SYLLABUS

(With effect from 2015-2016)

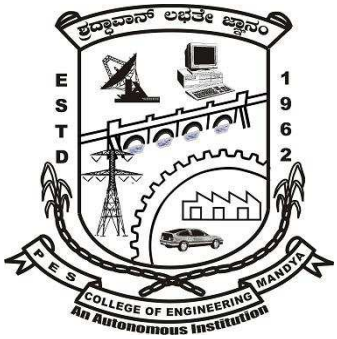
ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕವರ್ಷ 2015–16)

III and IV Semester

Bachelor Degree
in
Automobile Engineering

Out Come Based Education
with
Choice Based Credit System



P.E.S. College of Engineering

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

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ
ಮಂಡ್ಯ–571 401, ಕರ್ನಾಟಕ
(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

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

Preface

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

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

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

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

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

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

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

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

B.Dinesh Prabhu
Deputy Dean (Academic)
Associate Professor,
Dept. of Automobile Engg

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

PES COLLEGE OF ENGINEERING, MANDYA
(An Autonomous Institution, Under VTU)

Vision

"An institution of high repute, imparting quality education to develop innovative and Humane engineers"

Mission

"Committed to develop students potential through high quality teaching- learning processes and state of the art infrastructure"

DEPARTMENT OF AUTOMOBILE ENGINEERING

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

Vision

Outstanding department, exploring new technologies through continuous learning, research and innovation towards developing competent automobile engineers.

Mission

Committed to**,**

- *Impart knowledge in basic and applied areas*
- *Provide Teaching and Learning ambience in emerging areas with state of art infrastructure*
- *Enhance institute – industry interaction for developing centres of excellence.*
- *Develop students with excellent analytical skills and technical expertise*
- *Create environment on research and innovation for faculty and students.*
- *Committed to deliver interpersonal communication ,team work and engineers with high ethics*

Programme Education Objctives (PEOs)

- **PEO1:** Excel in professional career by acquiring knowledge in Basic sciences and Automobile engineering.
- **PEO2**: Expertise in Thermal, Design and Dynamics, Production, Automotive Electronics, Alternative Fuels and Vehicle Pollution Control with a focus on research and innovation.
- **PEO3**: Ability of problem solving by adopting analytical, numerical and experimental skills with Social Responsibility and societal impact.
- **PEO 4**: Exhibit professionalism, ethical attitude, communication skills, team work in their profession and adapt Innovative Technologies by engaging in life- long learning principles.

Program Outcomes (PO's)

The graduates of Automobile Engineering of PESCE will be able to:

a. **AUPO1**:Demonstrate basic knowledge in mathematics, basic science, materials and environmental science and engineering to identify, formulate and solve Automobile engineering problems
b. **AUPO2** :Design and conduct experiments, as well as to analyze and interpret the results
c. **AUPO3**:Design and analyse Automotive Systems, thermal systems or processes, Dynamics, and Vehicle Pollution Control for desired Automobile specifications
d. **AUPO4** :Function on multidisciplinary teams with sound communication skills
e. **AUPO5** : Self-learn to acquire and apply allied knowledge and update the same by engaging in life-long learning, practice profession with ethics and promote entrepreneurship
f. **AUPO6**: Apply engineering solutions in global, economic, environmental, and societal context.

PES COLLEGE OF ENGINEERING, MANDYA

(An Autonomous Institution, Under VTU)

SCHEME OF TEACHING AND EXAMINATION

III SEMESTER B.E.

SL. No	Subject Code	Title of the Subject	Teaching Dept.	Hours/week pattern L : T : P:H	Total Credits	Examination Marks		
						CIE	SEE	Total
1	P15MAT31	Engineering Mathematics –III	Maths	3:2:0:5	4	50	50	100
2	P15AU32	Mechanics of Materials	AU	4:0:0:4	4	50	50	100
3	P15 AU 33	Thermodynamics	AU	4:0:0:4	4	50	50	100
4	P15 AU 34	Material Science & Metallurgy	AU	4:0:0:4	4	50	50	100
5	P15 AU 35	Manufacturing Process-I	AU	4:0:0:4	3	50	50	100
6	P15 AU 36	Measurement and Metrology	AU	4:0:0:4	4	50	50	100
7	P15 AU L37	Metallography & Material Testing Lab	AUL	0:1:2:3	1.5	50	50	100
8	P15 AU L38	Foundry & Forging Lab	AUL	0:1:2:3	1.5	50	50	100
9	P15HUDIP39	Comprehensive Communication Development(CCD)	HS&M	2:0:0:2	[2]	(50)	(50)	(100)
10	P15HU39	** Aptitude and Reasoning Development – BEGINNER (ARDB)	Maths	2:0:0:2	0	(50)	-	-
	P15MADIP31	*Additional Maths-I	HS&M	4:0:0:4	0	-	-	-
	P15HMDIP310	* Indian Constitution, Human Rights & Professional Ethics	Human& Science	2:0:0:2	0	-	-	-
				Total	26[28]	400[450]	400[450]	800[900]

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

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

IV SEMESTER B.E.

SL. No	Subject Code	Title of the Subject	Teaching Dept.	Hours/week Pattern L : T : P:H	Total Credits	Examination Marks		
						CIE	SEE	Total
1	P15MAAC41	Engg Mathematics-IV	Maths	3:2:0:5	4	50	50	100
2	P15AU42	Fluid Mechanics	AU	4:0:0:4	4	50	50	100
3	P15 AU 43	Manufacturing Process-II	AU	4:0:0:4	4	50	50	100
4	P15 AU 44	Theory of Machines	AU	4:0:0:4	4	50	50	100
5	P15 AU 45	Computer Aided M/c Drawing	AU	4:0:0:4	4	50	50	100
6	P15 AU 46	Heat Transfer	AU	4:0:0:4	3	50	50	100
7	P15 AU L47	Fuel Testing and Measurement Lab	AU	0:1:2:3	1.5	50	50	100
8	P15 AU L48	M/c shop Practice	AU	0:1:2:3	1.5	50	50	100
9	P15HU49	Aptitude and Reasoning Development- Intermediate(ARDI)	HS & M	2:0:0:2	1	50	50	100
10	P15MADIP41	*Additional Mathematics-II	Maths	4:0:0:4	-	-	-	-
11	P15EVDIP410	*Environmental Studies	Env	2:0:0:2	-	-	-	-
				Total	27	450	450	900

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

Evaluation Scheme							
Scheme	**Weightage**	**Marks**	**Event Break Up**				
CIE	50%	50	**Test I**	**Test II**	**Quiz I**	**Quiz II**	**Assignment**
			35	35	05	05	10
SEE	50%	50	**Questions to Set: 10**		**Questions to Answer: 5**		

Evaluation Scheme of Practical Subjects					
CIE		**SEE(three hours duration of 50 marks)**			
Assessment	Weightage in Marks	Sl. No.		Marks allotment	
TEST 1	20	1.	Procedure and Condition	ONE Question from Chapter 1	10Marks
TEST2	20			ONE Question from Chapter 2	30Marks
Record	10			ONE Question from Chapter 3	
Total	50	2.	Viva		10 Marks
			Total Marks		50 Marks

Semester:- III

Course Title: Engineering Mathematics-III			
Course Code: P15MA31	**Semester: III**	**L – T – P – H : 3– 2 – 0 – 5**	**Credits: 04**
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 P15MA31 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.

Central differences: Gauss Forward and Backward difference formulae, Stirling's, and Bessel's formulae (All formulae without proof) – Illustrative problems. **10 Hrs**

UNIT-II

Numerical differentiation using Newton's forward and backward interpolation formulae, Newton's divided difference formula and Stirling'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 $(1/3)^{rd}$ rule, Simpson's $(3/8)^{th}$ rule, Boole's rule and Weddle's rule (All rules without proof)-Illustrative problems. **10 Hrs**

UNIT-III

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

UNIT-IV

Fourier Transforms: Infinite Fourier transforms-properties. Fourier sine and Fourier cosine transforms, properties. Inverse infinite Fourier and inverse Fourier sine & cosine transforms – problems. Convolution theorem, Parseval's identities for Fourier transforms (statements only).

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 Hrs

UNIT-V

Partial differential equations (PDE's):

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

Applications of PDE's:

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

Laplace's equation (No derivation)–various possible solutions. Solution of all these equations with specified boundary conditions (Boundary value problems). Illustrative examples from engineering field. **11 Hrs**

Text Books:

1. B.S. Grewal: Higher Engineering Mathematics, 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. Peter V O' Neil – Advanced Engineering Mathematics, Thomson Brooks/Cole ,5th edition,2007.

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

Course Outcomes

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

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

6.

Engineering Mathematics-III(P15MA31)

Time - 3Hrs **Max. Marks- 100**

Note: Answer any FIVE full questions choosing at least one full question from each unit

Model Question Paper	Marks	CO's	Levels
UNIT- I			
1. a) Find the missing values in the following data:			
x: 0, 1, 2, 3, 4, 5, 6 y: 5, 11, 22, 4, __, 140, __	6	1	L1
b) The table gives the distances in nautical miles of the visible horizon for the given heights (in feet) above the earth's surface: x = height: 100, 150, 200, 250, 300, 350, 400 y = distance: 10.63, 13.03, 15.04, 16.81, 18.42, 19.9, 21.27 Find the values of y when $x = 410\ ft$.	7	1	L2
c) Given $u_{20} = 24.37, u_{22} = 49.28, u_{29} = 162.86$ and $u_{32} = 240.5$, find u_{28} by Newton`s divided difference formula.	7	1	L2
2. a) Use Lagrange interpolation to fit a polynomial to the following data. x: 0, 1, 3, 4 y: -12, 0, 6, 12 Hence find f (1.5) and f(5).	6	1	L2
b) Using Gauss backward difference formula, find y(8) from the following table: X: 0, 5, 10, 15, 20, 25 Y: 7, 11, 14, 18, 24, 32	7	1	L2
c) Using sterlings formula find y_{35} given $y_{20} = 512$, $y_{30} = 439$, $y_{40} = 346$, $y_{50} = 243$	7	1	L3

UNIT- II

3 a).Given the data

x	-2	-1	0	1	2	3
y	0	0	6	24	60	120

Compute $y''(2)$ and $y''(4)$ — 6 | 2 | L3

b) Find the $f''(6)$ from the following data

X: 0 2 3 4 7 8

Y: 4 26 58 112 466 922

using Newton's divided difference formula — 7 | 2 | L3

c) The table below reveals the velocity v of a body during the specific time t , Find the acceleration at t=1.1 — 7 | 2 | L3

t: 1.0 1.1 1.2 1.3 1.4

v:43.1 47.7 52.1 56.4 60.8

4 a) Find the approximate value of $\int_0^{\pi/2} \sqrt{\cos\theta}\, d\theta$ by Simpson's $1/3^{rd}$ rule by dividing $[0,\ \pi/2]$ into 6 equal parts. — 6 | 2 | L2

b) Use Boole's formula to compute $\int_0^{\pi/2} e^{\sin x}\, dx$ — 7 | 2 | L2

c) Evaluate $\int_0^1 \frac{x\,dx}{1+x^2}$ by Weddle's rule taking seven ordinates and hence find $\log_e 2$. — 7 | 2 | L2

UNIT- III

5. (a) If f(x)= x(2π – x) in 0≤ x ≤ 2π, obtain the Fourier series of f(x) — 6 | 3 | L2

(b) Find a Fourier series in $[-\pi, \pi]$ to represent $f(x) = x - x^2$.

Hence deduce that $\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \cdots\cdots = \frac{\pi^2}{12}$. — 7 | 3 | L2

(c) Draw the graph of the function $f(x)=\begin{cases}\pi x, & 0\le x\le 1\\ \pi(2-x), & 1\le x\le 2\end{cases}$ and Express f(x) as a Fourier series — 7 | 3 | L3

6 (a) Obtain the complex Fourier series of $f(x)=\begin{cases}0, & 0<x<l\\ a, & l<x<2l\end{cases}$ over $[0, 2l]$. — 6 | 3 | L2

(b) Find the cosine half range series for $f(x)=x(l-x);\ 0\le x\le l$ — 7 | 3 | L3

(c) Express y as a Fourier series up to the third harmonic given the following data: — 7 | 3 | L3

x	0	π/3	2π/3	π	4π/3	5π/3	2π
y	1.98	1.30	1.05	1.30	-0.88	-0.25	1.98

UNIT- IV

7. (a) Find the Fourier transform of $f(x)=\begin{cases}1-x^2, & |x|<\alpha\\ 0, & |x|\ge\alpha\end{cases}$ and hence find the value of $\int_0^\infty \frac{x\cos x-\sin x}{x^3}dx$ — 6 | 4 | L2

(b) Find the Fourier sine transform of $f(x)=e^{-|x|}$ and hence evaluate $\int_0^\infty \frac{x\sin mx}{1+x^2}dx, m>0$. — 7 | 4 | L2

(c) Solve the integral equation $\int_0^\infty f(x)\cos\alpha x\,dx=e^{-a\alpha}$. — 7 | 4 | L3

8. (a) Obtain the Z-transform of $\cos n\theta$ and $\sin n\theta$. — 6 | 4 | L1

(b) Compute the inverse Z-transform of $\frac{3z^2+2z}{(5z-1)\ (5z+2)}$ — 7 | 4 | L2

(c) Solve by using Z-transforms: $y_{n+2}+2y_{n+1}+y_n=n$ with $y_0=0=y_1$. — 7 | 4 | L3

UNIT- V

9 (a). Form the partial differential equations by elimination of arbitrary — 6 | 5 | L1

function in $f(x^2+2yz, y^2+2xz\ )=0$.			
(b). Solve by the method of separation of variables $4\frac{\partial u}{\partial x}+\frac{\partial u}{\partial y}=3u$	7	5	L3
given that $u(0,y)=2e^{5y}$.	7	4	L2
(c). Solve: $(mz-ny)p+(nx-lz)q=(ly-mx)$.			
	10	5	L3
10 (a) Find the various possible solutions of the one dimensional heat equation $\frac{\partial u}{\partial t}=c^2\frac{\partial^2 u}{\partial x^2}$ by the method of separation of variables			
(b) Solve the wave equation $\frac{\partial^2 u}{\partial t^2}=c^2\frac{\partial^2 u}{\partial x^2}$ subject to the conditions $u(0,t)=0,\ u(l,t)=0$ for $t\geq 0$ and $u(x,0)=0$, $\frac{\partial u}{\partial t}(x,0)=x(l-x),\ 0\leq x\leq l$.	10	5	L3

Course Title: MECHANICS OF MATERIALS			
Course Code: P15AU32	**Semester: III**	**L:T:P:H: 4:0:0:4**	**Credits: 4**
Contact Period-Lecturer: 52Hrs,: Exam: 3Hrs		**Weightage:CIE:50%; SEE:50%**	

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

Course Learning Objectives (CLOs)

This course aims to

1. Classify different types of stresses, strain and deformations induced in the mechanical components due to external loads.
2. Determine stresses in composite bars, thermal stresses and principal stresses in simple 20 elements.
3. Draw Shear Force Diagrams and Bending Moment Diagrams for different types of loads and support conditions.
4. Compute and analyze bending and shear stresses and deflections induced in beams.
5. Determine stresses in thin and thick cylinders, torsional stresses, and Analyze buckling phenomenon in columns.

Course Content

Unit -1

Simple stresses and strains: Stress, types of stresses, Strain, Saint Venant's principle, stress-strain diagram for mild steel, working stress, proof stress, factor of safety, Hooke's law, modulus of elasticity, strain energy due to gradually applied load, proof resilience, longitudinal strain, lateral strain, poison ratio, stress strain analysis of bars of uniform cross section, stepped bars, bars with continuously varying section, principle of superposition. Modulus of rigidity, volumetric strain, expression for volumetric strain, bulk modulus, relation among elastic constants. **10hrs**

Unit-2

Compound bars: Stress analysis of composite bars. Thermal stresses in uniform and compound bars**. Compound stresses**: Principal planes and stresses, planes of maximum shear stress in general two dimensional systems, Mohr' circle diagram. **10 hrs**

Unit -3

Shear force and Bending moment diagrams: Types of beams, loads and supports. Shear forces and bending moments, sign conventions, relationship between load intensity, shear force and bending moment. Shear force and bending moment diagrams for different beams subjected to concentrated loads, UDL, UVL and couple. **12 hrs**

Unit-4

Bending and shear stresses in Beams: Theory of simple bending, assumptions in simple bending, relationship between bending stresses and radius of curvature, relationship between bending moment and radius of curvature, section modulus, moment of resistance of a section. Bending stresses in beams of uniform section. Shearing stresses in beams, shear stress across rectangular, circular, I and T sections. **(*Composite beams are not included and moment of inertia to be supplied for numerical problems*).**

Deflection of Beams: Introduction, relation between slope, deflection and radius of curvature. Macaulay's method for cantilever and simply supported beams with point load and UDL. **10 hrs**

Unit -5

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

Torsional stresses: Introduction to torsion, pure torsion, assumptions, derivation of torsional equation, polar modulus, torsional rigidity, and torque transmitted by solid and hollow circular shafts. C**olumns and struts:** Introduction to Columns, Euler's theory for axially loaded elastic long columns, Euler's equation for columns with different end conditions, Rankine's formula. **10 hrs**

Text Books:

1. S. S. Bhavikatti, "Strength of Materials", Vikas publication House-pvt ltd 2nd edition.
2. Dr. B.C. Punmia, "Mechanics of Materials", Ashok Kumar Jain and Arun Kumar Jain, Laxmi publications, New Delhi. 2002
3. Dr. R. K. Bansal , "Strength of Materials", Laxmi publication, New Delhi

References:

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

Course Outcomes

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

1. Classify different types of stresses, strain and deformations induced in the mechanical components due to external loads
2. Determine stresses in composite bars, thermal stresses and principal stresses in simple 20 elements
3. Draw Shear Force Diagrams and Bending Moment Diagrams for different types of loads and support conditions.
4. Compute and analyze bending and shear stresses and deflections induced in beams.
5. Determine stresses in thin and thick cylinders, torsional stresses, and Analyze buckling phenomenon in columns.

Course Title: Thermodynamics			
Course Code: P15AU33	**Semester:** III	**L:T:P:H** -4:0:0:4	**Credits:** 4
Contact Period-Lecturer: 52Hrs,: Exam:3 Hrs		**Weightage:**CIE:50%; SEE:_%	

Prerequisites: Engineering Physics, Engineering Mathematics-I

Course Learning Objectives (CLOs)

This course aims to

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

Unit – I

Fundamental Concepts & Definitions:-

Definition of Thermodynamics. Microscopic and Macroscopic approaches to the study of thermodynamics. Definitions of System (closed system) and Control Volume (open system) with examples. Definition of thermodynamic property, Intensive and extensive properties, thermodynamic state, process, quasi-static process, thermodynamic cycle. Thermodynamic equilibrium; definitions of thermal, chemical and mechanical equilibrium. Zeroth law of thermodynamics, Concept of Temperature, types commonly used of temperature scales and relation between them. Thermodynamic definition of work, sign convention and examples to illustrate the definition of work. Work done at the system boundary, process equation and expressions for work done in different processes. Definition of heat and sign convention. Comparison of work and heat. Simple numerical problems on work and heat transfer only. **11 hrs**

Unit – II

First Law of Thermodynamics:

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

Steady flow process, First law applied to steady flow process, derivation of steady flow energy equation and its applications to steady flow process. Simple numerical problems on systems undergoing steady flow process. **10 hrs**

Unit – III

Second Law of Thermodynamics:

Thermal reservoir. Source and sink. Heat engine, heat pump and refrigerator, their: schematic representation, efficiency and coefficient of performance. Kelvin – Planck and Clausius statement of the Second law of thermodynamics and equivalence of the two Statements of second law. Definition of perpetual motion machines of II kind with example. Reversible and

Irreversible processes, factors that make a process irreversible. Reversible heat engine-Carnot Cycle and expression for efficiency of Carnot cycle. Simple numerical problems on heat engines and heat pumps. **10 hrs**

Unit – IV

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

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

Unit –V

Refrigeration and Air Conditioning: Introduction, Heat Engines and Heat Pumps, Pressure-enthalpy diagram. Vapour compression refrigeration systems, description, analysis, refrigerating effect, capacity, power required, units of refrigeration, and COP. Properties of atmospheric air: Dry Air, Relative Humidity, Specific humidity, degree of saturation, dry bulb and wet bulb temperature. Psychometric Chart and Psychometric Process: Sensible heating or cooling, cooling and dehumidification, heating and humidification and adiabatic mixing of two streams. **11 hrs**

Text Books:

1. P .K. Nag, Basic and Applied Thermodynamics, Tata McGraw Hill, 3rd Edi. 2006
2. R K Rajput, Engineering Thermodynamics by , Laxmi Publications Pvt Ltd

Reference Books:

1. Spalding and Cole, Engineering Thermodynamics, ELBS edition.
2. Prakash and Gupta, Engineering Thermodynamics
3. Yunus A,Thermodynamics – An engineering approach. Cenegal Tata McGraw Hill
4. Van and Wylen, Introduction to Classical Thermodynamics

Course Outcomes

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

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

Course Title: Material Science and Metallurgy			
Course Code: P15AU34	**Semester: III**	**L:T:P:H -4:0:0:4**	**Credits: 4**
Contact Period-Lecturer: 52Hrs,: Exam: 3Hrs		**Weightage:CIE:50%; SEE:50%**	

Prerequisites: Engineering Physics, Engineering Chemistry, Mechanics of materials

Course Learning Objectives (CLOs)

This course aims to

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

COURSE CONTENTS

Unit - 1

Crystal Structure: Fundamental concepts of Unit cell space lattice, Bravais Lattices, Unit cells for cubic structures and HCP. Study of stacking of layers of atoms in cubic structure and HCP, calculations of radius, co-ordination number and Atomic Packing Factor for different cubic structures, Crystal imperfections – point, line, surface & volume defects, Diffusion – diffusion mechanism, Fick's laws of diffusion 6 hrs

Mechanical Behavior: Stress-strain diagram to show ductile and brittle behavior of materials, linear and non linear elastic behavior and properties, mechanical properties in plastic range, yield strength, offset yield strength, ductility, ultimate tensile strength, toughness. True stress & true strain, Plastic deformation of single crystal by slip and twinning 6 hrs

Unit II

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

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

Creep: creep curves – structural change – mechanism of creep deformation. 5 hrs

Unit III

Solidification & Phase diagrams: Mechanism of solidification, Homogenous and heterogeneous nucleation, Crystal growth, Cast metal structures. Solid solutions Hume Rothary rules- substitutional, and interstitial solid solutions, intermediate phases, Gibbs phase

rule, construction of equilibrium diagrams, equilibrium diagrams involving complete and partial solubility, lever rule**.** 5 hrs

Iron carbon equilibrium diagram: phases in the Fe-C system, Invariant reactions, critical temperatures, Microstructures of slowly cooled steels, effect of alloying elements on the Fe-C diagram, ferrite and austenite stabilizers. The TTT diagram, drawing of TTT diagram, TTT diagram for hypo & hyper eutectoid steels, effect of alloying elements on CCT diagram 5 hrs

Unit IV

Heat treatment of metals: Definition and aims of heat treatment – Annealing and its types, normalizing, hardening, tempering, austempering, martempering with microstructure changes 5 hrs

Surface treatment – Diffusion methods – Carburizing, Nit riding, Cyaniding – Thermal methods – flame hardening, induction hardening 5 hrs

Unit V

Engineering alloys: Properties, composition and uses of low Carbon, medium and high carbon steels, Steel designation AISI and SAE designation; Cats Irons – gray CI, White CI, Malleable CI & SG CI; Microstructures of CI. The light alloys Al, Mg and Ti alloys; Copper and its alloys, Brasses & Bronzes, Glass, Corrosion prevention materials 5 hrs

Advanced Materials: Composite materials-definition, classification, types of matrix materials & reinforcements, fundamentals of production of FRP's and MMC's, advantages and application of composites 5 hrs

TEXT BOOKS:

1. Smith, Foundations of Materials Science and Engineering- 3rd Edition, McGraw Hill, 1997

2. Murthy, Structure and properties of engineering Materials, TATA McGraw hill, 2003

Reference Books:

1. William D. Callister Jr. **"Materials Science & Engineering- An Introduction"**, Wiley India Pvt. Ltd. 6th Edition, 2006, New Delhi.
2. Donald R. Askland, Predeep P. Phule Thomson, **"Essentials of Materials for Science and Engineering"**, -Engineering, 2006
3. James F. Schakel ford, **"Introduction to materials Science for Engineering"**, 6th edition Pearson, Prentice Hall, New Jersy, 2006

Course Outcomes

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

1. Explain the different crystalline structure of the metals, imperfection associated with them and laws governing the diffusion phenomena.
2. Apply the knowledge of mechanical behavior to select appropriate material for given automotive component and the Griffith's criterion for fracture, fatigue tests and mechanism of creep.
3. Study the construction and analysis of phase diagram and Iron-carbon equilibrium diagram.
4. Apply the heat treatment process knowledge for improving physical and mechanical properties of different types of engineering materials.
5. Discuss different alloys and composite materials (PMC, MMC & CMC), their properties and application in automobiles with economic and social concerns.

Course Title: Manufacturing Process - I			
Course Code: P15AU35	**Semester:III**	**L:T:P:H -4:0:0:4**	**Credits: 3**
Contact Period-Lecturer: 52Hrs,: Exam: 3Hrs		**Weightage:CIE:50%; SEE:50%**	

Course Learning Objectives (CLOs)

This course aims to

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

Course Content

Unit – I

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

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

FOUNDRY: Introduction, Tools and equipments, Moulding sands, Types of molding sands, Sand additives, Properties of Molding sand. Sand preparation, Sand testing, **11 Hrs**

Unit – II

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

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

Additives: need, types of additives used.

SPECIAL MOULDING PROCESS : Study of Molding processes, CO2 molding, Shell mould, Investment casting, permanent mould casting : Gravity die-casting, Pressure die casting, centrifugal casting, Squeeze Casting, Slush casting, Thixocasting and continuous casting 1**1 Hrs**

Unit – III

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

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

Principles of Gating: Elements of gating system, types of gates, gating ratio, function of risers, types of risers – open and blind risers. Types of defects in Castings, Causes and remedies **10 Hrs**

Unit – IV

WELDING PROCESS: Arc Welding: Principle, Flux Shielded Metal Arc Welding

(FSMAW), Inert Gas Welding (TIG & MIG) Submerged Arc Welding (SAW) and Atomic Hydrogen Welding processes (AHW).

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

10 Hrs

Unit – V

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

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

10 Hrs

Text Book

1. S.K.Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy, "Elements of Workshop Technology"-Vol-I-Media Promoters & Publishers Pvt Ltd ,2006.

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

References:

1. Serope Kalpakjain, Steuen.R.Sechmid, "Manufacturing Technology",-Pearson **Education Asia, 5th Ed. 2006.**

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

Course Outcomes

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

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

Course Title: Measurement and Metrology			
Course Code: P15AU36	**Semester:**III	**L:T:P:H** -4:0:0:4	**Credits**: 4
Contact Period-Lecturer: 52Hrs,: Exam: 3Hrs		**Weightage:**CIE:50%; SEE:_%	

Prerequisites: The student should have undergone the courses on Engineering Physics, Engineering Mechanics, Basic Electrical Engineering, and Engineering Mathematics

Course learning Objectives (CLOs)

1. Describe various standards and measurements of fundamental quantities.
2. Explain and perform calibration of various measuring instruments like Comparators and Angular measuring Instruments.
3. Discuss transducers. Intermediate modifying devices and Interferometer.
4. Explain the measurement of Force, Torque and terminating devices. Calibrate the instruments to measure force and torque,
5. Describe strain. Pressure and temperature measurement. Calibrate the instruments to measure temperature and pressure.

Relevance of the Course:

1. Facilitate students to calibrate various measuring instruments.
2. Provide familiarization with the various gauges and measuring instruments generally used in industries.
3. Familiarization with measurement systems and related concepts.
4. Understanding the use of Instruments in measurement.
5. Measurements & Metrology is a fundamental course in BE Automobile Engineering program, where student learn necessary and applications of measurement and metrology, different standards of measurement. The course gives the students an understanding of characteristics and fundamental elements of measuring system.
6. The course gives the students an understanding of principles of various measurements like force, torque pressure temperature and strain.

Unit – I

Measurements, Measurement Systems and Standards of Measurement: Definition, significance of measurement, generalized measurement system, definition and concept of accuracy, precision, sensitivity, Calibration, threshold, hysteresis, repeatability, linearity, loading effect, system response, time delay, errors in measurement, classification of errors. Definition and objectives of metrology, Standard of length- International prototype meter, Imperial standard yard, Wave length standard, Subdivision of standards, line and end standard, comparison, Transfer from line standard to end standard, calibration of end bars (Numerical) **11 hrs**

Unit – II

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

10 hrs

Unit – III

Transducers, Intermediate Modifying Devices and Interferometer: Transfer efficiency, primary and secondary transducers, Mechanical, electrical, electronic transducers, advantages of each type of transducers. Mechanical systems, inherent problems, electrical intermediate modifying devices, input circuitry, signal transmission (hydraulic transmission, magnetic transmission, electrical transmission) Clinometers. Principle of inter-ferometry, autocollimator, optical flats **11 hrs**

Unit – IV

Measurement of Force, Torque, and terminating devices: Principle, analytical balance, platform balance proving ring, torque measurement, types of dynamometers prony brake, Hydraulic dynamometer, Eddy current dynamometer. Mechanical, digital read out devices, ultra-violet recorders, servo-recorders cathode ray oscilloscope, Oscillographs, X-Y plotters. **10 hrs**

Unit –V

Strain Measurement, Pressure Measurement and Temperature Measurement: Strain gauge, preparation and mounting of strain gauges, gauge factor, Methods of strain measurement Principle, use of elastic members, bridge man gauge, Mc leod gauge, thermal conductivity gauge, (pirani gauge and thermocouple vacuum gauge) ionization gauge, Resistance thermometers, thermocouple, law of thermocouple, thermocouple circuits, thermocouple materials, pyrometers, optical pyrometer. **10 Hrs**

TEXT BOOKS:

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

REFERENCES:

1. ASTME- Hand book of Industrial Metrology - PHI
2. K.J. HUME, Engineering Metrology - Third (metric) Edition - Kalyani publishers.
3. BECKWITH, BUCK & MARAN-GONI, Mechanical Measurements - Narosa Publishing House.
4. DOEBELIN, Measurement systems - Application a Design, (4th Edition) - McGraw Hill.

Course Outcomes

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

1. Describe various standards and measurements of fundamental quantities
2. Explain and perform calibration of various measuring instruments like comparators and angular measuring instruments
3. Discuss transducers, intermediate modifying devices and interferometer
4. Explain the measurement of force, torque and terminating devices calibrate the instruments to measure force and torque
5. Describe strain pressure and temperature measurement, calibrate the instruments to measure temperature and pressure

Course Title: METALLOGRAPHY & MATERIAL TESTING LABORATORY			
Course Code: P15AUL37	**Semester:III**	**L:T:P:H -1:0:2:3**	**Credits: 1.5**
Contact Period-Lecturer: Hrs,: Exam: Hrs		**Weightage:CIE:50%; SEE:_%**	

Prerequisites: Chemical composition of the material. Physical and mechanical properties of the material. How these above properties can be changed by different heat treatment process? How inclusion of heat treatment affects the manufacturing flow chart? Selection of material for a given application.

Course Learning Objectives (CLOs)

This Course aims to

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

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

Reference Books:

1. Material Science by K.M. Gupta
2. Material Science by Raghavan .S

Course Outcomes (COs)

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

1. Prepare material specimen for metallographic studies and recognize the micro structural features of material.
2. Determine the mechanical properties of different materials
3. Determine the wear coefficient of material
4. Determine the variation in properties before and after heat treatment of metal specimens
5. Demonstrate fatigue test.

Course Title: Foundry And Forging Laboratory			
Course Code: P15AUL38	Semester: III	**L:T:P:H** -1:0:2:3	**Credits**: 1.5
Contact Period-Lecturer: Hrs,: Exam: Hrs		**Weightage**:CIE:50%; SEE:_%	

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

Course Learning Objectives {CLOs}

This Course aims to

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

Part-A
1. Testing of Moulding sand and Core sand Preparation of sand specimens and conduction of the following tests: • Compression, Shear and Tensile tests on Universal Sand Testing Machine. • Permeability test • Core hardness & Mould hardness tests. • Grain fineness number test (Sive Analysis test) • Clay content test. • Moisture content test
2. Foundry Practice Use of foundry tools and other equipments. Preparation of moulds using two moulding boxes using patterns or without patterns. (Split pattern, Match plate pattern and Core boxes). Preparation of one casting (Aluminum or cast iron-Demonstration only)
Part -B
3. Forging Operations Preparing minimum three forged models involving upsetting, drawing and bending operations. Out of these three models, at least one model is to be prepared by using Power Hammer.

Text Books:

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

Reference Books:

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

Course Outcomes

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

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

Course Title: Aptitude and Reasoning Development - BEGINNER. (ARDB)			
Course Code : P15HU39	**Semester :** III	**L - T - P :** 0 - 0 - 2	**Credits:** NA
Contact Period: Lecture: 32 Hrs, Exam: 3 Hrs		**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

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

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 Hrs**

Unit – II

Analytical Reasoning 1: series

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

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

Picture series : image analysis, addition deletion rotation or modification of lines or shapes. Understanding the symmetry of the image. Mirror image analysis. sample company questions. **6 Hrs**

Unit – III

Number system:

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

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

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

6 hrs

Unit – IV

Simple equations, Ratio Proportions and Variations:

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

Ratio Proportions and Variations: Understanding the meaning and difference between ratio, proportion and variation. Properties of ratio, Comparison of more than two quantities, Proportion, Properties of proportion - Componendo, Dividendo, Invertendo, Alternendo. Continued proportion, Mean proportion. Variation - Direct variation, Indirect variation, Joint variation, Short cut methods to solve problems on variation. **6 hrs**

Unit – V

Building the fundamentals of logical reasoning:

Arrangement:

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

Directions :

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

Blood relations :

Some typical relations that we come across, family tree, Structuring the given problem step by step. Suggested methods– Backtracking, drawing family tree. Problems on blood relations and professions. **6 hrs**

Reference Books:

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

Course Outcomes

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

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

Course Title : Additional Mathematics-I (A Bridge course for Diploma qualified students of III Sem. B. E.)			
Course Code : P15MADIP31	**Semester :** III	**L :T:P:H :** 2:2:0:4	**Credits:** NA
Contact Period: Lecture: 52 Hrs,		**Weightage: CIE:**100%, [P/NP]	

Course contents

UNIT -I

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

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

12Hrs

UNIT -II

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

UNIT -III

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

UNIT-IV

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

10 Hrs

UNIT-V

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

Text Book:

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

References:

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

Course Title: Indian Constitution, Human Rights and Professional Ethics (A course for Diploma qualified students of III Sem. B. E.)			
Course Code: P15HMDIP310	**Semester :** III	**L-T-P-H:** 2–0-0-0-2	**Credits:** NA
Contact Period : Lecture :26 Hr		**Weightage :** CIE:100% - [P/NP]	

COURSE CONTENT

I. Indian Constitution:

1. Introductory Part - The preamble, Fundamental rights
2. Directive principles of state policy - and fundamental duties
3. The union executive, union legislature and the union judiciary
4. The state executive, state legislature and the high court in the states
5. Special provision for scheduled caste and scheduled tribes
6. Election commission - Functions - Emergency provisions and amendment of the constitution

II. Human rights:

Aims and objectives to create responsible citizenship with awareness of human rights and latest development.

1. Protection of human rights and protection of human rights act - 1993
2. Human right - with related to rights of women, children disabled, tribal's, aged and minorities

III. Professional Ethics:

1. Aims, objects - advantages with national and international, recent development.

4th SEMESTER

Course Title: Engineering Mathematics-IV (Common to AU, CV, ME and IP&E Branches)		
Course Code: P15MAAC41	**Semester:** 4	L – T – P – H : 3– 2 – 0 – 5
Contact Period - Lecture: 52Hrs.; Exam: 3Hrs.	**Weightage:** CIE: 50%; SEE: 50%	

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

Course Learning Objectives (CLOs):

This Course aims to;

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

Relevance of the Course:

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

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

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

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

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

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

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

Course Content

UNIT-I

Complex Analysis: Introduction to functions of complex variables. Definitions- limit, continuity and differentiability. Analytic functions. Cauchy–Riemann equations in cartesian and polar forms, 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's theorem, Cauchy's integral formula. Taylor's and Laurent's series (Statements only). Singularities, poles and residues. Cauchy's residue theorem (statement only). Simple illustrative examples. **11 Hrs**

UNIT-II

Numerical Methods-II: Solution of algebraic and transcendental equations : Bisection Method, Regula-Falsi, Newton–Raphson,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. Euler's and modified Euler's method. Runge - Kutta method of IV order –Milne's and Adams predictor and corrector methods (All formulae without proof). **10 Hrs**

UNIT-III

Statistics: Brief review of measures of central tendency and dispersion. Moments, skewness and kurtosis. Curve fitting – least square method

$y = a + bx; y = ax^b, y = ab^x$ *and* $y = ax^2 + bx + c$.

Prof. Karl Pearson's coefficient of correlation and lines of regression

Probability Theory: Brief review of elementary probability theory. Random variables (discrete and continuous)-Introduction to probability distributions – probability mass/density functions and cumulative probability density functions – Illustrative examples. Discrete probability distributions – Binomial and Poisson's distributions. Continuous probability distributions - exponential and normal distributions (No derivation of mean and variance for all distributions) - Illustrative examples from engineering and industrial fields. **11 Hrs**

UNIT-IV

Joint probability distributions and Markov chains:

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

Linear Algebra-II: Numerical methods for system of linear equations- Gauss-Jacobi and Gauss- Seidel iterative methods. Relaxation method**.** Determination of largest eigen value and corresponding eigen vector by power method. **10 Hrs**

UNIT-V

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

Series solutions of ODE's and special functions: 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 Hrs

Text Books:

1. B.S. Grewal: Higher Engineering Mathematics, 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., **3rd Edition, 2011.**

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

Course Outcomes

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

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

Engineering Mathematics-IV(P15MAAC41)			
Time- 3Hrs	**Max. Marks- 100**		
Note: Answer any FIVE full questions choosing at least one full question from each unit			
Model Question Paper	Marks	CO's	Levels
UNIT- I			
1 a) If $\phi + i\psi$ represents the complex potential of an electrostatic field where $\psi = (x^2 - y^2) + \frac{x}{x^2 + y^2}$, find ϕ and also the complex potential as a function of the complex variable z.	6	1	L2
b) Discuss the transformation $w = z + 1/z$, $z \neq 0$.	7	1	L3
c) Find the bilinear transformation which maps the points $z = \infty, i, 0$ into $w = -1, -i, 1$. Also find the invariant points of the transformation.	7	1	L3
2 (a) Evaluate $\int_0^{2+i} (\bar{z})^2 dz$ along (i) the line $x = 2y$ (ii) the real axis up to 2 and then vertically to $2+i$.	6	1	L2
b) Expand $f(z) = \frac{z+1}{(z+2)(z+3)}$ as Laurent's series in the regions (*i*) $\lvert z \rvert > 3$ *and* (*ii*) $2 < \lvert z \rvert < 3$.	7	1	L3
c) Evaluate $\int_C \frac{e^{2z}}{(z+1)^2(z-2)} dz$ where C is the circle $\lvert z \rvert = 3$ by Cauchy residue theorem.	7	1	L3

UNIT- II			
3. a) Using Regula–Falsi method find the approximate root of the equation $x log_{10} x = 1.2$ (perform three iterations)	6	2	L2
b) Use Newton – Raphson method to find a real root of $x \sin x + \cos x = 0$ near $x = \pi$. Carry out the iterations upto four decimal places of accuracy.	7	2	L2
c) Find the smallest root of the equation $x^2 + 2x - 2 = 0$, using fixed point iteration method and accelerate the convergence by Aitken's Δ^2 – method.	7	2	L2
4. (a).From Taylor's series method, find $y(0.1)$ considering upto fourth degree term if $y(x)$ satisfies the equation $\frac{dy}{dx} = x - y^2, y(0) = 1$	6	2	L2
b). Using modified Euler's method find y at $x = 0.2$ given $\frac{dy}{dx} = 3x + \frac{1}{2}y$ with $y(0) = 1$ taking $h = 0.1$. Perform three iterations at each step	7	2	L3
c). Apply Milne's method to compute $y(1.4)$ correct to four decimal places given $\frac{dy}{dx} = x^2 + \frac{y}{2}$ and the data: $y(1) = 2,\ y(1.1) = 2.2156,\ y(1.2) = 2.4649,\ y(1.3) = 2.7514$	7	2	L2

UNIT- III

5. a) The first four moments about an arbitrary value 5 of a frequency distribution are -4, 22, -117 and 560. Find the skewness and kurtosis based on moments. — 6 | 3 | L1

b) Fit a best fitting parabola $y = a + bx + cx^2$, by the method of least squares for the data: — 7 | 3 | L2

x	2	4	6	8	10
y	3.07	12.85	31.47	57.38	91.29

c) The following data gives the age of husband (x) and the age of wife (y) in years. Find the correlation coefficient and hence obtain the regression lines. Also calculate the age of husband corresponding to wife of 16 years age : — 7 | 3 | L2

x	36	23	27	28	28	29	30	31	33	35
y	29	18	20	22	27	21	29	27	29	28

6. a) Find the value of k such that the following distribution represents a finite probability Distribution: — 6 | 3 | L2

x	-3	-2	-1	0	1	2	3
$p(x)$	k	$2k$	$3k$	$4k$	$3k$	$2k$	k

Also, find $P(x \le 1), P(x > 1)$ *and* $P(-1 < x \le 2)$

b) The number of telephone lines at an instant of time is a binomial variate with probability 0.1 that a line is busy. If 10 lines are chosen at random , what is the probability that (i) no line is busy (ii)all lines are busy (iii)at least one line is busy (iv)almost 2 lines are busy — 7 | 3 | L2

c) State probability density function of Gaussian (normal) distribution. An analog signal received at a detector (measured in micro-volts) may be modeled as a Gaussian random variable with mean 200 and variance 256 at a fixed point of time. What is the probability that the signal will exceed 240 micro-volts? — 7 | 3 | L3

UNIT- IV

7. a) random variable of X and Y having the following joint distribution — 6 | 4 | L2

X \ Y	-3	2	4
1	0.1	0.2	0.2
2	0.3	0.1	0.1

Find (i) Marginal distributions of X and Y (ii)Cov (X,Y)
(iii) Are the variables X, Y statically independent?

b) Define (i) stochastic matrix (ii) regular stochastic matrix. Find the unique probability vector for the regular stochastic matrix $\begin{bmatrix} 0 & 1 & 0 \\ 1/6 & 1/2 & 1/3 \\ 0 & 2/3 & 1/3 \end{bmatrix}$ — 7 | 4 | L3

c) Verify that $f(x,y) = \begin{cases} e^{-(x+y)}, & x \ge 0,\ y \ge 0 \\ 0, & otherwise \end{cases}$ is a probability density function of two -dimensional probability function.Evaluate $P(x<1), P(x \le y)$ and $P(1/2 < x < 2, 0 < y < 4)$ — 7 | 4 | L2

8 a) Solve the system of the equations by Gauss –Seidel method (Perform 3 iterations) $x+y+54z=110,\quad 27x+6y-z=85,\quad 6x+15y+2z=72$.	6	4	L2
b) Solve the system: $2x_1+8x_2-x_3=24;12x_1+x_2+x_3=31;3x_1+4x_2+10x_3=58$, by relaxation method	7	4	L2
c) Find the dominant eigen value and the corresponding eigen vector of A= $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$ by Power method taking the initial eigen vector a $[1,1,1]^T$	7	4	L3

UNIT- V			
9. a) Find the extremals of the functional. $\int_{x_1}^{x_2}(y^2+y'^2+2ye^x)dx$	6	5	L2
b) Solve the variational problem $\int_0^{\frac{\pi}{2}}(y^2-y'^2)dx=0;\ y(0)=0,\ y\left(\frac{\pi}{2}\right)=2$	7	5	L2
c) Prove that Catenary is the curve which when rotated about a line generates a surface of minimum area.	7	5	L2
10. a) Develop a series solution of the equation $(1+x^2)y''+xy'-y=0$.	6	5	L2
b) Solve the Bessel's differential equation $x^2\frac{d^2y}{dx^2}+x\frac{dy}{dx}+(x^2-n^2)y=0$.	7	5	L3
c) Express $4x^3-2x^2-3x+8$ in terms of Legendre's polynomials.	7	5	L3

Course Title: Fluid Mechanics			
Course Code: P13AU42	**Semester:** IV	**L T P H:** 3 2 0 5	Credits: 4
Contact Period-Lecturer: 52Hrs,: Exam: 3Hrs		**Weightage:**CIE:50%; SEE:50%	

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

Course Learning Objectives (CLOs)

This Course aims to

1. Define the properties of fluids and Describe the phenomena associated with fluid static (Pressure and Measurement), Identify, formulate and solve engineering problems on fluid statics
2. Describe the phenomena associated with Hydrostatic forces(fluid statics). Identify, formulate and solve engineering problems in fluid statics and Buoyancy.
3. Explain and derive the conservation laws that govern fluid motion, Identify, formulate and solve engineering problems in Fluid Kinematics and Fluid dynamics. Analyze and solve engineering problems involving fluid flow
4. Explain and derive for fluid motion for laminar flow and viscous effects and Define, classify and compute the effect of compressible fluids in the practical scenario
5. Analyzing and solving engineering problems involving fluid flow considering major and minor energy losses and Apply dimensional techniques (Buckingham PI Theorem) in fluid dynamic analysis

Course Content

Unit – 1

Properties of Fluids: Introduction, properties of fluids, classifications, viscosity, thermodynamic properties, Surface tension and Capillarity, Vapour pressure and Cavitation

Fluid Statics - Pressure and its Measurement: Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, Absolute, gauge, atmospheric and vacuum pressures, simple manometers, and differential manometers. **10 Hrs**

Unit – 2

Fluid Statics - Hydrostatic forces on surfaces: Total pressure and center of pressure, vertical plane surface submerged in liquid, horizontal plane surface submerged in liquid, inclined plane surface submerged in liquid, and curved surface submerged in liquid.

Buoyancy and floatation: Buoyancy center of buoyancy, meta-center and meta-centric height, conditions of equilibrium of floating and submerged bodies. **10 Hrs**

Unit –3

Fluid Kinematics: Introduction, Types of fluid flow, continuity equation in one and three dimension (Cartesian co-ordinate system only), velocity and acceleration, velocity potential function and stream function for 2D flow and types of motion.

Fluid Dynamics: Introduction, equations of motion, Euler's equation of motion, Bernoulli's equation from Euler's equation, Bernoulli's equation for real fluids. **Fluid flow measurements -** Venturimeter, Orifice meter, Pitot tube. **11 Hrs**

Unit – 4

Laminar flow and viscous effects: Reynold's number, critical reynold's number, Laminar flow through circular pipe-Hagen poiseulle's equation, Laminar flow between parallel stationery plates.

Introduction to compressible flow: Basic equations of compressible flow, Velocity of sound in a fluid, Mach number, Propagation of pressure waves in a compressible fluid, Sonic velocity.

10 Hrs

Unit – 5

Flow through pipes: Introduction, loss of energy in pipes, Major Energy Losses, Darcy-Weisbach equation for loss of head due to friction in pipes, Chezy's equation for loss of head due to friction in pipes, Minor Energy Losses, hydraulic gradient and total energy line.

Dimensional Analysis: Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Buckingham's $\prod$ theorem, Rayleigh's method, dimensionless numbers, similitude, types of similitude. **11 Hrs**

Text Books:

1. Dr. Bansal.R.K, Fluid Mechanics by, Lakshmi Publications, 2005.
2. Dr. Jagadishlal, Fluid Mechanics and hydraulics,: Metropolitan Book Co-Ltd., 1997.

Reference books:

1. Yunus A, Cenegel, John M,Cimbala,Fluid Mechanics, Fundamental & applications, by Tata MacGraw Hill, 2006.
2. John F.Douglas, Janul and M.Gasiosek and john A. Swaffield, Fluid Mechanics Pearson Education Asia, 5th ed., 2006
3. Kumar.D.S, Fluid Mechanics and Fluid Power Engineering," Kataria and Sons.,2004

Course Outcomes

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

1. Define the properties of fluids and Describe the phenomena associated with fluid static (Pressure and Measurement), Identify, formulate and solve engineering problems on fluid statics
2. Describe the phenomena associated with Hydrostatic forces(fluid statics). Identify, formulate and solve engineering problems in fluid statics and Buoyancy.
3. Explain and derive the conservation laws that govern fluid motion, Identify, formulate and solve engineering problems in Fluid Kinematics and Fluid dynamics. Analyze and solve engineering problems involving fluid flow
4. Explain and derive for fluid motion for laminar flow and viscous effects and Define, classify and compute the effect of compressible fluids in the practical scenario
5. Analyzing and solving engineering problems involving fluid flow considering major and minor energy losses and Apply dimensional techniques (Buckingham PI Theorem) in fluid dynamic analysis

Course Title: Manufacturing Process-II			
Course Code: P15AU43	**Semester:** IV	**L:T:P:H**-4:0:0:4	Credits: 4
Contact Period-Lecturer: 52Hrs,: Exam: 3Hrs		**Weightage:**CIE:50%; SEE:50%	

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

Course Learning Objectives (CLO'S):

This course aims to:

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

Course Content

Unit I

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

CUTTING TOOL MATERIALS: Desired properties, types of cutting tool materials – HSS, carbides, coated carbides CBN, PCD and ceramics **10 hrs**

Unit -II

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

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

Unit -III

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

SHAPING AND PLANING MACHINES: Classification, specification, constructional features, and driving mechanisms. Shaping and planning operations. Comparison between shaping and planning, Problems on calculation of machining time. **10 hrs**

Unit- IV

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

GRINDING MACHINES: Types of abrasives, bonding process, classification, constructional features of cylindrical and surface grinding machines, tool and cutter grinder, specification of grinding wheel, selection of grinding wheel, balancing of grinding wheel. **10 hrs**

Unit-V

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

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

Surface finishing processes: Introduction Lapping, honing, Surface finishing, Polishing, buffing, electroplating, hot dipping, Galvanizing and metal spraying. **12 hrs**

Text Books

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

REFERENCES:

1. Amitabha Ghosh and Mallik,"Manufacturing Science"- Affiliated East West Press, 2003.
2. G. Boothroyd, "Fundamentals of Metal Machining and Machine Tools"- McGraw Hill, 2000.
3. A. Bhatta charya."Theory of Metal cutting & practice"

Course Outcomes

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

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

Course Title: Theory of Machines			
Course Code: P15AU44	**Semester:** IV	**L:T:P:H** -3:2:0:5	Credits: 4
Contact Period-Lecturer:52 Hrs,: Exam: 3Hrs		**Weightage:**CIE:50%; SEE:50%	

Prerequisites: Engineering Mechanics, Engineering Mathematics and Strength of material

Course Learning Objectives (CLOs)

This Course aims to

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

Course Content

UNIT-I:

INTRODUCTION TO MECHANISMS

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

Quick return motion mechanisms-whitsworth mechanisms, Crank and slotted lever mechanisms. Principle of Straight line motion mechanism – Peaucelliers Mechanism, Engine Indicator, Intermittent motion mechanisms- Geneva mechanism and Ratchet and pawl mechanism. Toggle mechanism, Pantograph. **10 hrs**

UNIT-II:

VELOCITY ANALYSIS OF MECHANISMS

Introduction to Vectors, Absolute and relative motions, Motion of a link, velocity analysis by relative velocity method, four-link mechanism, slider-crank mechanism, crank and slotted lever mechanism. Instantaneous centre, number of I- centres, Kennedy's theorem, locating I-centres, velocity analysis by I-centre method. **10 hrs**

UNIT-III :

ACCELERATION ANALYSIS OF MECHANISMS

Total acceleration of a link, acceleration of a point on a link, acceleration diagram for four bar mechanism, slider-crank mechanism, coriolis acceleration component, acceleration diagram for

crank and slotted lever quick return motion mechanism, klien's construction to find velocity and acceleration in single slider crank mechanism. **10 hrs**

UNIT-IV:

GEARS AND GEAR TRAINS

Classification & application of different types of gears, Spur Gear terminology, law of gearing, gear tooth profiles, Path of contact, Arc of contact, Contact ratio, Interference in involute gears. Simple gear trains, Compound gear trains, Epicyclic gear trains, Tabular methods of finding velocity ratio of epicyclic gear trains. 12 hrs

Unit V

UNIT-V :CAMS

Types of cams, types of followers, Follower Motions including SHM, Uniform velocity, uniform acceleration and retardation and Cycloidal motion. Disc cam with reciprocating follower having knife edge, roller and flat faced follower. Disc cam with oscillating follower. Analysis of tangential cam with roller follower and circular arc cam with flat faced follower. **10 hrs**

TEXT BOOKS:

1. Rattan S.S. "Theory of Machines" Tata McGraw-Hill Publishing Company Ltd. New Delhi and 2nd edition 2005.
2. V P Singh, "Theory of Machines" Publisher, Dhanpat Rai Publishing Company (P) Limited, 2004.

REFERENCE BOOKS :

1. Thomas Bevan, " Theory of Machines-I", CBS Publications, New Delhi.2010
2. Shigley. J.V. and Uickers, J. J., " Theory of Machines & Mechanisms" OXFORD University Press.2004
3. R.S.Khurmi and J.K.Gupta, Theory of Machines S.Chand and Co.2012

Course OutComes

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

Course Title: Computer Aided M/c Drawing			
Course Code: P15AU45	**Semester:**IV	**L:T:P:H** -2:0:4:6	Credits: 4
Contact Period-Lecturer:52 Hrs,: Exam: 3Hrs		**Weightage:**CIE:50%; SEE:50%	

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

Course Learning Objectives (CLOs)

This Course aims to

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

UNIT-I (2D Only)

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

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

Orthographic views: Conversion of pictorial views into orthographic projections of simple machine parts (Bureau of Indian Standards conventions are to be followed for the drawings) Hidden line conventions. Precedence of lines. **9 hrs**

UNIT-II (2D Only)

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

Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly). Types of Bolt heads, special types of nuts, locking of nuts, Studs, set screws, grub screws. **8 hrs**

UNIT-III(2D Only)

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

Riveted Joints: lap joints- single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag, using snap head rivets) **9 hrs**

UNIT-IV(2D Only)

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

UNIT-V(2D and 3D)

Assembly Drawings

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

1. Plummer block (Pedestal Bearing) 2. Piston, 3. Connecting rod
4. Screw jack 5. Fuel Injector 6. Clutches (Single and multi Plate) **18 hrs**

Text books:

1. K.R. Gopala Krishna Machine Drawing, Subhash Publication, 2013
2. R.B.Gupta, Automobile Engineering Drawing, , Satya Prakashan, New Delhi, 2000.
3. N.D.Bhat & V.M.Panchal Machine Drawing, 2011

Reference Books

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

Course Outcomes

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

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

Course Title: Heat Transfer			
Course Code: P15AU46	**Semester:** IV	**L:T:P:H** -3:2:0:5	**Credits:** 3
Contact Period-Lecturer: 52Hrs,: Exam: Hrs		**Weightage:**CIE:50%; SEE:50%	

Prerequisites:

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

Course Learning Objectives (CLOs)

This Course aims to

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

Course Content

UNIT-I

Introductory concepts and definitions: - Modes of heat transfer; Basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity; convective heat transfer coefficient; Radiation heat transfer coefficient; combined heat transfer mechanism. Conduction - Basic Equations: - General form of one dimensional heat conduction equation in rectangular, cylindrical and spherical coordinates. Discussion (no derivation) on three dimensional conduction in rectangular, cylindrical and spherical coordinate systems. Boundary conditions of first, second and third kinds; Illustrative problems on mathematical formulation of conduction problems **12 hrs**

UNIT-II

One-dimensional Steady state conduction: - Steady state conduction in a slab, in a cylinder and in a sphere without and with heat generation; overall heat transfer coefficient for a composite medium; thermal contact resistance; critical thickness of insulation; Steady state conduction in fins of uniform cross section long fin, fin with insulated tip and fin with convection at the tip; fin efficiency; conduction in solids with variable thermal conductivity**.** **12 hrs**

UNIT-III

One-dimensional Transient conduction :- Conduction in solids with negligible internal temperature gradients (Lumped system analysis); Use of Transient Temperature charts (Jeisler 's Charts) for transient conduction in slab, long cylinder and sphere; Use of transient temperature charts for transient conduction in semi infinite solids. **Forced Convection**: - Application of dimensional analysis for forced convection problems. Physical significance of Reynolds,

Prandtl, Nusselt and Stanton numbers. Use of various correlations for hydrodynamically and thermally developed flows; use of correlations for flow over a flat plate, over a cylinder and across a tube bundle. **10 hrs**

UNIT-IV

Free or Natural convection :- Application of dimensional analysis for free convection-physical significance of Grashoff number; Use of correlations for free convection from or to vertical, horizontal and inclined flat plates, vertical and horizontal cylinders. Heat Exchangers: - Classification of heat exchangers; overall heat transfer coefficient, Fouling and fouling factor; LMTD and NTU methods of analysis of heat exchangers. **10 hrs**

UNIT-V

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

TEXT BOOKS:

1) P.K. Nag, Heat Transfer by Tata Mc Graw Hill 2002
2) M Necats Osisik , Heat Transfer- A Basic approach by Mc Graw Hill International Ed 1988

REFERENCE BOOKS:

1) Yunus A Cengel, Heat transfer a practical approaches by Tata Mc Graw Hill 2002.
2) Kreith Thomas, Principles of Heat Transfer by learning 2001.
3) Frank. P. Incropera and David. P, Fundamentals of Heat and Mass Transfer by Dewitt Jhon wiley and Sons 4th Ed 1995.
4) Sucec, Heat Transfer by Jaico Book house 2002.
5) Jojo, Heat transfer Jaico Book house 2003**.**

Course Outcomes

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

1. **understand** and **formulate** to solve problems in fundamentals of three heat transfer modes using basic material properties: thermal conductivity, heat capacity and thermal diffusivity
2. **Understand** and **apply** basics of heat conduction: steady and unsteady, one-dimensional conduction, with special applications to extended surfaces with fin design in mind.
3. **Understand** and **apply** concepts of convection heat transfer with both analytical and empirical approaches.
4. **understand** and **demonstrate** about the application of heat exchangers
5. **Understand** and **demonstrate** fundamentals of radiation heat transfer: explaining concepts and application to radiations in daily life.

Course Title: Fuel Testing and measurement Lab			
Course Code: P15AUL47	**Semester:** IV	**L:T:P:H** -1:0:2:3	**Credits:** 1.5
Contact Period-Lecturer: 32Hrs,: Exam: 3Hrs		**Weightage:**CIE:50%; SEE:50%	

Prerequisites:

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

Course learning objectives (CLOS)

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

Part-A

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

Part –B

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

Course Title: M/c shop Practice			
Course Code: P15AUL48	**Semester:**IV	**L:T:P:H** -1:0:2:3	**Credits:** 1.5
Contact Period-Lecturer: 36Hrs,: Exam: 3Hrs		**Weightage:**CIE:50%; SEE:50%	

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

Course Learning Objectives:

At the end of the Course the students should be,

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

Part-A

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

Part -B

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

Evaluation Scheme

CIE Scheme

Assessment	**Weightage in Marks**
Calculations	20
Evaluation of models	20
Record writing	10
Total	**50**

SEE Scheme

Semester End Examination (SEE) is a practical examination of three hours duration of 50 marks.

Sl. No.	**Marks allotment**		
1	Procedure and Conduction	ONE Question from part A	25
		ONE Question from part B	15
2	Viva Voce		10
Total Marks			**50**

Course Title : Aptitude and Reasoning Development - INTERMEDIATE (ARDI)			
Course Code : P15HU49	**Semester :** IV	**L - T - P :** 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. Identify the assumptions, analyse the given argument and evaluate the inference.
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

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 hrs**

Unit – II

Analytical reasoning 2: The basics of logic, some informal tips, **Assumptions**– Some standard categories of assumptions, Where is the assumption invalid?, **Forcefulness of arguments**– Preliminary screening, Will the results really follow?, Is the result really desirable?, Are the argument and suggested course of action properly related?, **Evaluating Inferences**– A study of key words, How to avoid confusion?, **Evaluating given course of action**– Problem -solution relation, Fact-follow-up action relationship. **8 Hrs**

Unit – III

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

Syllogism: Meaning of syllogisms, Format of problems and standard qualifiers, Concept of

distribution, Standard question pattern, Application of venn diagram to solve problems. **Logical Venn diagrams:** Analysis of the given problem and solve it. **6 Hrs**

Unit – IV

Geometry and Mensuration:

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

Co-ordinate geometry:

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

Unit – V

Time and Work:

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

4 hrs

Reference Books:

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

Course Outcomes (CO)

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

1. Solve problems of higher difficulty level with ease in the following topics– Time , speed and distance and Geometry. L5
2. Analyze the statements and identify the assumptions and infer the results based on the arguments or premises. 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 (A Bridge course for Diploma qualified students of IV Sem. B. E.)			
Course Code : P15MADIP41	**Semester :** IV	**L :T:P:H :** 2:2:0:4	**Credits:** NA
Contact Period: Lecture: 52 Hrs.		**Weightage: CIE:**100%, [P/NP]	

UNIT –I

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

UNIT –II

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

UNIT –III

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

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

UNIT –IV

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

UNIT –V

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

Text Book:

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

References:

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

Course Title : Environmental Studies			
Course Code: P15EVDIP410	**Semester :** I/II	**L-T-P-H:** 2–0-0-2	**Credits:** NA
Contact Period : Lecture :26 Hrs	**Weightage :**CIE:100% - [P/NP]		

Prerequisites*:*

The student should have undergone the course on Environmental Studies (Code: P15EV19/29)

a) ***Course Learning Objectives (CLO) :***

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

1 Explain the need for Environmental Management
2 Implement standard data like water, wastewater and air pollution.
3 Demonstrate the use of standard data to compare with the field data.
4 Choose appropriate data to protect environmental.
5 Design environmental amenities based on the needs.

b) Relevance of the Course

Environmental Studies is a foundation course in BE (Environmental Engineering) program, that builds the program design and implementation competence in student through choice of appropriate areas.

The course aims at developing the understanding variations in water, wastewater and air pollution and also the ability to build new ideas.

Course Content

Unit – I

Environment – Definition, Ecosystem – Balanced Ecosystem, Human activities – Food Shelter, Economic and Social Security. Transportation activities, Environmental impact Assessment, Sustainable Development. **6 Hrs.**

Unit – II

Natural Resources – Water resources – Availability and Quality aspects, Mineral Resources, Forest Wealth, Material Cycles – (Carbon, Nitrogen and Sulphur Cycles) Water borne diseases, water induced diseases, Fluoride problem in drinking water. 5**Hrs.**

Unit – III

Energy – Different types of energy, Conventional and Non-Conventional sources – Hydro Electric, Fossil fuel based, Nuclear, Solar, geothermal, tidal, wind, Biomass and Bio-gas. Hydrogen as an alternative future source of energy. **5 Hrs.**

Unit – IV

Environmental Pollution and their effects. Water pollution, Land pollution, Noise pollution, Public Health aspects. Current Environmental issues of importance: Population Growth, Climate change and Global warming – Effect, Urbanizations industrialization. **5 Hrs.**

Unit –V

Acid Rain, Ozone layer depletion, Animal Husbandry. Environmental protection – Role of Government, Legal aspects, initiatives by Non-Governmental Organizations (NGO), Environmental Education, Women Education. **5 Hrs.**

Text Book:

1) Environmental Studies – Benny Joseph – Tata McGraw Hill – 2005

References:

1) Principles of Environmental Science and Engineering – .VenugopalaRao P, Prentice Hall of India, 2005
2) Elements of Environmental Science and Engineering – Meenakshi P, Prentice Hall of India, 2005
3) Environmental Studies – Anil Kumar D.C, New age International Publishers, 2007