram.*

UNIT – IV

Heat Treatment: Annealing and its types, Normalizing, Hardening, Tempering, Martempering, Austempering, Surface hardening like Case hardening, Carburizing, Cyaniding, Nitriding, Induction hardening. Hardenability. Age hardening of Al & Cu alloys.

Ferrous Materials: Properties, Composition and uses of Grey cast iron, malleable iron, SG iron and steel. **11 Hours**

SSC: *Study of Jominy – End Quench Test.*

UNIT – V

Non-Ferrous Materials: Properties, Composition and uses of Copper alloys-brassesand bronzes. Al, Mg & Titanium alloys.

Introduction to Composites: Definition, classifications, types of matrix material sand reinforcements, fundamentals of production of FRP's and MMC's, advantages and applications of composites. **10 Hours**

SSC: *Study of Copper – Zinc Partial Phase diagram.*

Text Books:

1. William. D. Callister**, "Material Science and Engineering – An Introduction",** Wiley India Pvt. Ltd., New Delhi, 6th Edition, 2006.
2. Donald. R. Askeland, Pradeep. P**, "Essentials of Materials for Science and Engineer ing",**Phule Thomson – Engineering, 2006.

Reference Books:

1. James. F. ShackelFord**, "Introduction to Material Science for Engineering ",** Pearson Prentice Hall, New Jersy, 6th Edition. 2006.
2. V. Raghavan**, "Physical Metallurgy, Principles and Practices",** PHI, New Delhi, 2nd Edition 2006.
3. Smith**, "Foundation of Material Science and Engineering",** McGraw Hill, 3rd Edition, 1997.

Course Outcomes:

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

1. Know the Fundamental concepts of Materials, and different Structures of Materials and common types of defects in the materials.
2. Analyze the concept and mechanism of Fracture, Fatigue and Creep.
3. Construct and analyze the different types of Solid Solutions and Iron Carbon Equilibrium diagram.
4. Analyze the different heat treatment techniques to improve the specific properties of the engineering materials.
5. Identify the composition, properties and application of ferrous, non-ferrous materials and composite materials.

Course Articulation Matrix

Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Know the Fundamental concepts of Materials, and different Structures of Materials and common types of defects in the materials.	2		3		2		2	2		2			1	
CO2	Analyze the concept and mechanism of Fracture, Fatigue and Creep.	2	3	2		2			2						
CO3	Construct and analyze the different types of Solid Solutions and Iron Carbon Equilibrium diagram.	2	2				2	2							
CO4	Analyze the different heat treatment techniques to improve the specific properties of the engineering materials.	2	2			3	2	2						2	
CO5	Identify the composition, properties and application of ferrous, non-ferrous materials and composite materials.	2	3	2		2			2					2	

Course Title: **Mechanics of Materials**			
Course Code: P17IP34	Semester: III	L-T-P-H: 4-1-0-5	Credits: 4
Contact Period - Lecture: 52 Hrs; Exam:3Hrs.		Weightage: CIE: 50 %;	SEE: 50%

Prerequisites: The students should have undergone the course on basic concept on stress and strain in Elements of Mechanical Engineering.

Course Learning Objectives (CLOs):

The Course aims to:

1. Define the concept Stress, Strain, deflections, Hooke's law and Poisson's ratio [L1].
2. Solve the problems on composite sections, temperature stresses, etc., [L3].
3. Understand the concept of Thick and thin cylinders [L1].
4. Understand the concept of bending and shear force [L1].
5. Solve the problems related to the deflection of beams and torsion of circular shafts [L3].

Relevance of the Course:

- Mechanics of Materials is a basic subject which deals with the concept of,
- Engineering Stress, Strain, Hooke's law and Poisson's ratio,
- Composite section – Volumetric strain, expression f or volumetric strain, elastic constants.
- Temperature stresses and compound stresses.
- Thick and Thin cylinders – Problems.
- Bending moment and shear force diagrams.
- Deflection of beams – differential equation for deflection.
- Torsion of circular shafts and elastic stability of columns – Euler's theory and problems.

Course Content

UNIT – I

Simple Stress and Strain: Introduction, stress, strain, linear elasticity, Hooke's Law and Poisson's ratio, Stress-Strain relation. Extension / Shortening of a bar, bars with cross sections varying in steps, bars with continuously varying cross sections (circular and rectangular) Principle of super position

Stress in composite section: Volumetric strain, expression for volumetric strain, elastic constants. **11 Hours**

SSC: *Problems on Principle of Superposition.*

UNIT – II

Compound Bars and Temperature Stresses: Temperature stresses (including compound bars).

Compound Stresses: Plane stress, stresses on inclined sections, principal stresses and Maximum shear stresses, Mohr's circle for plane stress. **10Hours**

SSC: *Principle of Complimentary Shear Stresses.*

UNIT – III

Thick and Thin Cylinders: Stresses in thin cylinders, changes in dimensions of cylinder (diameter, length and volume), and Thick cylinders subjected to internal and external pressures (Lame's equation), (compound cylinders not included).

Bending moment and Shear force in beams: Introduction, Types of beams, shear forces and bending moments, sign conventions, relationship between shear force and bending moment, shear force and bending moment diagrams for Simply Supported beams subjected to concentrated loads and uniform distributed load (UDL). **11 Hours**

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

UNIT – IV

Bending and shear stresses in beams: Introduction, theory of simple bending, assumptions in simple bending, relationship between bending stresses and radius of curvature, relationship between bending moment and radius of curvature, , Bending stresses in beams of Uniform cross section, shearing stresses in beams, shear stress across rectangular, circular, symmetrical I and T sections (composite / fletched beams not included). **10 Hours**

SSC: *Moment carrying capacity of different sections.*

UNIT –V

Deflection of beams: Introduction, differential equation for deflection, equations for deflections, slope and moments, Macaulay's method.

Torsion of circular shafts and Elastic stability of columns: Introduction, pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity. Introduction to columns, Euler's theory for axially loaded elastic long columns, derivation of Euler's load for various end conditions, Rankine's formula. **10Hours**

SSC: *Problems on Rankine's formula.*

Text books:

1. Hibbeler, "Mechanics of Materials", Practice Hall, PersonEdu., 2005.
2. James. M. Gere, "Mechanics of Materials", Thomson, Fifth Edition, 2004.

Reference books:

1. S.S. Bhavikatti, "Strength of Materials",VikasPublications House Pvt. Ltd., 2nd Edition, 2006.
2. Dr. R. K. Bansal, "Strength of Materials", LaxmiPublications (P) Ltd, New Delhi, 3rd Edition 1996.
3. R. S. Khurmi, "Strength of Materials", S. Chand & C ompany Ltd, New Delhi, 10th Edition, 2007.

Course Outcomes:

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

1. **Analyze** determinate and indeterminate problems to determine fundamental stress states associated with kinematic modes of deformation.
2. Apply Mechanics of materials equations (and formulas) to the solution of engineering and design problems, and Recognize and extract fundamental modes in combined loading and do the appropriate stress analysis
3. Extract material properties (modulus of elasticity, yield stress, Poisson's ratio) from data and apply these in the solution of problems.
4. Calculate the geometric properties (moments of inertia, centroids, etc) of structural elements and apply these in the solution of problems which will enable them to solve real engineering problems.

5. Identify kinematic modes of deformation (axial, bending, torsional, buckling and two dimensional) and associated stress states on infinitesimal elements and sketch stress distribution over cross sections.

Course Articulation Matrix															
Course Outcomes		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Analyze determinate and indeterminate problems to determine fundamental stress states associated with kinematic modes of deformation.	2	1											1	
CO2	Apply Mechanics of materials equations (and formulas) to the solution of engineering and design problems, and Recognize and extract fundamental modes in combined loading and do the appropriate stress analysis.	1	2												
CO3	Extract material properties (modulus of elasticity, yield stress, Poisson's ratio) from data and apply these in the solution of problems.	3	2	3		3									
CO4	Calculate the geometric properties (moments of inertia, centroids, etc) of structural elements and apply these in the solution of problems which will enable them to solve real engineering problems.	3	2	2		2								2	
CO5	Identify kinematic modes of deformation (axial, bending, torsional, buckling and two dimensional) and associated stress states on infinitesimal elements and sketch stress distribution over cross sections.	3	3	2		3								2	

Course Title: **Fluid Mechanics and Hydraulic Machines**			
Course Code: P17IP35	Semester: III	L-T-P-H: 4-0-0-4	Credits: 4
Contact Period - Lecture: 52 Hrs.; Exam: 3Hrs.		Weightage: CIE: 50 %;	SEE: 50%

Prerequisites: The students should have undergone the course on Elements of Mechanical Engineering.

Course Learning Objectives (CLOs):

This course aims to:

1. Recall the basic principles involved in fluid behavior and equipment's involving fluid flow, thus preparing themselves for an advanced course on hydraulic drives.[L1]
2. Define the properties of fluids, fluid statics and fluid kinematics involving flow.[L1]
3. Explain the equations of motion and demonstrate fluid flow measurement and energy losses in pipe flow.[L2]
4. Explain the operation of energy producing devices like turbines through velocity triangles knowing fully the principles of impact of jets on valves. [L2]
5. Define the velocity triangles for energy absorbing devices like centrifugal pumps and the working principle of reciprocating pump.[L1]

Relevance of the Course

Fluid mechanics and Hydraulics is a basic subject which deals with the concept of,

- Properties of fluids like density, specific weight, specific gravity, viscosity, surface tension and Capillarity.
- Pascal's law, hydrostatic law and relation between various pressures and different manometers,
- Fluid Statics, Archimedes principle and fluid Kinematics types of fluid flow and related equation.
- Fluid flow measurement using venture-meter, orifice meter, Pitot tube.
- Frictional loss in pipe flow by various equations for loss of head from Darcy &Chezy's equation.
- Turbines like Impulse and reaction turbines, Francis turbine, Kaplan turbine to find work done, efficiency, velocity diagrams.
- Hydraulic Machines Impact of jets: Force exerted by the jet on a stationery vertical plate, curved plate, unsymmetrical moving curved plate.
- Reciprocating pumps, Types, work done by single acting and double acting reciprocating pumps
- Centrifugal pump: Advantages of centrifugal pump over Reciprocating pump, working of C/F pump.

Course Content

UNIT – I

Properties of Fluids: Introduction, properties of fluids, density, specific weight, specific gravity, viscosity, thermodynamic properties, surface tension and Capillarity, Vapor pressure and Cavitation.

Fluid Statics: Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, absolute, gauge, atmospheric and vacuum pressures, simple manometers, differential manometers. **10 Hours**

UNIT – II

Fluid Statics. Total pressure and center of pressure for vertical, Horizontal, inclined and curved plane surfaces submerged in liquid.

Buoyancy – center of buoyancy, Archimedes principle metacenter and metacentric height, conditions of equilibrium of floating and submerged bodies. **10 Hours**

UNIT – III

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

Fluid Dynamics: Introduction, equation of motion, Euler's equation of motion, Bernoulli's equation from first principles and Euler's equation, Bernoulli's equation for real fluids.

Fluid Flow measurement: Introduction, venture-meter, orifice meter, Pitot tube. **10 Hours**

UNIT – IV

Flow through pipes: Frictional loss in pipe flow, Darcy & Chezy's equation for loss of head due to friction in pipes, minor energy losses.

Impact of jets: Force exerted by the jet on a stationery vertical plate, Force exerted by the jeton a curved plate moving in the direction of the jet.

Turbines: classification of Hydraulic turbines, Impulse and reaction turbines, work done and efficiency of Pelton wheel and reaction turbine, velocity diagrams, draft tube, (Simple problems only). **10 Hours**

UNIT – V

Pumps

Reciprocating pumps: Types, work done by reciprocating pump, single acting and double acting, coefficient of discharge, Percentage slip, effect of acceleration on piston, Air vessels.

Centrifugal pump: Advantages of centrifugal pump over Reciprocating pump, working of C/F pump, work done by the impeller, losses & efficiency, specific speed, multistage pump. (Simple problems only). **12 Hours**

Text Books:

1. Dr. Bansal.R.K**, Fluid Mechanics & Hydraulic machines**, Lakshmi Publications, 9th ed., 2005.
2. Modi and Seth, **Hydraulics and Fluid Mechanics**.

References:

1. Yunus A, **"Essentials of Fluid Mechanics: Fundamental &applications"** ,Cenegel, John M,Cimbala, Tata MacGraw Hill, 2007.
2. John F.Douglas, Janul and M.Gasiosek and john A. Swaffield, **"Fluid Mechanics** ", Pearson Education Asia, 5th ed., 2008
3. Kumar.D.S,Kataria and Sons., **"Fluid Mechanics and Fluid Power Engineering",** 7th edition, 2010.

Course Outcomes:

After learning all the units of the course the students is able to

1. Explain the properties of fluid like density, specific weight, specific gravity, viscosity etc; estimate the variations of pressure in a static mass of fluid, and Applying Pascal's Law.
2. Explain the principles of fluid kinematics involving different types of flows, velocity and acceleration, continuity equation.
3. Derive the equations of motion and explain fluid flow measurement devices like Venturimeter, orifice meter etc.; evaluate the energy losses in pipe flow.

4. Explain the operation of energy producing devices like turbines through velocity triangles knowing fully the principles of impact of jets on vanes.
5. Draw the velocity triangles to explain the working of energy absorbing device like centrifugal pump and the working principle of reciprocating pump.

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 properties of fluid like density, specific weight, specific gravity, viscosity etc; estimate the variations of pressure in a static mass of fluid, and Applying Pascal's Law.	1		2		2								1	
CO2	Explain the principles of fluid kinematics involving different types of flows, velocity and acceleration, continuity equation.	1	1			2									
CO3	Derive the equations of motion and explain fluid flow measurement devices like Venturimeter, orifice meter etc.; evaluate the energy losses in pipe flow.	1	1			3							2		
CO4	Explain the operation of energy producing devices like turbines through velocity triangles knowing fully the principles of impact of jets on vanes.	1	1	2		2							1	1	
CO5	Draw the velocity triangles to explain the working of energy absorbing device like centrifugal pump and the working principle of reciprocating pump.	1	1			2							1	1	

Course Title: **Manufacturing Technology - I**			
Course Code:P17IP36	Semester: III	L-T-P-H: 4-0-0-4	Credits: 3
Contact Period: Lecture:52Hrs; Exam: 3Hr		Weightage: CIE:50; SEE:50	

Prerequisites: Students should have the knowledge of elements of Mechanical engineering.

Course Learning Objectives (CLO):
This course aims to:

1. Define the concept of Manufacturing processes and the classification of the process.
2. Define the concept and methods used in casting & Sand moulding techniques.
3. Understand the classification and constructional features of furnaces.
4. Understand principle, classification and applications of welding process.

Course Content

UNIT – I

Casting Process:
Introduction: Concept of manufacturing process. Classification of Manufacturing processes. Introduction to Casting process & steps involved. Application, Advantages& Limitations of casting process.
Patterns: Definition, functions, Materials used for pattern, various pattern allowances and their importance. Classification of patterns.
Binder and Additives: Definition, Types, Need, Types of additives used.
Cores: Definition, Need, Types.
Gating and Risering: Principle involved and types
Fettling and Cleaning of Castings. Basic steps involved. Casting defects causes, features and remedies. **11 Hours**
SSC *:* *Steps involved in Casting Design Consideration.*

UNIT -II

Sand Moulding: Types of base sand, properties, requirement of base sand. Types of sand moulds.
Moulding Machines: Jolt type, Squeeze type, Jolt & Squeeze type and sand slinger.
Special Moulding Process: Green sand, Core sand, CO2 mould, Shell mould and Investment mould.
Metal Moulds: Gravity die-casting, Pressure die casting, centrifugal casting, Squeeze Casting, Slush casting, continuous casting and stir casting processes. **10 Hours**
SSC: *Concept of Moulding Sand Test.*

UNIT - III

Melting Furnaces: Classification of furnaces. Constructional features & working principle of Gas fired furnace, Resistance furnace, Coreless Induction furnace, Electric Arc Furnace, Cupola furnace.
Welding Process: Definition, Principles, Classification, Application, Advantages & limitations of welding.
Arc Welding: Principle, Metal Arc welding **(MAW)**, Flux Shielded Metal Arc Welding **(FSMAW)**, Inert Gas Welding **(TIG & MIG)** Submerged Arc Welding **(SAW)** and Atomic Hydrogen Welding processes. **(AHW).** **10 Hours**
SSC*:* *Casting of Aluminium Material and its Application.*

UNIT - IV

Gas Welding: Principle, Oxy–Acetylene welding, Reaction in Gas welding, Flame characteristics, Gas torch construction & working. Forward and backward welding.

Advance welding processes: Resistance welding - principles, Seam welding, Butt welding, Spot welding, projection welding, Friction welding, Explosive welding, Thermit welding, Laser welding and Electron beam welding. **10 Hours**

SSC*:* *Concept of Welding Symbols.*

UNIT – V

Friction Stir Welding: Principle, working, Application, Advantages & Limitations.

Metallurgical Aspects in Welding: Structure of welds, Formation of different zones during welding. Heat affected zone **(HAZ),** Parameters affecting HAZ, Shrinkage & Residual stresses, concept of Electrode, Filler rod & Flux, welding defects – Detection causes & remedy.

Inspection of Casting and Welding: Visual inspections, liquid penetrate inspection, magnetic particle inspection, ultrasonic inspection, radiography. **11 Hours**

SSC: *Welding Applications in Automobile Industry.*

Text Books:

1. P. N. Rao, **"Manufacturing Technology": Foundry Forming and Welding"**, Tata McGraw Hill, 2nd Ed., 2013.
2. Dr. K. Radhakrishna, **"Manufacturing Process-I"**, Sapna Book House, 2nd Edition, 2016.

Reference Books:

1. SeropeKalpakjian and Steuen.R.Schniid - **Manufacturing Technology**, Pearson Education Asia, 5th Edition. 2013.
2. Roy A Lindberg**,"Process and Materials of Manufacturing",** Pearson Edu, 4th Edition, 2010.

Course Outcomes:

After learning all the units of the course the students is able to

1. Explain the requirements of patterns, Binder, Additives and core.
2. Identify and explain different types of Sand Moulds, Moulding Machines &Metal Moulds.
3. Describe different Welding processes and melting furnace with its applications.
4. Identify different advance welding processes with its Industrial applications.
5. Explain metal joining, Inspection techniques and Microstructure concept to meet Industrial requirements.

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 requirements of patterns, Binder, Additives and core	2	2	2		1							2		
CO2	Identify and explain different types of Sand Moulds, Moulding Machines & Metal Moulds.	2	2	2		1							2		
CO3	Describe different Welding processes and melting furnace with its applications.	2	2	1		1							2	2	
CO4	Identify different advance welding processes with its Industrial applications.	3	3	1		1							2	2	
CO5	Explain metal joining, Inspection techniques and Microstructure concept to meet Industrial requirements.	2	2	1		2							2	2	

Course Title: **Metrology Laboratory**			
Course Code: P17IPL37	Semester: III	L-T-P-H: 0-0-3-3	Credits: 1.5
Contact Period - Practical: 36Hrs. Exam: 3Hrs.		Weightage: CIE: 50 %; SEE: 50%	

Course Objectives

The course covers the different areas of measurements. The objective is to provide basic knowledge in the field of industrial metrology through the use of traditional and state of the art instruments, how to select and handle precision measuring tools etc.

Relevance of the Course

1. Metrology lab teaches the students about measurement and calibration of different measuring instruments, implementation ideas for measurement of various Engineering applications.
2. It helps the students to understand the basic measurements in metrology and to enhance the student's skill in measurement techniques.

Course Content

1. Introduction to Metrological instruments like gauges and commonly using instruments.
2. Measurements using Micrometer, Vernier Calliper, Dial Gauges, Height gauges
3. Measurement of inside diameter using internal micrometer/ bore gauge /telescopic gauges
4. Measurements of Dovetail angle using Bevel Protractor / Roller set
5. Measurements of angle using Sine Centre / Sine bar
6. Measurements using Profile Projector
7. Measurements using Toolmaker Microscope/ Vision measuring instrument

8. Measurements of Screw Thread Parameters using thread measuring machine / micrometer.
9. Measurements on Universal length measuring machine
10. Measurements of gear tooth profile using gear tooth Vernier /gear tooth micrometer.
11. Measurements of straightness, squareness using Autocollimator
12. Measurement of roundness, eccentricity using bench centre/ roundness measuring machine
13. Measurement of flatness using Interferometer & Optical Flats
14. Use of comparators: Mechanical/ Electronics/ Pneumatic/ Dial type air gauge
15. Measurements of Surface roughness using roughness tester (demo)

Note: At least 60% of the above experiments should be conducted depending upon the availability of the instruments.

Course outcomes:

At the end of the session students should be able to

1. Conduct and interpret measurement data to estimate measurement uncertainties, control of the production process.
2. Demonstrate the importance of calibration in the field of Metrology and Measurements.

Course Articulation Matrix															
Course Outcomes		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Conduct and interpret measurement data to estimate measurement uncertainties, control of the production process.	2	2	2		2							2	2	
CO2	Demonstrate the importance of calibration in the field of Metrology and Measurement Rology Measurements	2	2	2		2							2	3	

Course Title: **Foundry and Forging Lab.**			
Course Code: P17IPL38	Semester: III	L – T – P– H :0 – 0 – 3–3	Credits: 1.5
Contact Period - Practical: 36Hrs. Exam: 3Hrs.		Weightage: CIE: 50 %; SEE: 50%	

Prerequisites: The student should have studied Production Engineering – I.

Course Learning Objectives:

This course aims to:

1. Able to understand different types of sand molds.
2. Able to learn operations of smith and forging.
3. Able to do calculations for the preparation of given models both in molding and forging.

Course Content

1. **Testing of Moulding sand and Core sand**
   Preparation of sand specimens and conduction of the following tests:

I. Compression, Shear and Tensile tests on Universal Sand Testing Machine. Permeability test
II. Core hardness &Mould hardness tests.
III. Grain fineness number test (Sieve Analysis test)
IV. Clay content test.
V. Moisture content test. **09 Hours**

2. **Foundry Practice**

I. Use of foundry tools and other equipment's.
II. Preparation of moulds using two moulding boxes using patterns or without patterns. (Split pattern, Match plate pattern and Core boxes). **12 Hours**

3. **Forging Operations**

I. Preparing minimum three models involving upsetting, drawing and bending operations. **15 Hours**

Course Outcome

At the end of the session students should be able to

1. Demonstrate the knowledge and necessary skills to perform sand testing and preparation of moulds.
2. Demonstrate the steps involved and necessary skills to perform metal forging operation.

Course Articulation Matrix															
Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Demonstrate the knowledge and necessary skills to perform sand testing and preparation of moulds.	2	2	2		2							2		
CO2	Demonstrate the steps involved and necessary skills to perform metal forging operation	2	2	2		2							2	1	

Course Title: **Aptitude and Reasoning Development - BEGINNER. (ARDB)**			
Course Code : P15HU39	Semester : III	L - T - P– H : 0 - 0 – 0- 2	Credits: NA
Contact Period: Lecture: 32 Hr, Exam: 3 Hr		Weightage :CIE:100% - [P/NP]	

Prerequisites: Basics of mathematics.

Course Learning Objectives (CLOs)

This course aims to

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

Relevance of the course:

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

Course Content

UNIT – I

Sharpen your axe!!

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

Self-Study Component- *Get hands on multiplication tables, increasing the speed in basic arithmetic operations. Classification of numbers.*

Percentage Calculations and Ratio Comparison:

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

Ratio Comparison: calculations method for ratio compressions: 1. the cross multiplication method, 2. percentage value compression method 3. numerator and denominator percentage change method. Method for calculating the value of percentage change in the ratio. Application based problems. **8 Hours**

Self-Study Component- *Thorough with fractions and decimal values. Applications of tabulated fractions. Product of means and extremes.*

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, and 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. **6 Hours**

Self-Study Component- *Basic knowledge of letter positions, Different number series for example – even, odd, prime, composite etc*

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. **6Hours**

Self-Study Component-*Basic arithmetic operations, knowledge about quotient and remainders, multiples and factors.*

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. **6 Hours**

Self-Study Component-*Knowledge about factors, types of factors. Splitting the middle term rule, formula rule.*

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. **6 Hours**

Self-Study Component-*Basic knowledge of directions, Pythagoras theorem. Logical reasoning skills, Relations, Family tree.*

Reference Books:

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

Course Outcomes

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

1. Solve mathematical calculations in less duration compared to the conventional method. L2
2. Give examples for AP, GP and HP and differentiate between them. L1
3. Apply divisibility rules , power cycle method and evaluate the significance of the number system module. L2

4. Point out the errors in the problems concerning inequalities and solve simple equations and problems based on ratio, proportion and variation. L5
5. Solve the problems based on blood relations, directions and arrangement. L4

Course Title: **Additional Mathematics-I**			
Course Code : (P17MADIP31)	Semester : III	L -T- P- H : 0 – 0- 0-4	Credits: NA
Contact Period: Lecture: 32 Hr, Exam: 3 Hr		Weightage :CIE:100% - [P/NP]	

Course Content

UNIT -I

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

Vector Algebra: Scalar and vectors. Vectors addition and subtraction. Multiplication of vectors (Dot and Cross products). Scalar and vector triple products-simple problems. 12

UNIT -II

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

UNIT -III

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

UNIT-IV

Vector Differentiation: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl and Laplacian (Definitions only). Solenoidal and irrotational vector fields-Problems. **10 Hours**

UNIT-V

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

Text Book:

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

References:

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

Course Title: **Engineering Mathematics-IV**			
Course Code: P17MAAC41	Semester: IV	L-T – P- H : 3– 2 – 0 -5	Credits:4
Contact Period - Lecture: 52Hrs.; Exam: 3Hrs.		Weightage: CIE: 50%; SEE: 50%	

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

Course Learning Objectives (CLOs):

This Course aims to:

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

Relevance of the Course:

- Engineering Mathematics-IV deals with Complex analysis. Here we understand the basics of complex variable, analyticity and potential fields through complex potential and conformal transformations interpret the solution in fluid flow and electromagnetic problems.
- The process of complex integration and series representation of functions of complex variables in field theory and other Engineering applications.
- Solving algebraic, transcendental and ordinary differential equations arising in various engineering flow and design data problems.

- In Statistics interpretation and analyzing the data, fitting of curves of best fit for experimental data arising in engineering calculations and analyze the same by expressing in the form of regression lines.
- Probability distributions and use them in analyzing and solving engineering problems associated with probability models
- Variational problems used in structural engineering, aerospace, ground water flows and environmental fluid dynamics, etc
- Understand series solution of ODE's and special functions in engineering fields.

Course Content

UNIT-I

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

Complex integration: complex line integrals. Cauchy theorem, Cauchy integral formula. Taylor's and Laurent's series (Statements only). Singularities, poles and residues. Cauchy residue theorem (statement only). Simple illustrative examples. **11 Hours**

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

UNIT-II

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

Numerical solution of ordinary differential equations (ODE's): Numerical solutions of ODE's of first order first degree – Introduction. Taylor's series method. Modified Euler's method, Runge - Kutta method of IV order, Milne's and Adams predictor & corrector methods (All formulae without proof)**.** **10 Hours**

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

UNIT-III

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

Probability Theory: Brief review of elementary probability theory. Random variables (discrete and continuous)-Introduction to probability distributions- probability mass/density functions and cumulative probability density functions – Illustrative examples. Discrete probability distributions- Binomial and Poisson's distributions; Continuous probability distributions -

exponential and normal distributions. (No derivation of mean and variance). Illustrative examples from engineering and industrial fields. **11 Hours**

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

UNIT-IV

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

Linear Algebra-II: Numerical methods for system of linear equations- Gauss-Jacobi and Gauss- Seidel iterative methods. Relaxation method**.** Determination of largest eigen value and corresponding eigen vector by power method. **11 Hours**

Self-Study Component: *Ramanujan's Method to find the smallest root of a polynomial.*

UNIT-V

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

Series solutions of ODE's and special functions: Power series solution of a second order ODE, Series solution-Frobenius method. Series solution leading to $J_n(x)$- Bessel's function of first kind. Expansions for $J_{1/2}(x)$ *and* $J_{-1/2}(x)$. -simple related examples. Series solutions of Legendre's differential equation leading to $P_n(x)$-Legendre's polynomials. Rodrigue's formula (No Proof) - simple illustrative examples. **10 Hours**

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

Text Books:

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

References:

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

Course Outcomes

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

1. Explain the concept of analyticity and potential fields through complex functional/potential, conformal transformations and interpret the solution in fluid flow and electromagnetic problems and describe the process of complex integration and learn series representation of a function of complex variables, residues and poles.

2. Apply the familiarity of numerical methods for solving algebraic and transcendental equations and demonstrate single-step and multi-step numerical methods for solving ordinary differential equations and interpret the solution in engineering applications.
3. Apply the knowledge of statistics in interpretation the data, fitting of a linear and non-linear curves of best fit for experimental data arising in engineering calculations and analyze the same by expressing in the form of regression lines. And, Illustrate the concept of random variables (discrete/continuous) and related probability distributions and use them in analyzing and solving engineering problems associated with probability models
4. Define the concept of joint probability of two random variables and apply the knowledge of joint probability distribution in interpreting data through statistical measure. And, analyze the notion of higher transition probabilities, the Markov chain and queuing models arising in engineering problems for feasible random events. Understand the procedure of numerically solving large systems of linear algebraic equations and obtaining eigen value and eigen vector corresponding to a large eigen vector, with the aid of standard methods of numerical linear algebra.
5. Explain functional and extremal of functional Euler's equation and applications of calculus of variations to the standard variational problems and basic concepts of reliability theory including failure laws required in the analysis of engineering experiments occurring in engineering fields. Obtain series solution of essential ODE's such as Bessel's and Legendre's differential equations and understand their scientific/engineering utility
6.

Course Articulation Matrix (CAM)

Sl. No	Course Outcome	Program outcome											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	Explain the concept of analyticity and potential fields through complex functional /potential, conformal transformations and interpret the solution in fluid flow and electromagnetic problems and describe the process of complex integration and learn series representation of a function of complex variables, residues and poles. (Unit-I)	2	3										
CO2	Apply the familiarity of numerical methods for solving algebraic and transcendental equations and demonstrate single-step and multi-step numerical methods for solving ordinary differential equations and interpret the solution in engineering applications. (Unit-II)	2	2										
CO3	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-III)	2	3										
CO4	Define the concept of joint probability of two random variables and apply the knowledge of joint probability distribution in interpreting data through statistical measure. And, analyze the notion of higher transition probabilities, the Markov chain and queuing models arising in engineering problems for feasible random events. Understand the procedure of numerically solving large	3	3										

	systems of linear algebraic equations and obtaining eigen value and eigen vector corresponding to a large eigen vector, with the aid of standard methods of numerical linear algebra (Unit-IV)												
CO5	Explain functional and extremal of functional Euler's equation and applications of calculus of variations to the standard variational problems and basic concepts of reliability theory including failure laws required in the analysis of engineering experiments occurring in engineering fields. Obtain series solution of essential ODE's such as Bessel's and Legendre's differential quations and understand their scientific/engineering utility (Unit-V)	3	3										

Course Title: **Computer Aided Design and Manufacturing**			
Course Code: P17IP42	Semester: IV	L-T-P-H: 4-0-0-4	Credits: 4
Contact Period: Lecture:52 Hr Exam: 3Hr		Weightage: CIE:50; SEE:50	

Prerequisites: Students should have the knowledge on basic concept on influence of computer in design and manufacturing.

Course Learning Objectives:
This course aims to:

1. Understand CAD and CAM and the product cycle in conventional and computerized manufacturing environment.
2. Analyze the software configuration, construction of geometry, wire frame and solid modeling.
3. Understand NC, CNC, & DNC technology.
4. Explain in details about group technology and FMS technology.
5. Understand the robot configuration, programming and sensors.

Relevance of the Course
Computer concept & programme is a basic subject which deals with the concept of,

- Hardware & software
- NC, CNC, DNC, graphics etc.
- Flexible manufacturing system.
- Group technology, Robots technology.
- Sensors, frameworks.

Course Content

UNIT –I

Introduction: Role of computers in design and manufacturing. Influence of computers in manufacturing environment. Product cycle in conventional & computerized manufacturing environment. Introduction to CAD, Introduction to CAM. Advantages and disadvantages of CAD and CAM.

Minicomputers, Microcomputers and Programmable Controllers: Introduction, Minicomputers, minicomputer instructions, microprogramming, Microcomputers, Microcomputer instructions, Programmable Controllers, Programming the PC, Programmable control functions and advantages of programmable controller. **10Hours**
SSC: *Study of Computers versus programmable controllers.*

UNIT – II

Computer Graphics: Software configuration of a graphic system, function of a Graphics package, construction of geometry, wire frame and solid modelling, Geometric 2D and 3D homogeneous transformations with simple problems(problems on 2D transformations). Introduction to exchange of modelling data – Basic features of IGES, STEP, DXF, and DMIS. **10 Hours**
SSC: *Problems of 3D Transformations.*

UNIT – III

NC, CNC, DNC Technology: NC, CNC, DNC modes, NC elements, advantages and limitations of NC, CNC. Functions of computer in DNC.

CNC Machine Tools: Turning tools geometry, milling tooling systems, tool presetting, ATC, work holding. CNC machine tools, Overview of different CNC machining centres, CNC turning centres. **12 Hours**

SSC: Study of high speed CNC machine tools.

UNIT – IV

CNC Programming: Part program fundamentals – steps involved in development of a part program. Manual part programming-milling & turning with problems. **10 Hours**

SSC: *Problems on CNC milling and drilling.*

UNIT –V

Group Technology & Flexible Manufacturing: Part families, Part classification & coding, Machine cell design & benefit of GT, FMS work stations, planning the FMS, FMS layout configuration. Analysis method, application and benefit of FMS. Shop floor control, Functions, Shop floor control system.
Industrial Robotics: Introduction, Robot Configuration, Robot Motions, End effectors, Robot Sensor, Robot Applications. **10 Hours**
SSC: *Application of robots in Material Transfer and Assembly.*

Text Books:

1. **CAD / CAM Principles and Applications**- P.N. Rao, TMH, New Delhi, Edition 3, 2010.
2. **CAD/CAM** – Mikell P Groover, Emory W. ZimrnersJr Pearson Education Inc, 2013.

Reference Books:

1. **Principles of Interactive Computer Graphics** - Newman and Sproull, Tata McGraw Hill, 2006.
2. **NC Machine programming & software Design** -Chno-Hwachang, Michel.A. Melkanoff, Prentice Hall, 1989.
3. **Computer Graphics** -Steven Harrington, McGraw Hill Book Co.

4. **Computer Aided Manufacturing** - P.N. Rao, N.K. Tewari and T.K. Kundra Tata McGraw Hill 2010.
5. **Basic Computer Aided Geometric Design** - Ganesh. M – I. K. International, New Delhi – 2011.

Course Outcome

After learning all the units of the course the students is able to

1. Apply knowledge in the field design & manufacturing with help of CAD / CAM
2. Learn and Analyze concepts of graphics package regarding 2D & 3D transformations.
3. Learn concepts of NC, CNC & DNC technology. And also known CNC machine tool & tooling system.
4. Develop steps for CNC part programming and able to solve the problems.
5. Recognize in detail the group technology & coding system also should know FMS technology and know details about the industrial robots and their applications.

Course Articulation Matrix

Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Apply knowledge in the field design & manufacturing with help of CAD / CAM.	2	2	1										1	
CO2	Learn and analyse concepts of graphics package regarding 2D & 3D transformations.	2	2	1											
CO3	Learn concepts of NC, CNC & DNC technology. And also known CNC machine tool & tooling system.	2	2	1											
CO4	Develop steps for CNC part programming and able to solve the problems.	2	2	1										2	
CO5	Recognise in detail the group technology & coding system also should know FMS technology and know details about the industrial robots and their applications.	2	1	1										2	

Course Title: **Engineering Thermodynamics**			
Course Code: P17IP43	Semester: IV	L-T-P-H: 4-1-0-5	Credits: 4
Contact Period - Lecture: 52 Hrs.; Exam:3Hrs.		Weightage: CIE: 50 %; SEE: 50%	

Prerequisites: The students should have undergone the course on Elements of Mechanical Engineering and Engineering Thermodynamics.

Course Learning Objectives (CLO):

The Course aims to:

1. Apply the basic principles of thermodynamics in solving engineering problems knowing the real world engineering examples.[L3]
2. Define thermodynamic system, process, cycle, equilibrium, properties, work and heat transfer in thermodynamic context, laws of thermodynamics and properties of pure substances and perfect gases.[L1]
3. Explain basic constructional features of energy producing cycles like Rankine cycle, Air standard cycle and gas turbine cycles.[L2]
4. Explain the basic principles of energy absorbing device like Air compressor.[L2]

Relevance of the Course:

Engineering Thermodynamics is a basic subject which deals with the concept of,

- Steam power plants, IC engines, Domestic Refrigerator, Room Air conditioner.
- Macroscopic and Microscopic view points, Thermodynamic system and Properties like equilibrium, Quasistatic process, Zeroth law of thermodynamics.
- Thermodynamic definition of work, displacement work, Path and Point functions, expression for P-dv work in various Quasistatic processes and heat transfer
- First law for closed system undergoing a cycle and a change of state, Enthalpy , Specific heat at constant pressure, PMMI, First law applied to a flow process.
- Second law of Thermodynamics, Heat engine and Heat pump and Carnot cycle and Carnot Theorem.
- Pure Substance and Perfect Gas: P-T and P-v diagrams, dryness fraction (Quality), steam tables and its use, charts of thermodynamic properties, T-s and h-s.
- Vapour power cycles – Carnot cycle, Rankine cycle, Efficiency, Effect of pressure and temperature on Rankine cycle, Reheat and Regenerative cycles
- Air standard cycles – Otto, Diesel, Dual cycles, P- v and T-s diagrams.
- Brayton cycle, efficiency, methods to improve the efficiency.
- Operation of a single stage reciprocating compressor, Effect of clearance and Multi-stage compressor.

Course Content

UNIT – I

Introduction: Definition – Engineering Thermodynamics – some practical examples; Simple steam power plants, IC engines, Domestic Refrigerator, Room Air conditioner, Macroscopic and Microscopic view points, Thermodynamic system and control volume, Thermodynamic Properties, Processes and Cycles, Thermodynamic equilibrium, Quasistatic process, units and dimensions, Force, Pressure, Specific Volume and Density, Energy, Power, Temperature, Thermal equilibrium, Zeroth law of thermodynamics, simple problems.

Work and Heat Transfer: Work transfer, Thermodynamic definition of work, sign convention ,P-dv work or displacement work, Path and Point functions, expression for P-dv work in various Quasistatic processes, heat transfer – a path function, Specific heat and latent heat, points to remember about work and heat transfer. **12 Hours**

UNIT – II

Laws of Thermodynamics: First law for closed system undergoing a cycle, First law for a closed system undergoing a change of state, Energy – a property of the system, different form of energies, specific heat at constant volume, Enthalpy , Specific heat at constant pressure, PMMI, First law applied to a flow process.

Second Law of Thermodynamics, Heat engine and efficiency, Heat pump and COP, Energy reservoirs, Kelvin Planck and Clausius Statements of Second law of thermodynamics, PMM II, Reversible and Irreversible processes, Carnot cycle, Carnot Theorem,

Entropy – Clausius inequality, showing cyclic integral of $\delta Q/T$ is independent of path. (No problems on entropy) **10 Hours**

UNIT – III

Pure Substance and Perfect Gas: P-T and P-v diagrams, Triple point and critical points, sub-cooled liquid, saturated liquid, Mixture of saturated liquid and Vapours saturated vapour and superheated vapour states of a pure substance with water as an example, enthalpy of change of phase (latent heat), dryness fraction (Quality), steam tables and its use, charts of thermodynamic properties, T-s and h-s diagrams with constant Property lines, simple problems.

The Perfect Gas: The equation of state of a perfect gas, specific heats, internal energy and enthalpy of an Ideal gas, Reversible adiabatic process, Reversible Isothermal Process, Polytropic process. **10 Hours**

UNIT – IV

Power Cycles: Vapour power cycles – Carnot cycle, Rankine cycle, Efficiency, Steam rate andheat rate, actual vapour cycle process, comparison of Rankine and Carnot cycle, Mean Temperature of Heat addition, Effect of pressure and temperature on Rankine cycle performance, Reheat and Regenerative cycles(simple problems).

Gas power cycles: Air standard cycles – Otto, Diesel, Dual cycles, P -v and T-s diagrams, Description, efficiencies and Mean effective pressures (MEP),comparison of Otto, Diesel and Dual cycles.(no derivation for MEP). **10 Hours**

UNIT – V

Gas Turbine Cycle: Brayton cycle, efficiency, methods to improve the efficiency of Brayton cycle using regeneration, intercooling & reheating (simple problems).

Air Compressors: Operation of a single stage reciprocating compressor, Work input equation through P-v diagram and steady state, steady flow analysis, Effect of clearance and Volumetric efficiency, Adiabatic, Isothermal and Mechanical efficiencies, Multistage compressor, Saving in work, Optimum intermediate pressure, Minimum work for compression.(simple problems). **10 Hours**

Text Books:

1. P.K.Nag, “Basic and Applied Thermodynamics”, Tata M cGraw Hill, 3rd Edi. 2005
2. Yunus A. Cenegal and Michael A.Boles, “Thermodynamicsan engineering approach”, Tata McGraw hill pub. 2008.

Reference Books:

1. J.B.Jones and G.A.Hawkins, “Engineering Thermodynamics: an Introductory, John Wiley and sons.2ndEdn. 2009
2. Y.V.C. Rao, “An Introduction to Thermodynamics”,, U niversity press 2009.

3. R.K.Rajput, "A text book of Engineering Thermodynamics" by, Laxmi Publications, Pvt Ltd, 4th Edn, 2010.

Course Outcomes:

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

1. Explain Working of IC Engines, Refrigerator and Air Conditioner, and to Explain Thermodynamic system and Properties like equilibrium, Quasistatic process, Zeroth law of thermodynamics etc.
2. Apply first and second laws of Thermodynamics to the real world engineering devices knowing fully the limitations of energy conversion.
3. Identify and explain the properties of Pure Substance and Perfect Gas.
4. Explain different Power cycles like Carnot cycle, Rankine cycle, Efficiency, Effect of pressure and temperature on Rankine cycle, Reheat and Regenerative cycles, Air standard cycles – Otto, Diesel, Dual cycles, P-v and T-s dia grams,
5. Recognize the working of gas turbines and air compressor.

Course Articulation Matrix

Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Explain Working of IC Engines, Refrigerator and Air Conditioner, and to Explain Thermodynamic system and Properties like equilibrium, Quasistatic process, Zeroth law of thermodynamics etc.	1		2		2								1	
CO2	Apply first and second laws of Thermodynamics to the real world engineering devices knowing fully the limitations of energy conversion.	1	1			2									
CO3	Identify and explain the properties of Pure Substance and Perfect Gas.	1	1			3							2		
CO4	Explain different Power cycles like Carnot cycle, Rankine cycle, Efficiency, Effect of pressure and temperature on Rankine cycle, Reheat and Regenerative cycles, Air standard cycles – Otto, Diesel, Dual cycles, P-v and T-s dia grams,	1	1	2		2							1	1	
CO5	Recognize the working of gas turbines and air compressor.	1	1			2							1	1	

Course Title: **Theory of Machines**			
Course Code: P17IP44	Semester: IV	L-T-P-H: 4-0-0-4	Credits: 4
Contact Period - Lecture: 52 Hrs.; Exam:3Hrs.		Weightage: CIE: 50 %; SEE: 50%	

Prerequisites: The students should have undergone the course on basic concept on mechanisms and Elements of Mechanical Engineering.

Course Learning Objectives (CLO):

This course aims to:

1. Define link, kinematic pairs, degrees of freedom, kinematic chains and mechanisms [L1].
2. Understand the kinematic chains and Inversions – Four bar chain and single slider crank chain and double slider crank chain [L1].
3. Understand the quick return motion mechanisms and Whitworth mechanisms [L1].
4. Define the gear terminology – Spur gears [L1].
5. Understand the concept of Simple and compound gear trains [L1].
6. Understand the concept Friction [L1].
7. Solve the problems on Balancing [L1].

Relevance of the Course:

Theory of Machines is a basic subject, which deals with the concept of:

- Link or element, Kinematic pairs, degrees of freedom, kinematic chain and mechanisms,
- Mechanisms – quick return motion, whitworth and crank and slotted lever mechanism,
- Spur gears – terminology and law of gearing,
- Gear Trains – Simple and Compound gear trains,
- Belt drives – ratio of belt tensions, centrifugal tension, power transmitted and v-belt.
- Gyroscope and Gyroscopic effects.
- Balancing and Governors.

Course Content

UNIT– I

Introduction: Definitions - Link or element, kinematic pairs, degrees of freedom, Kinematic chain, Mechanism, structure, Mobility of Mechanism, Inversion, Machine. KINEMATIC CHAINS AND INVERSIONS: Inversions of Four bar chain; Single slider crank chain and Double slider crank chain.

Mechanisms: Quick return motion mechanisms Whitworth mechanism and Crank and slotted lever Mechanism. Intermittent Motion mechanisms –Geneva mechanism and Ratchet and Pawl Mechanism. Ackerman steering gear mechanism. **11 Hours**

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

UNIT – II

Gears: Types of Gears, Spur Gear terminology, law of gearing, Gear Tooth Profiles, Characteristics of involute action, Path of contact, Arc of contact, Contact ratio, Interference in involute gears, Methods of avoiding interference.

Gear Trains: Simple gear trains, Compound gear trains for large speed reduction, Epicyclic geartrains, Algebraic and tabular methods of finding velocity ratio of epicyclical gear trains.

10 Hours

SSC: *Uses of different gears and gear trains*

UNIT – III

Belt Drives: Definition, Laws of Static and Dynamic Co-efficient of Friction: Belt drives, ratio of belt tensions, centrifugal tension, power transmitted. Effect of centrifugal tension on power transmitted and V-Belt Drives. **10 Hours**

SSC: *Applications of belt drives*

UNIT - IV

Balancing of Machinery: Static and dynamic balancing, Balancing of single rotating mass in same plane and in different planes. Balancing of several masses rotating in same plane and in different planes. (No graphical method)

Governors: Types of governors; force analysis of porter Governor, Hartnell Governor, controlling force, stability and sensitiveness. **11 Hours**

SSC: *Concept of static and dynamic loads*

UNIT - V

Gyroscopic Effects and Gyroscope: Introduction, Spinning and Precision, Gyroscopic Couple, Effect of Gyroscopic couple on the stability of Automobile Vehicles (Four Wheelers and Two Wheelers), Stability of Two wheelers, Gyroscopic Effects on Ships and Aeroplanes, Gyroscope and Problems on Gyroscopic Couple. **10 Hours**

SSC**:** *Applications and uses of gyroscopic couple in industry*

Text Books:

1. Rattan S.S, "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2nd edition -2005.
2. Thomas ,Bevan , "Theory of Machines", CBS Publications.

Reference books:

1. Shigley. J. V. and Uickers, J.J., "Theory of Machin es& Mechanisms" , OXFORD University press - 2004
2. R.K Bansal, "Theory of Machines", S. Chand; 14th R evised edition, st 2005)
3. R.S.Khurmi, "Theory of Machines"

Course Outcomes

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

1. Calculate mobility (number of degrees-of-freedom) and enumerate rigid links and types of joints within mechanisms, and to Understand gear mechanism classification and to become familiar with gear standardization and specification in design.
2. Explain Terminology of gears and Importance of gear trains and their practical applications.
3. Know uses and advantages of belt drives Types and their nomenclature, Relationship between belt tensions commonly used design parameters.
4. Draw inversions and determine velocity and acceleration of different mechanisms, and to Calculate loss of power due to friction in various machine elements and Importance of Governors.
5. Explain Gyroscopic Effects and Gyroscope in automobile sector.

Course Articulation Matrix															
Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Calculate mobility (number of degrees-of-freedom) and enumerate rigid links and types of joints within mechanisms, and to Understand gear mechanism classification and to become familiar with gear standardization and specification in design.	2	1											1	
CO2	Explain Terminology of gears and Importance of gear trains and their practical applications.	1	2											2	
CO3	Know uses and advantages of belt drives Types and their nomenclature, Relationship between belt tensions commonly used design parameters.	2	2	3		3									
CO4	Draw inversions and determine velocity and acceleration of different mechanisms, and to Calculate loss of power due to friction in various machine elements and Importance of Governors.	3	2	2		2								2	
CO5	Explain Gyroscopic Effects and Gyroscope in automobile sector.	3	2	2		3								2	

Course Title: **Manufacturing Technology - I**			
Course Code:P17IP45	Semester: IV	L-T-P-H: 4-0-0-4	Credits: 4
Contact Period: Lecture:52Hr Exam: 3Hr		Weightage: CIE:50; SEE:50	

Prerequisites: Students should have the knowledge of elements of Mechanical engineering.

Course Learning Objectives:

At the end of the Course the students should be able to:

1. Apply the fundamental concepts, constructions and principal of machine and parts.
2. Demonstrate the operation principles, advantages, applications, limitations of the various machines.
3. Impart knowledge to students about the different type's attachments, and Work holding devices their application.

Course Content

UNIT-I

The Lathe: Introduction, Functions of lathe, types of lathes, parts of lathes, feed mechanism, Lathe accessories- three jaw and four jaw chucks, collets chuck, steady and follower rests, mandrels, operations of lathe, nomenclature of a single point turning tool, cutting speed, feed and depth of cut, machining time(simple problems).

Capstan and Turret lathe: principal parts, turret indexing mechanism, Production of a hexagonal bolt, Differences between Capstan, turret and engine lathe. **11 Hours**

SSC: *Different types of Cutting Tools and its Application.*

UNIT-II

Drilling Machine: Introduction, types of drilling machines, important parts of upright and radial drilling machines, work and tool holding devices, drilling machine operations, twist drill nomenclature, cutting speed, feed, depth of cut, machining time in drilling (simple problems)

Shaper and Planer: Introduction, types, principal parts of a shaper, work holding devices, shaper operations. **Planer:** types, comparison between shaper and planer. **11Hours**

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

UNIT-III

Milling machines: Introduction, classification: -column and knee, plain, universal, vertical milling machine, principal parts of column and knee type, work holding devices, plain milling cutter nomenclature, milling operations, up milling and down milling concepts.

Indexing: Simple, compound, differential and angular indexing calculations. **10 Hours**

SSC*:* *Use of milling machine in Industry.*

UNIT-IV

Grinding Machines: kinds of grinding, Types of grinding machines, Construction and principal parts of plain centre–type grinders, centre less grinders, surface grinders, wet and dry grinding, abrasives, types, bond and Bonding processes, Selection of grinding wheels, mounting the grinding wheels, dressing and truing of grinding wheels, balancing of grinding wheels, Diamond wheels. **10 Hours**

SSC*:* *Application of different materials for surface finishing and machining processes.*

UNIT-V

Surface finishing processes: Lapping, Honing, super finishing operations, polishing, buffing, metal spraying.

Broaching: Introduction, broaching methods, broaching machines, operations, advantages & Limitations.

Gear cutting: Rack cutter generating process, pinion cutter generating process, gear hobbing. **10 Hours**

SSC*:* *Application of surface finishing, broaching and gear cutting in Industry.*

Text Books:

1. Hazara Choudhry, **"** Workshop Technology**",** Vol-II, Media Promoters & Publishers Pvt. Ltd. 2015

Reference Books:

1. Roy A. Lindberg "Manufacturing Process and Materials of Manufacture", Prentice Hall of India, 2008.
2. R.K.Jain, "Production Technology", Khanna Publications, 2010.

3. HMT "Production technology" Tata MacGraw Hill, 2016.

Course Outcome:
After learning all the units of the course the students is able to

1. Identify lathe parts and explain its operations.
2. Explain the drilling machine, its operations and distinguish shaper and planer.
3. Describe the importance of milling machine and solve different types of indexing calculations.
4. Describe the types of grinding machines and abrasive particles with its applications.
5. Summarize surface finishing processes and explain importance of broaching and gear cutting.

Course Articulation Matrix															
Course Outcomes		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Identify lathe parts and explain its operations.	2	2	1		2							2	2	
CO2	Explain the drilling machine, its operations and distinguish shaper and planer.	2	2	1		2							2	2	
CO3	Describe the importance of milling machine and solve different types of indexing calculations.	2	2	1		2							2	2	
CO4	Describe the types of grinding machines and abrasive particles with its applications.	2	2	1		2							2	2	
CO5	Summarize surface finishing processes and explain importance of broaching and gear cutting.	1	1	1		2							2	2	

Course Title: **Computer Aided Machine Drawing**			
Course Code:P17IP46	Semester: IV	L-T-P-H: 2-0-4-6	Credits: 3
Contact Period: Lecture:52Hr Exam: 3Hr		Weightage: CIE:50; SEE:50	

Prerequisites: Students should have the knowledge of Computer aided machine engineering

Course Learning Objectives: To learn and draw the various views, to locate the section line at appropriate location and to assemble the drawings of machine components.

Course Content

PART A

UNIT- I

Sections of Solids: True shape Sections of pyramids, prisms, tetrahedron, cones and cylinders resting only on their bases and section plane inclined to horizontal plane only.

06 Hours

Orthographic Views: Conversion of pictorial views into orthographic projections of simple machine parts with or without section, hidden line conventions, precedence of lines.**08 Hours**

UNIT -II

Thread Forms: Thread terminology, sectional view of threads. ISO Metric -Internal and External, BSW, square, acme and sellers thread.

Fasteners: Hexagonal headed bolt and nut with washer, square headed bolt and nut with washer. **06 Hours**

PART B

UNIT- III

Keys and Joints: Keys: Sunk Taper key, Feather key, Woodruff key and Gib - head key. **Joints:** Single and double riveted lap joints, butt joints with single/double cover straps -chain and zigzag, using snap head rivets. **06 Hours**

UNIT IV

Cotter joint -socket and spigot, knuckle joint (pin joint).

Couplings: Solid muff coupling, protected type flanged coupling and pin (bush) type flexible coupling& Oldham's coupling. **08 Hours**

PART C

UNIT V

Assembly Drawings- (Part drawings should be given)

1. Plummer Block (Pedestal Bearing)
2. Tailstock of a Lathe
3. Machine Vice
4. Tool head of a shaper
5. Screw jack (bottle type)

18 Hours

Software: *Solid works 2015.*

Text Books:

1. **"Machine Drawing"**, K.R. Gopala Krishna, Subhash Publication.2007
2. **"Machine Drawing"**, P.S.Gill, S.K.Kataria and Sons, Seventeenth Revised Edition, 2008.

Reference Books:

1. **"Machine Drawing"**, N.D. Bhat and V.M.Panchal, 2007.
2. A Primer on Computer Aided Machine Drawing-2007**,** Published by VTU, Belgaum.

Course outcomes:

1. Analyze different views of solids of projections and orthographic views.
2. Identify and draw the views of Threads and fasteners.
3. Draw the different types of keys and joints.
4. Draw different types of coupling required to couple two shafts for power transmission
5. Design and assemble different machine parts and other mechanical equipment's.

Internal assessment: 50 Marks

All the sheets should be drawn in the class using software. Sheet sizes should be A3/A4. All sheets must be submitted at the end of the class by taking printouts.

Evaluation Scheme

CIE Scheme

Assessment	Weightage in Marks
Test	15
Submission	35
Total Marks	**50**

SEE Scheme

Semester End Examination (SEE) is a written examination of three hours duration of 100 marks with 50% weightage.

Scheme of Examination

Two questions to be set from each **Part-A, Part-B and Part-C.** Student has to answer one question each from Part-A and Part-B for 20 marks each. And one question from Part-C for 60 marks.

PART-A	1x20	=	20 Marks
PART-B	1x20	=	20 Marks
PART-C	1x60	=	60 Marks
Total		=	100 Marks

Course Articulation Matrix

Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Analyze different views of solids of projections and orthographic views	2	1	2		2							2		
CO2	Identify and draw the views of Threads and fasteners.	2	1	2		2							2		
CO3	Draw the different types of keys and joints.	2	2	2		2							2		
CO4	Draw different types of coupling required to couple two shafts for power transmission	2	2	2		2							2		
CO5	Design and assemble different machine parts and other mechanical equipment's.	3	1	3		2							3		

Course Title: **Material Testing and Metallography Lab**			
Course Code:P17IPL47	Semester: IV	L-T-P-H: 0-0-3-3	Credits: 1.5
Contact Period: Practical:36Hrs Exam: 3Hrs		Weightage: CIE:50; SEE:50	

Prerequisites: Students should have studied Elements of Mechanical Engineering, Materials Science and Metallurgy and Mechanics of Materials.

Course Learning Objectives (CLO):

At the end of the Course the students should be able to:

1. Learn the preparation of the specimen of different engineering materials for identifying the microstructures.
2. Learn hardness with and without heat treated materials.
3. Learn few non-destructive test experiments for detection of Ultrasonic flaw, magnetic crack, dry penetration and also know the defects of casted and welded materials.
4. Learn different material testing machines which are used for testing.

Course Content

1. Tensile test of metallic specimen using Universal Testing Machine.
2. Single shear and double shear using Universal Testing Machine.
3. Compression test on metallic specimen using a Universal Testing Machine.
4. Bending Test on wood using a Universal Testing Machine.
5. Izod and Charpy tests on M.S. Specimen.
6. Brinell, Rockwell and Vickers's Hardness test.
7. Jominy Hardenability Test
8. Hardness studies of heat treated samples
9. Non-destructive test experiments
   (a). Ultrasonic flaw detection
   (b). Magnetic crack detection
10. Demonstrations of the following;
    (a). Preparation of specimen for metallographic examination of different engineering materials and to identify the microstructures.

Course Outcome:

At the end of the session students should be able to

1. **Prepare** the specimen for metallographic examination of nonferrous material and conduct the non-destructive testing.
2. **Conduct** and **evaluate** mechanical properties of the ferrous and nonferrous material.

Course Articulation Matrix															
Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Prepare the specimen for metallographic examination of nonferrous material and conduct the non-destructive testing.	2	2	2		3							2	2	
CO2	Conduct and evaluate mechanical properties of the ferrous and nonferrous material.	2	2	2		3							2	2	

Course Title: **Machine Shop Practice**			
Course Code:P17IPL48	Semester: IV	L-T-P-H: 0-0-3-3	Credits: 1.5
Contact Period: Practical:36Hrs Exam: 3Hrs		Weightage: CIE:50; SEE:50	

Prerequisites: The student should have studied Elements of Mechanical Engineering and Production Technology-II.

Course learning objectives:

At the end of the Course the students should be able to:

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

Course Content

1. Introduction to cutting tools, Machine tools and preparing the layout of machine shop.
2. Preparation of models on lathe involving Facing, Plain turning, Taper turning, Step turning.
3. Thread cutting, Knurling.
4. Boring and Reaming operations.
5. Drilling operations.
6. Eccentric turning.
7. Machining V Groove Rectangular groove using Shaping machine
8. Gear Teeth Cutting using Milling Machine **36 Hours**

Course Outcome

At the end of the session students should be able to

1. Operate Lathe, Drilling, Milling and shaping machine to perform operations like facing, plain turning, step turning, taper turning thread cutting and knurling on lathe, gear cutting on milling machine, drilling and reaming operation on pillar drilling machine, grooves on shaping machine.
2. Do Calculations for taper turning, thread cutting and for Indexing mechanism.

Course Articulation Matrix															
Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Operate Lathe, Drilling, Milling and shaping machine to perform operations like facing, plain turning, step turning, taper turning thread cutting and knurling on lathe, gear cutting on milling machine, drilling and reaming operation on pillar drilling machine, grooves on shaping machine.	2	2	3		3							2	1	
CO2	Do Calculations for taper turning, thread cutting and for Indexing mechanism.	2	2	2		3							2	1	

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

Prerequisites: ARDB

Course Learning Objectives (CLOs):
This course aims to

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

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

Course Content

UNIT – I

Time, Speed and Distance: Concept of motion and mathematical representation of motion, The rule of proportionality, Conversion between kmph to m/s, Concept of average speed and its application in different scenarios, Relative speed– Importance, application and observation in day to day life, same direction and opposite direction, An application of allegation in Time speed and distance, Trains– Different scenarios. Boats and streams– resultant speed, upstream and downstream concept. Circular motion– Two or three bodies meeting at the starting point or anywhere in the track. Races– Concept of head start, solving problems under different constraints. Application of solving problems under Clocks. **6 Hours**

Self-study Component- *Basic relation between the 3 different quantities. Conversions between different units of measurement. Speed and velocity.*

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. **8 Hours**

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

UNIT – III

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

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

Logical Venn diagrams: Analysis of the given problem and solve it. **6 Hours**

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

UNIT – IV

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

Co-ordinate geometry: Cartesian coordinate geometry– rectangular coordinate axis, distance formula, Section formula, Area of a triangle, Centre of gravity or Centroid of a triangle, In-centre of a triangle, Circumcentre of a triangle, Orthocentre of a triangle, Collinearity of three points, Slope of a line, Different forms of equations of a straight line, Perpendicularity and parallelism, Length of perpendicular. **8 Hours**

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

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. **4Hours**

Self-study Component-*LCM methods, basic arithmetic. Fractions and efficiency.*

Reference Books:

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

Course Outcomes (CO)

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

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

Course Title : **Additional Mathematics-II (P17MADIP41)**			
Course Code : P17MADIP41	Semester : IV	L - T – P- H : 0 - 0 – 0-4	Credits: 0
Contact Period: Lecture: 52 Hr,		Weightage: CIE:50%; SEE:50%	

Course Content

UNIT –I

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

UNIT –II

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

UNIT –III

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

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

UNIT –IV

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

UNIT –V

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

Text Book:

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

References:

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