SYLLABUS

(With effect from 2023 -24)

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕ ವರ್ಷ 2023-24)

Bachelor Degree

In

Mechanical Engineering

III & IV Semester

Out Come Based Education

With

Choice Based Credit System

[National Education Policy Scheme]

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 (All UG Programs), NAAC and 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

VISION

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

MISSION

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

QUALITY POLICY

Highly committed in providing quality, concurrent technical education and continuously striving to meet expectations of stake holders.

CORE VALUES

***P**rofessionalism*
***E**mpathy*
***S**ynergy*
***C**ommitment*
***E**thics*

About Department of Mechanical Engineering

The Department of Mechanical Engineering was established in the year 1962 during the origination of the institute. The department was granted academic autonomy in the year 2009. The department presently offers B.E in Mechanical Engineering, M Tech in Machine Design, M.Sc., (Engg.) by research and research leading to Ph.D. The present intake capacity of the department is 180 for BE, 24 for M Tech Machine Design. The department has a faculty-student ratio of 1:15 for UG courses and 1:12 for PG courses. The department has well established laboratories to meet the academic requirements of UG and PG programmes and a skilled technical faculty to train the students. The department has its own library which has a collection of about 4600 reference books.
The department is accredited with NBA for 3Years in 2019.
The department regularly organizes industrial visits, technical talk by experts from industries and institutes in contemporary areas to bridge the gap between syllabi and current corporate developments. The students are encouraged to undergo industrial training as well as to take up industry oriented projects during their academic course. Mechanical Engineering Association (MEA), formed by the students and faculty of the department regularly organizes co-curricular and extracurricular activities for the students.

Department Vision

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

Department Mission

The Mission of the Department of Mechanical Engineering is to:

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

Program Educational Objectives (PEOs)

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

The Mechanical Engineering graduates will be able to:

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

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

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

Program Specific Outcomes (PSOs)

Engineering graduates should be able to:

PSO1: Apply computer simulation and experimental methods in the design and development of sustainable products of mechanical systems.

PSO2: Utilize the knowledge of advanced manufacturing and condition monitoring techniques in industrial applications.

Program Outcomes (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Bachelor of Engineering (III –Semester)										
Sl. No.	**Course Code**	**Course Title**	**Teaching Department**	**Hrs / Week**			**Credits**	**Examination Marks**		
				L	**T**	**P**		**CIE**	**SEE**	**Total**
1	P22MA301	Transforms and Series	MA	2	2	-	3	50	50	100
2	P22ME302	Basic Thermodynamics	ME	3	-	-	3	50	50	100
3	P22ME303	Fluid Mechanics & Machinery	ME	3	-	-	3	50	50	100
4	P22ME304	Manufacturing Process – I	ME	3	-	2	4	50	50	100
5	P22ME305	Material Science & Metallurgy	ME	3	-	2	4	50	50	100
6	P22MEL306	Computer Aided Machine Drawing	ME	-	-	2	1	50	50	100
7	P22HSMC307	Employability Enhancement Skills - III	HSMC	-	2	-	1	50	50	100
8	P22BFE308	Biology For Engineers	ME	2	-	-	2	50	50	100
9	P22NSS309	National Service Scheme (NSS)	NSS coordinator	-	-	2	0	100	-	100
	P22PED309	Physical Education (PE) (Sports and Athletics)	PED							
	P22YOG309	Yoga	YOGA							
Total							**21**			

10	P22MDIP301	Additional Mathematics – I	MA	2	2	-	0	100	-	100
11	P22HDIP307	Additional Communicative English - I	HSMC	-	2	-	0	100	-	100

Bachelor of Engineering (IV –Semester)										
Sl. No.	**Course Code**	**Course Title**	**Teaching Department**	**Hrs / Week**			**Credits**	**Examination Marks**		
				L	**T**	**P**		**CIE**	**SEE**	**Total**
1	P22MA401A	Applied Mathematical Methods	MA	2	2	-	3	50	50	100
2	P22ME402	Applied Thermodynamics	ME	3	-	-	3	50	50	100
3	P22ME403	Mechanics of Materials	ME	3	-	-	3	50	50	100
4	P22ME404	Manufacturing Process – II	ME	3	-	2	4	50	50	100
5	P22ME405	Mechanical Measurements and Metrology	ME	3	-	2	4	50	50	100
6	P22MEL406	Fluid Mechanics and Machinery Laboratory	ME	-	-	2	1	50	50	100
7	P22HSMC407A	Employability Enhancement Skills - IV	HSMC	-	2	-	1	50	50	100
8	P22INT408	Internship – I	ME	-	-	-	2	-	100	100
9	P22NSS409	National Service Scheme (NSS)	NSS coordinator	-	-	2	0	100	-	100
	P22PED409	Physical Education (PE) (Sports and Athletics)	PED							
	P22YOG409	Yoga	YOGA							
Total							**21**			

10	P22MDIP401	Additional Mathematics – II	MA	2	2	-	0	100	-	100
11	P22HDIP407	Additional Communicative English - II	HSMC	-	2	-	0	100	-	100

TRANSFORMS AND SERIES

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – III

Course Code:	**P22MA301**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**2-2-0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives:

1	**Understand** the concept of infinite series; learn and apply Fourier series to represent periodical physical phenomena in engineering analysis.
2	To facilitate students to study, analyse and apply various transforms to solve engineering problems.

Unit	Syllabus content	No. of hours	
		Theory	Tutorial
I	**Infinite Series:** Introduction, convergence, divergence and oscillation of a series, Tests for convergence – Comparison test, Ratio test, Cauchy's root test Raabe's test, (All tests without proof)-Problems. **Self-study component:** Integral Test, Alternating series, Leibnitz's theorem – absolute and conditional convergence.	06	02
II	**Fourier Series:** Introduction, periodic function, even and odd functions, Dirichlet's conditions, Euler's formula for Fourier series (no proof). Fourier series for functions of arbitrary period of the form 2L (all particular cases) – problems, analysis- Illustrative examples from engineering field. Half Range Fourier series- Construction of Half range cosine and sine series and problems. Practical harmonic analysis- Illustrative examples from engineering field. **Self study**: Complex Fourier series.	06	02
III	**Laplace Transforms**: Definition – Transforms of elementary functions. Properties of Laplace Transforms- linearity, Change of scale, shifting, Transform of Derivative and Integrals, Transform of a function multiplied by t^n and division t (no proof)-Problems, Transforms of periodic function, unit step function (All results without proof)-Problems only. Inverse Laplace Transforms: Evaluation of inverse transforms by standard methods. Convolution theorem - Problems only. **Self-study component**- Transform of Unit impulse function. Solution of ODE by Laplace method and L-R-C circuits.	06	02
IV	**Fourier Transforms**: **Complex Fourier Transform**: Infinite Fourier transforms and Inverse Fourier transforms. Properties of Fourier Transforms- linearity Change of scale, shifting and modulation (no proof)-Problems, Fourier sine and cosine transforms and Inverse Fourier cosine and sine transforms with properties-Problems Convolution theorem and Parseval's identity for Fourier Transform (no proof)-problems. **Self study**: Fourier integrals- Complex forms of Fourier integral.	06	02

V	**Z-Transforms**: Definition. Some standard Z-transforms. Properties- linearity, Damping, Shifting, multiplication by *n*, initial and final value theorem-problems. Evaluation of Inverse Z- transforms- problems. **Application to Difference Equations**: Solutions of linear difference equations using Z- transforms. **Self study**: Convolution theorem and problems, two sided Z-transforms.	06	02

COURSE OUTCOMES: On completion of the course, student should be able to:	
CO1	**Understand** the fundamental concepts of infinite series, transforms of functions
CO2	**Apply** series and transform techniques to obtain series expansion, discrete and continuous transformation of various mathematical functions.
CO3	**Analyze** various signals using series expansions and differential, integral and difference equations using transforms
CO4	**Evaluate** indefinite integrals, differential equations and difference equations subject to initial conditions using transforms and develop series for a discontinuous function

TEACHING - LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos.

TEXT BOOKS

1. B.S. Grewal, Higher Engineering Mathematics (44th Edition 2018), Khanna Publishers, New Delhi.
2. E. Kreysizig, Advanced Engineering Mathematics, John Wiley and sons, 10th Ed. (Reprint) 2016.

REFERENCE BOOKS

1. V. Ramana: Higher Engineering Mathematics, McGraw –Hill Education, 11th Ed.,
2. H. C. Taneja, Advanced Engineering Mathematics, Volume I & II, I.K. International Publishing House Pvt. Ltd., New Delhi.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,Reprint, 2010.

ONLINE RESOURCES

1. http://www.nptel.ac.in
2. https://en.wikipedia.org
3. https://ocw.mit.edu/courses/18-03sc-differential-equations-fall-2011/
4. https://ocw.mit.edu/courses/18-06sc-linear-algebra-fall-2011/
5. https://math.hmc.edu/calculus/hmc-mathematics-calculus-online-tutorials/differential-equations/first-order-differential-equations/

QUESTION PAPER PATTERN (SEE)	
PART-A	PART-B
One question from each unit carrying two marks each	Answer any **TWO** sub questions for maximum 18 marks from each unit

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**2**										
CO2	**2**	**3**										
CO3	**3**	**2**										
CO4	**2**	**3**										
Strength of correlation: Low-1, Medium- 2, High-3												

BASIC THERMODYNAMICS

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – III

Course Code: P22ME302	**Semester: III**	**L-T-P: 3-0-0**	**Credits: 03**
Contact Period-Lecture: 40Hrs.	**Exam: 3Hrs.**	**Weightage: CIE:50 %;**	**SEE: 50%**

Course Learning Objectives:

The objectives of this course are to,

- Acquire knowledge of the fundamentals of thermodynamics and temperature scales.
- Determine heat, work, internal energy and enthalpy for flow and non-flow processes using First and Second law of thermodynamics.
- Determine changes in internal energy, enthalpy and entropy using T-dS relations for ideal gases.
- Identify the properties of substances on property diagrams and obtain the data from property tables.
- Apply concepts of thermodynamics in analyzing the thermal efficiencies of heat engines, Carnot cycles and the coefficients of performance for refrigerators.

Course Content

UNIT-I

Fundamental Concepts and Definitions: Definition of thermodynamics. Microscopic and Macroscopic approaches, Thermodynamic system, thermodynamic properties, State, path, process and cycle, quasi-static process, thermodynamic equilibrium, reversible and irreversible processes, Zeroth law of thermodynamics, measurement of temperature, scales of temperature, Numerical Problems. **Work and Heat:** Thermodynamic definition of work, sign convention, displacement work, displacement work done for different thermodynamic processes. Definition of heat and its sign convention. Comparison of work and heat. Numerical problems on work transfer.

9 Hrs

Self-study component: Types of thermometers, concept of absolute scale of temperature, mechanical forms of work.

UNIT-II

First Law of Thermodynamics: Statement, application of first law of thermodynamics to a system undergoing a cyclic process and a change of state, concept of energy, energy as a property of the system. First law applied to thermodynamic processes. Definition and significance of internal energy, enthalpy and specific heats. Numerical on systems undergoing closed process. **Steady flow process:** First law applied to a control volume, derivation of steady flow energy equation on unit mass and time basis, application of SFEE for mechanical devices. Numerical problems.

8 Hrs

Self-study component: Engineering application of SFEE, SFEE for unsteady flow process (Tank filling and Tank emptying).

UNIT-III

Second Law of Thermodynamics: Thermal reservoir; Source and sink. Heat engine, heat pump and refrigerator. Efficiency and coefficient of performance. Kelvin–Planck and Clausius statements for Second law of thermodynamics and equivalence of the two Statements. Reversible and Irreversible processes. Factors that make the process irreversible. Carnot cycle, reversed Carnot cycle, Carnot theorem. Numerical problems on heat engines and heat pumps. **Entropy**: Definition, Clausius theorem, Clausius inequality, Principle of increase of entropy, T-dS relations, Numerical Problems.

8 Hrs

Self-study component: Available and unavailable energy, irreversibility. Concept of Exergy.

UNIT-IV

Pure substances: Definition of pure substance, two-property rule, behaviour of pure substance (steam) with reference to T-v, P-T and T-h diagrams. Definitions: Sub-cooled liquid, saturated liquid, mixture, saturated vapor, superheated vapor, triple point, critical point, sensible heat, latent heat and super heat. Properties of steam, quality of steam and its determination. Measurement of dryness fraction using throttling calorimeter, separating and throttling calorimeter. Expressions for the change in internal energy, enthalpy, work, heat, entropy in various processes, Use of Mollier chart.

8 Hrs

Self-study component: P-v-T surface, Bucket and Barrel calorimeter.

UNIT-V

Ideal and Real Gases: Concept of an ideal gas, basic gas laws, characteristic gas equation, Avogadro's law and Universal gas constant, Vander Waal's Equation of state, Reduced Co-ordinates, Compressibility factor and law of corresponding states. Numerical Problems. **Mixtures of Gases:** Mole fraction and mass fraction, Partial pressure and Dalton's Law of partial pressure, Amagat's laws of partial volumes. Internal energy, enthalpy and specific heats of gas mixtures. Simple Numerical on gas mixtures.

7 Hrs

Self-study component: Relation between volumetric and gravimetric analysis.

Text Books

1. P.K.Nag, **"Basic and Applied Thermodynamics",** Tata McGraw Hill, 3rd Edition, 2006, ISBN: 9780070260627.
2. Yunus A. Cenegal, **"Thermodynamics– An Engineering Approach",** Tata McGraw Hill, Featured Edition, 2001, ISBN: 9780072383324.

Reference Books

1. Van and Wylen, **"Fundamentals of Classical Thermodynamics",** Wiley Eastern limited, 2nd Edition, 1976, ISBN: 9780471902294.
2. Mahesh. M. Rathore, **"Thermal Engineering",** McGraw Hill Pvt Ltd., 1st Edition, New Delhi, 2010,ISBN: 9780070681132
3. Spalding and Cole, "**Engineering Thermodynamics**", ELBS Publications, 1985, ISBN: 9780713133141.
4. R.K.Rajput, **"Engineering Thermodynamics",** Laxmi Publications Pvt Ltd, 3rd Edition, 2011, ISBN: 9789380298405.
5. Domkundwar, Kothandaraman**, "A course in Thermal Engineering",** Dhanpat Rai and Co., New Delhi, 2004, ISBN: 9788177000214.

e-Resources

1. https://www.youtube.com/watch?v=9GMBpZZtjXMandlist=PLD8E646BAB3366BC8
2. https://www.youtube.com/watch?v=xQwi9fveGTQandlist=PLD8E646BAB3366BC8andindex=2
3. https://www.youtube.com/watch?v=0jXeNaSM5Xcandlist=PLD8E646BAB3366BC8andindex=3
4. https://www.youtube.com/watch?v=sUDfpFD0xX4andlist=PLD8E646BAB3366BC8andindex=4
5. https://www.youtube.com/watch?v=bCToK4_dmbUandlist=PLD8E646BAB3366BC8andindex=5
6. https://www.youtube.com/watch?v=lvy8h-yWhRQandlist=PLD8E646BAB3366BC8andindex=6
7. https://www.youtube.com/watch?v=pJM9Fh9Fp-Iandlist=PLD8E646BAB3366BC8andindex=16

8. https://www.youtube.com/watch?v=QrEW5RKwglkandlist=PLD8E646BAB3366BC8andindex=18
9. https://www.youtube.com/watch?v=o9ueYSKj9ogandlist=PLD8E646BAB3366BC8andindex=19

Course Outcomes: At the end of the course, students will be able to,

1. **Apply** the basic concepts of thermodynamics such as system, properties, state, cycles and equilibrium on different thermodynamic processes.
2. **Apply** the fundamental concepts and laws of thermodynamics on control mass and control volume.
3. **Analyse** the performance of different thermodynamic processes and thermal systems such as Carnot cycle, heat engines, heat pumps, refrigerators and entropy by applying laws of thermodynamics.
4. **Analyse** the properties of working substances and gas mixtures on property diagrams to study the irreversibility and feasibility of the process.

Course Articulation Matrix

Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**Apply** the basic concepts of thermodynamics such as system, properties, state, cycles and equilibrium on different thermodynamic processes.	3													
CO2	**Apply** the fundamental concept and laws of thermodynamics on control mass and control volume.	3													
CO3	**Analyse** the performance of different thermodynamic processes and thermal systems such as Carnot cycle, heat engines, heat pumps, refrigerators and entropy by applying laws of thermodynamics.		3												
CO4	**Analyse** the properties of working substances and gas mixtures on property diagrams to study the irreversibility and feasibility of the process.		3												

SEE- Course Assessment Plan

COs	Marks Distribution					Total Marks	Weightage (%)
	Unit I	Unit II	Unit III	Unit IV	Unit V		
CO1	2+9			2+9	2+9	33	33%
CO2		2+9	2+9			22	22%
CO3	9	9	9			27	27%
CO4				9	9	18	18%
	20	20	20	20	20	100	100%
Application =55% Analysis = 45%							

FLUID MECHANICS AND MACHINERY

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – III

Course Code: P22ME303	**Semester: III**	**L-T-P: 3-0-0**	**Credits: 03**
Contact Period-Lecture: 40 Hrs.	**Exam: 3 Hrs.**	**Weightage: CIE: 50%;**	**SEE:50%**

Course Learning Objectives:

The objectives of this course are to,

- Understand the basic principles and equations of fluid mechanics and its applications to the various engineering fields involving fluid flow problems.
- Understand and apply the principles of fluid statics, fluid kinematics and dynamics.
- Determine flow rates, pressure changes, minor and major head losses for pipe flow.
- Understand the basic principles, governing equations and applications of turbomachines.
- Present an overall frame work for the fluid dynamic design and performance analysis of turbomachines.

Course Content

UNIT-I

Properties of fluids: Introduction, properties of fluids, viscosity, Newton's law of viscosity, surface tension, capillarity. **Fluid statics:** Pascal's law, fluid pressure at a point, pressure variation in a static fluid. Simple manometers and differential manometers. Total pressure, centre of pressure in vertical and inclined plane surfaces submerged in liquid. Buoyancy, Buoyant force and centre of buoyancy (concept only).

8 Hrs

Self-study component: Bourdon's tube pressure gauge and bellows pressure gauge.

UNIT-II

Fluid kinematics: Types of fluid flow, continuity equation in three dimensions (Cartesian co-ordinate system only) and velocity and acceleration, velocity potential function, stream function. **Fluid Dynamics:** Euler's equation of motion, Bernoulli's equation for ideal and real fluids. **Fluid Flow measurements**: Venturimeter, Orifice meter. Darcy and Chezy equations for loss of head due to friction in pipes, numerical problems, Concepts of dimensional analysis.

8 Hrs

Self-study component: Pitot tube and its types, Minor losses in flow through pipes.

UNIT-III

Fundamentals of turbo machines: Parts of turbo machine, classification of turbomachines, Euler turbine equation and alternate form of Euler turbine equation and components of energy transfer. Degree of reaction, general expression for degree of reaction. Utilization factor, relation between utilization factor and degree of reaction. Condition for maximum utilization in Impulse, reaction and 50% reaction turbines. Velocity triangles for different values of degree of reaction, numerical problems.

8 Hrs

Self-study component: Aerofoil section blade terminology.

UNIT-IV

Impulse turbine: Velocity triangles and power. Effect of friction and condition for maximum efficiency, Design parameters and design of Pelton turbines, numerical problems. **Reaction turbines:** Velocity triangles, power and efficiency of reaction turbines. Runner shapes for different blade speeds, design parameters and design of reaction turbines (Francis and Kaplan turbines). Draft tube: types of draft tube, design of draft tube and functions of draft tube, numerical problems.

8 Hrs

Self-study component: Unit quantities and their significance, performance curves of impulse and reaction turbines.

UNIT-V

Centrifugal Pumps: Introduction, working principle, parts, definition of manometric head, suction head, delivery head, static head, efficiencies. Manometric, mechanical and overall efficiencies, velocity diagram and work done, numerical problems, minimum starting speed, net positive suction head, priming. Multi-stage centrifugal pump for high head and high discharge, numerical problems.

8 Hrs

Self-study component: Vapour pressure and cavitation, effects of cavitation and its control.

Text Books

1. K.W. Bedford, Victor Streeter, E. Benjamin Wylie**, "Fluid Mechanics",** Tata Mcgraw Hill Education Private Limited, 9th edition, 1997, ISBN: 9780070625372.
2. Dr. R. K. Bansal, **"Fluid Mechanics and Hydraulic Machines",** Laxmi publications Ltd., New Delhi. 9thedition, 2015, ISBN: 9788131808153.
3. B K Venkanna, **"Fundamentals of Turbomachinary",** PHI Learning Pvt. Limited, 2009, ISBN: 978-8120337756.
4. D. G. Shepherd, **"Principles of Turbo Machinery",** Macmillan Company, 1964.

Reference Books

1. Dr. Jagadish Lal**, "Fluid Mechanics and Hydraulics",** Metropolitan Book Co. Pvt. Ltd, New Delhi, 2002, ISBN: 9788120002722.
2. Dr. K.L.Kumar, **"Engineering Fluid Mechanics",** S Chand Ltd., 2010, ISBN: 97881219010003.
3. Frank M.White, **"FluidMechanics",** Tata Mcgraw Hill Education Private Limited, 7th edition, 2011, ISBN: 9780071333122.
4. V. Ganesan, **"Gas Turbines",** Tata McGraw Hill Education Limited, 3rd Edition, 2010, ISBN: 978-0070681927.
5. G. Gopalakrishnan, **"A Treatise on Turbo machines",** Scitech Publications (India) Pvt. Ltd., 1st Edition, 2008, ISBN: 9788187328988.
6. V. Kadambi and Monohar Prasad, **"An introduction to energy conversion",** Volume III, New Age International Private Limited, 2011, ISBN: 978- 8122431896.

e-Resources

1. https://www.youtube.com/watch?v=vXPtNNLEOUcandlist=PLbMVogVj5nJTZJHsH6uLCO00I-ffGyBEmandindex=4
2. https://www.youtube.com/watch?v=lGL7Dp8xK_Uandlist=PLbMVogVj5nJTZJHsH6uLCO00I-ffGyBEmandindex=13
3. https://www.youtube.com/watch?v=nmubCbgd_KMandlist=PLbMVogVj5nJQQp3QLuzbcHrt0XncZZTiEandindex=2
4. https://www.youtube.com/watch?v=utOHXJvqI9oandlist=PLbMVogVj5nJQQp3QLuzbcHrt0XncZZTiEandindex=12
5. https://www.youtube.com/watch?v=VQqiVVYuNksandlist=PLbMVogVj5nJQQp3QLuzbcHrt0XncZZTiEandindex=8

Course Outcomes: At the end of the course, students will be able to,

1. **Apply** the mathematical knowledge of fluid mechanics to predict the behaviour of a fluid flow.
2. **Apply** the knowledge of fluid statics, kinematics and dynamics while addressing problems of mechanical engineering.
3. **Analyse** fluid flow problems with the use of fluid properties and measurement of pressure in engineering applications.
4. **Illustrate** the basic principles and operations of turbo-machines to appreciate the concept of velocity triangles for different values of reaction.
5. **Apply** the basics of fluid mechanics for the **design** and **analysis** of pipe flows as well as fluid machinery.

Course Articulation Matrix															
Course Outcomes		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Apply** the mathematical knowledge of fluid mechanics to predict the behaviour of a fluid flow.	3													
CO2	**Apply** the knowledge of fluid statics, kinematics and dynamics while addressing problems of mechanical engineering.	3													
CO3	**Analyse** fluid flow problems with the use of fluid properties and measurement of pressure in engineering applications.		3												
CO4	**Illustrate** the basic principles and operations of turbo-machines to appreciate the concept of velocity triangles for different values of reaction.	3													
CO5	**Apply** the basics of fluid mechanics for the **design** and **analysis** of pipe flows as well as fluid machinery.		2	2											

SEE- Course Assessment Plan							
COs	**Marks Distribution**					**Total Marks**	**Weightage (%)**
	Unit I	**Unit II**	**Unit III**	**Unit IV**	**Unit V**		
CO1	2+9					11	11%
CO2		2+9				11	11%
CO3	9	9				18	18%
CO4			2+9	2+9	2+9	33	33%
CO5			9	9	9	27	27%
	20	20	20	20	20	100	
Application =55% Analysis = 45%							

Manufacturing Process - I

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – III

Course Code: P22ME304	**Semester: III**	**L-T-P: 3-0-2**	**Credits: 04**
Total Theory Teaching Hours: 40 **Total Laboratory Hours: 24**	**Exam: 3Hrs.**	**Weightage: CIE: 50%; SEE: 50%**	

Course Learning Objectives:

The objectives of this course are to,

- Acquire basic knowledge about casting, welding and metal cutting theory which are relevant to manufacturing of engineering components.
- Give comprehensive insight regarding the mechanical equipment and operations involved to fulfill various applications.

Course Content

UNIT-I

Introduction to Casting: Concept of Manufacturing process, Casting process- Steps involved, advantages, limitations and applications of casting process. Patterns: Definition, Pattern materials, classification of patterns, Pattern allowances. Binder: Definition and types. Casting defects, causes and remedies.

8 Hrs

Self study component: Melting furnace classification.

UNIT-II

Sand Moulding: Types of sand moulds, Ingredients of moulding sand and properties, core making, principles of gating: Elements of gating system, types of gates, gating ratio, Risers: types and functions. Special Moulding Process: CO_2 moulding, Shell moulding, permanent mould casting, Pressure die casting, Squeeze Casting.

8 Hrs

Self study component: stir casting and centrifugal casting.

UNIT-III

Special types of welding: Resistance welding-principle, working principle, advantages, disadvantages and applications of the following types-Seam welding, Spot welding, Friction welding, Explosive welding. Metallurgical aspect in welding: Formation of different zones during welding, Heat Affected Zone (HAZ), Parameters affecting HAZ, Welding defects.

8 Hrs

Self-study component: weldability and friction stir welding.

UNIT-IV

Theory of Metal Cutting: Introduction, Single point cutting tool nomenclature, geometry, orthogonal and oblique cutting, Mechanism of chip formation, Types of chips Cutting tool materials: HSS, Carbides, Coated carbides, CBN and Ceramics. Heat generation in metal cutting, factors affecting heat generation. Tool Wear: Causes and types, effects of cutting parameters on tool life, tool failure criteria, Taylor's tool life equation, simple problems on tool life evaluation.

8 Hrs

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

UNIT-V

Machine Tools and Mechanisms: Constructional feature of turret lathe, Turret lathe indexing mechanism, Shaping Machine-classification of shaping machine, Shaper mechanism - Crank and slotted lever quick return mechanism and hydraulic driving mechanism, Planing Machine-classification of planer - Planer mechanism -open and cross belt drive mechanism.

8 Hrs

Self study component: Milling machine and grinding machine.

Practical Content

24 Hrs

Testing of molding sand and core sand:

1. Compression, shear and permeability tests on green sand specimen.
2. Sieve analysis to find grain fineness number of base sand.

Foundry and casting:

3. Use of foundry tools and other equipments.
4. Preparation of moulds using two moulding boxes with and without Patterns (Split pattern, Core boxes).
5. Production of metal component using sand casting.

Machining processes:

6. Preparation of one model on lathe involving plain turning, facing, knurling and eccentric turning.
7. External threads cutting, V-thread and square thread.
8. Taper turning by different methods.
9. Cutting of V-groove using a shaper.
10. Surface grinding.

Text Books

1. Serope Kalpak Jian and Steven R Schmid, **"Manufacturing Engineering and Technology"**, Pearson Education Asia, 4th Edition, 2002, ISBN: 97881775817062.
2. Dr. K. Radhakrishna, **"Manufacturing Process-I"**, 5th Edition, Sapna Book House, 2006, ISBN: 8128002074.

Reference Books

1. P. N. Rao, **"Manufacturing and Technology: Foundry Forming and Welding"**, Tata McGraw Hill, 2nd Edition, 2013, ISBN: 97893832866143.
2. Roy A Lindberg, **"Process and Materials of Manufacturing"**, Prentice Hall, 4th Edition, 1998, ISBN: 9780205118175.

Course Outcomes: At the end of the course, students will be able to,

1. **Apply** the concept of primary manufacturing processes such as casting, welding and machining.
2. **Identify** real-time applications of special casting, welding and Machining processes.
3. **Examine** the defects in casting and welding by **analysing** the microstructure.
4. **Analyse** various cutting parameters in metal cutting.
5. **Prepare** a report as an **individual** or **as a team** member to **communicate** effectively.

e-Resources

1. http://efoundry.iitb.ac.in/Academy/index.jsp
2. http://nptel.ac.in/courses/112107145/
3. http://www.elcoweld.com/files/editor/downloads/elmi/AWP1.pdf
4. https://books.google.co.in/books?id=NOotk64Grx0Candprintsec=frontcoverandsource=gbs_ge_summary_randcad=0#v=onepageandqandf=false
5. https://youtu.be/YtksJ12suFM
6. https://youtu.be/yPpyyABaqcw
7. https://youtu.be/MD-PDz4EQAg
8. http://nptel.ac.in/courses/112105126/

Course Articulation Matrix

Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Apply** the concept of primary manufacturing processes such as casting, welding and machining.	3													

CO2	**Identify** real-time applications of special casting, welding and Machining processes.	3													
CO3	**Examine** the defects in casting and welding by **analysing** the microstructure.		3												
CO4	**Analyse** various cutting parameters in metal cutting.		3												
CO5	**Prepare** a report as an **individual** or **as a team** member to **communicate** effectively.									3	3				1

SEE- Course Assessment Plan

COs	**Marks Distribution**					**Total Marks**	**Weightage (%)**
	Unit I	**Unit II**	**Unit III**	**Unit IV**	**Unit V**		
CO1	2+9			2+9		22	22%
CO2		2+9	2+9		2+9	33	33%
CO3	9	9	9	9		36	36%
CO4					9	9	9%
CO5	**Note: Assessment only in CIE**						
	20	20	20	20	20	100	100%
Application =55% Analysis = 45%							

MATERIAL SCIENCE AND METALLURGY

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – III

Course Code: P22ME305	**Semester: III**	**L-T-P: 3-0-2**	**Credits: 04**
Total Theory Teaching Hours: 40 **Total Laboratory Hours: 24**	**Exam: 3 Hrs.**	**Weightage: CIE:50%; SEE:50%**	

Course Learning Objectives:

The objectives of this course are to,

- Material science and Metallurgy perceives materials behavior and atomic characterization, interpret with the selection of materials for suitable applications.
- The course introduces basic knowledge over phase diagrams and also deals with behaviors, transformation of metals expose to different environment and heat treatment.
- Course also exposed to inculcate the knowledge over advanced materials and composite materials.

Course Content

UNIT-I

Structure of Crystalline Solids: Atomic bonding in solids, Fundamental concepts of unit cell, space lattice, Bravais lattice, Unit cells for cubic structure and HCP, study of stacking of layers of atoms in cubic structures and HCP, Calculation of atomic radius, co-ordination number and atomic packing factors for different cubic structures. Crystal imperfections - point, line, surface and volume defects. Diffusion Mechanisms and Fick's laws of diffusion. **8 Hrs**

Self-study component: Crystal planes and Direction

UNIT-II

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

8 Hrs

Self-study component: ASTM standards for different mechanical tests.

UNIT-III

Phase Diagrams and Solid Solution: Solid solutions, Rules governing formation of solid solutions, Phase diagram- Basic terms, phase rule, cooling curves, construction of Phase diagrams, interpretation of equilibrium diagrams, Types of Phase diagrams, Lever rule. Iron Carbon Equilibrium Diagram: Phases in the Fe-C system, invariant reactions, critical temperatures, Microstructures of slowly cooled steels, effect of alloying elements on the Fe-C diagram. Construction of TTT diagram, TTT diagram for hypo and hyper eutectoid steels. **8 Hrs**

Self-study component: Continuous Cooling Transformation (CCT) diagram.

UNIT-IV

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

8 Hrs

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

UNIT-V

Composites: Classification, functions of matrix and reinforcement in composites, Rule of mixture, Polymer, metal and ceramic matrix composites, carbon- carbon composites, Applications of composites. **Advanced Materials**: Nanomaterials- Size-dependant properties, applications, Shape Memory Alloys (SMA) - Characteristics, applications, Metallic glasses: properties and applications.

8 Hrs

Self-study component: Cryogenic materials

Practical Content **24 Hrs**

1. Preparation of specimen for metallographic examination.
2. Rockwell Hardness test.
3. Brinell Hardness test.
4. Vickers Hardness test.
5. Tension test using a UTM.
6. Izod Impact Tests.
7. Charpy Impact Tests.
8. Heat treatment: Annealing, Normalizing, Hardening and Tempering of Ferrous alloys and study their hardness.
9. Shear tests using UTM.
10. Bending Test using UTM.

Text Books

1. Willian D. Callister Jr., **"Materials Science and Engineering – an Introduction"**, John Wiley India Pvt.Ltd, New Delhi, 6th Edition, 2006, ISBN: 978-0471736967.
2. Donald R. Askeland, Pradeep, **"Essentials of Materials For Science and Engineering"**, CL Engineering, 2nd Edition, 2006, ISBN: 978-0495244462.

Reference Books

1. James F. Shackel ford, "**Introduction to Material Science for Engineering**", 6th edition Pearson, Prentice Hall, New Jersy, 2006.
2. V. Raghavan, "**Physical Metallurgy, Principles and Practices**", PHI 2nd Edition, New Delhi, 2006, ISBN: 978-8120330129.
3. Smith, "**Foundations of Materials Science and Engineering**", 3rd Edition McGraw Hill, 1997.

e-Resources

1. https://youtu.be/OTDVov_kw6A
2. https://www.digimat.in/nptel/courses/video/113104014/L20.html
3. https://youtu.be/I9fQ9KDk_uU
4. https://nptel.ac.in/courses/112104168
5. https://archive.nptel.ac.in/courses/113/104/113104074/

Course Outcomes: At the end of the course, students will be able to,

1. **Apply** the fundamental concepts of material science and metallurgy.
2. **Apply** various heat treatment processes to ferrous and nonferrous metals.
3. **Analyse** materials properties, composition and their phase transformation.
4. **Make use of** experimental data for writing a report as an **individual** or **as a team** member to **communicate** effectively.

Course Articulation Matrix															
Course Outcomes		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Apply** the fundamental concepts of material science and metallurgy.	3													
CO2	**Apply** various heat treatment processes to ferrous and nonferrous metals.	3													
CO3	**Analyse** materials properties, composition and their phase transformation.		3												
CO4	**Make use of** experimental data for writing a report as an **individual** or **as a team** member to **communicate** effectively.									3	3			1	

SEE- Course Assessment Plan							
COs	**Marks Distribution**					**Total Marks**	**Weightage (%)**
	Unit I	**Unit II**	**Unit III**	**Unit IV**	**Unit V**		
CO1	2+9	2+9	2+9		2+9	44	44%
CO2				2+9		11	11%
CO3	9	9	9	9	9	45	45%
CO4	**Note: Assessment only in CIE**						
	20	20	20	20	20	100	100%
Application =55% Analysis = 45%							

COMPUTER AIDED MACHINE DRAWING

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – III

Course Code: P22MEL306	**Semester: III**	**L-T-P: 0-0-2**	**Credits: 01**
Contact Period - Lecture: 30(P) Hrs	**Exam: 3 Hrs.**	**Weightage: CIE:50%;**	**SEE:50%**

Course Learning Objectives:

The objectives of this course are to,

- Empower the students with drafting skills and strengthen their ability to draw, read and interpret machine parts.
- Assemble the machine parts using computer software and implementing the standards, codes and norms.

Course Content

Part - A

Section and Development of Solids: Sections of Pyramids, Prisms, Cone and Cylinder resting only on their bases. True shape of sections, Development of lateral surfaces.

Orthographic Views: Conversion of isometric views into orthographic projections of simple machine parts. (Bureau of Indian standards conventions are to be followed for the drawings).

Thread Forms and Fasteners: Thread terminology, sectional view of threads. ISO Metric (Internal and External), BSW (Internal and External), square and ACME threads. Hexagonal headed bolt and nut with washer (assembly). **16 Hrs**

Part - B

Assembly Drawings

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

Introduction to geometrical dimensioning and tolerance.

1. Screw Jack
2. I.C. Engine Connecting Rod
3. Plummer Block
4. Machine Vice **14 Hrs**

Case study

1. Identify the engineering drawings symbols using GD and T.
2. Assembly drawing of fuel injector, knuckle joint, cotter joint and riveted joints.
3. Preparing Bill of Materials for mechanical system.

Text Books

1. N.D. Bhat and V.M. Panchal, "**Machine Drawing"**, Charotar Publishing House, 46th Edition, 2011, ISBN: 9789380358390.
2. K.R. Gopala Krishna, "**Machine Drawing"**, Subhash Publication, Revised and enlarged edition, 2017, ISBN: 978-93-83214-81-5.

Reference Books

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

Course Outcomes: At the end of the course, students will be able to,

1. **Apply** the concepts of engineering drawing to **develop** mechanical components.
2. **Apply** the concepts of section of solids to **analyse** cut section of machine components.
3. **Develop** the mechanical components in 2D and 3D environment and assemble the same.
4. **Create** the components of mechanical systems using modern CAD tool.
5. **Communicate** effectively through sketching and drawing.

Course Articulation Matrix														
Course Outcomes		**Program Outcomes**												**PSO**
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Apply** the concepts of engineering drawing to **develop** mechanical components.	3		2											
CO2	**Apply** the concepts of section of solids to **analyse** cut section of machine components.	3	3												
CO3	**Develop** the mechanical components in 2D and 3D environment and assemble the same.			3											
CO4	**Create** the components of mechanical systems using modern CAD tool.			3		3							1	1	
CO5	**Communicate** effectively through sketching and drawing.										3				

e-Resources

1. https://www.youtube.com/watch?v=-_qz8_sbhwY
2. https://www.youtube.com/watch?v=zO8coRhrJM0
3. https://www.youtube.com/watch?v=-_qz8_sbhwY
4. https://www.youtube.com/watch?v=zO8coRhrJM0
5. https://www.youtube.com/watch?v=4hhJ0OSKVYgandlist=PLQL-DlNb9_TXAbUK_H4JyZnhv9MW3nhG
6. https://www.youtube.com/watch?v=boyN1l3fA6gandlist=PLQL-DlNb9_TVqG1Zrw-9F-S0LItg3T5fD
7. https://www.youtube.com/watch?v=yKl_FiUdAu4andlist=PLQL-DlNb9_TUHs8CUXYw-Lna-Gp4rTu9g

SEE- Course Assessment Plan

COs	**Marks Distribution**		**Total Marks**	**Weightage (%)**
	Part A	**Part B**		
CO1		8	8	16%
CO2	5	7	12	24%
CO3	8	7	15	30%
CO4	7	8	15	30%
CO5	**Note: Assessment only in CIE**			
	20	30	50	
Application =40% Develop = 60%				

EMPLOYABILITY ENHANCEMENT SKILLS - III

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – III

Course Code:	**P22HSMC307**	**Credits:**	**01**
Teaching Hours/Week (L:T:P)	**0:2:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**30**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Calculations involving percentages, profit & loss and discounts.
- Explain concepts behind logical reasoning modules of direction sense and blood relations.
- Prepare students for Job recruitment process and competitive exams.
- Develop Problem Solving Skills.
- Apply programming constructs of C language to solve the real-world problem.

UNIT – I		**06 Hours**
Quantitative Aptitude: Number System – Divisibility & Remainder, Multiples & Factors, Integers, HCF & LCM, Decimal Fractions, Surds & Indices, Simplification.		
Self-study component:	Linear equations.	
UNIT – II		**06 Hours**
Quantitative Aptitude: Percentages, Profits, Loss and Discounts. **Logical Reasoning:** Blood Relations.		
Self-study component:	Inferred meaning, Chain rule.	
UNIT – III		**06 Hours**
Logical Reasoning: Direction Sense Test. **Verbal Ability:** Change of Speech and Voice, Sentence Correction.		
Self-study component:	Height & distance.	
UNIT – IV	**C-PROGRAMMING - I**	**06 Hours**
Introduction: Keywords and Identifier, Variables and Constants, Data Types, Input/Output, Operators, Simple Programs. **Flow Control:** If…else, for Loop, while Loop, break and continue, switch…case, goto, Control Flow Examples, Simple Programs. **Functions:** Functions, User-defined Functions, Function Types, Recursion, Storage Class, Programs **Arrays:** Arrays, Multi-dimensional Arrays, Arrays & Functions, Programs.		
Self-study component:	Evaluation of Expression.	
UNIT – V	**C-PROGRAMMING - II**	**06 Hours**
Pointers: Pointers, Pointers & Arrays, Pointers and Functions, Memory Allocation, Array & Pointer Examples. **Strings:** String Functions, String Examples, Programs. **Structure and Union:** Structure, Struct & Pointers, Struct & Function, Unions, Programs. **Programming Files:** Files Input/output		
Self-study component:	Error handling during I/O operations.	

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	Exhibit amplified level of confidence to express themselves in English.	Applying	L3
CO2	Solve the problems based on Number systems, percentages, profit & loss and discounts.	Analyzing	L4
CO3	Solve logical reasoning problems based on direction sense and blood relations.	Analyzing	L4
CO4	Apply suitable programming constructs of C language and / or suitable data structures to solve the given problem.	Applying	L3

Text Book(s):

1. The C Programming Language (2nd edition) by Brian Kernighan and Dennis Ritchie.
2. C in Depth by S K Srivastava and Deepali Srivastava.
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.

Reference Book(s):

1. E. Balaguruswamy, Programming in ANSI C, 7th Edition, Tata McGraw-Hill. Brian W. Kernighan and Dennis M. Ritchie, The 'C' Programming Language, Prentice Hall of India.
2. Quantitative Aptitude by Arun Sharma, McGraw Hill Education Pvt Ltd.

Web and Video link(s):

1. Problem Solving through Programming in C - https://archive.nptel.ac.in/courses/106/105/106105171/

COURSE ARTICULATION MATRIX
(EMPLOYABILITY ENHANCEMENT SKILLS - III – P22HSMC307)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									2	3		2
CO2	2	2										
CO3	2	2										
CO4	2	2								2		1

BIOLOGY FOR ENGINEERS

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – III

Course Code:	**P22BFE308**	**Credits:**	**02**
Teaching Hours/Week (L:T:P)	**2:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**25**	**SEE Marks:**	**50**

Course Learning Objectives:

The objectives of this course are to,

- Familiarize the students with the basic biological concepts and their engineering applications.
- Enable the students with an understanding of bio-design principles to create novel devices and structures.
- Provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
- Motivate the students to develop the interdisciplinary vision of biological engineering.

Course Content

Biomolecules And Their Applications (Qualitative): Carbohydrates (cellulose-based water filters, PHA and PLA as bio-plastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (bio-diesel, cleaning agents/detergents), Enzymes (glucose-oxidase in bio-sensors, lingolytic enzyme in bio-bleaching).

5Hrs

UNIT-II

Human Organ Systems And Bio-Designs-1 (Qualitative): Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics, Engineering solutions for Parkinson's disease), Heart as a pump system (architecture, electrical signaling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators).

5Hrs

UNIT-III

HUMAN ORGAN SYSTEMS AND BIO-DESIGNS-2 (QUALITATIVE): Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine), Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems).

5Hrs

UNIT-IV

Nature Bio Inspired Materials And Mechanisms (Qualitative): Echolocation (ultra sonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts).

5Hrs

UNIT-V

Trends In Bio- Engineering (Qualitative): DNA origami and Bio-computing, Bio-imaging and Artificial Intelligence for disease diagnosis, Self healing Bio-concrete (based on bacillus spores, calcium lactate nutrients and bio-mineralization processes), Bio-remediation and Bio-mining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic).

5Hrs

Suggested Learning Resources:

- Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook, 16thEdition, 2022.
- Biology for Engineers, Thyagarajan S, SelvamuruganN, Rajesh M. P, Nazeer R. A, Thilagaraj W, Barathi. S and Jaganthan M.K, Tata McGraw-Hill, New Delhi, 2012.
- Biology for Engineers, Arthur T.Johnson, CRC Press, Taylor and Francis, 2011.
- Bio-medical Instrumentation, Leslie Cromwell, Prentice Hall, 2011.
- Biology for Engineers, Sohini Singh and Tanu Allen,Vayu Education of India, New Delhi, 2014.
- Bio-mimetics: Nature Based Innovation,Yoseph Bar-Cohen,1st edition, 2012, CRC Press.
- Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
- Bio-remediation of heavy metals: bacterial participation, C R Sunil Kumar, N Geetha, A C Udayashankar, Lambert Academic Publishing, 2019.
- 3D Bio-printing: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.
- Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016.

Web links and Video Lectures (e-Resources):

- VTUEDUSAT/SWAYAM/NPTEL/MOOCS/Coursera/MIT-open learning resource
- https://nptel.ac.in/courses/121106008
- https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
- https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
- https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
- https://www.coursera.org/courses?query=biology
- https://onlinecourses.nptel.ac.in/noc19_ge31/preview
- https://www.classcentral.com/subject/biology

1. https://www.futurelearn.com/courses/biology-basic-concepts

Course Outcomes

At the end of the course, students will be able to,

1. **Understand** the bio-design principles involved in building novel devices and structures.
2. **Elucidate** the basic biological concepts through relevant industrial/Engineering application.
3. **Apply** innovative bio based solutions solving socially relevant problems.

Course Articulation Matrix

Course Outcomes		Program Outcomes											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Understand** the bio-design principles involved in building novel devices and structures.	2	1				1	1	1				1
CO2	**Elucidate** the basic biological concepts through relevant industrial application.	2	1				1	1	1				1
CO3	**Apply** innovative bio based solutions solving socially relevant problems.	2	2				2	2	1				2

Blooms Level	Marks Weightage	Maps Course Outcome to the Corresponding Blooms Level
Understand/Elucidate	50-60%	
Apply	35-50%	

NATIONAL SERVICE SCHEME

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER - III

Course Code:	**P22NSS309/409**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**-**	**SEE Marks:**	**-**

Pre-requisites to take this Course:

1. Students should have a service oriented mind set and social concern.
2. Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works.
3. Students should be ready to sacrifice some of the time and wishes to achieve service oriented targets on time.

Corse Objectives :National Service Scheme (NSS) will enable the students to:

1. Understand the community in which they work
2. Identify the needs and problems of the community and involve them in problem-solving
3. Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems
4. Develop competence required for group-living and sharing of responsibilities & gain skills in
   mobilizing community participation to acquire leadership qualities and democratic attitudes
5. Develop capacity to meet emergencies and natural disasters & practice national integration and
   social harmony

Content

1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.
2. Waste management– Public, Private and Govt organization, 5 R's.
3. Setting of the information imparting club for women leading to contribution in social and economic issues.
4. Water conservation techniques – Role of different stakeholders– Implementation.
5. Preparing an actionable business proposal for enhancing the village income and approach for implementation.
6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/
   vocational education.
7. Developing Sustainable Water management system for rural areas and implementation approaches.
8. Contribution to any national level initiative of Government of India. Foreg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath,Make in India, Mudra scheme, Skill development programs etc.
9. Spreading public awareness under rural outreach programs.(minimum5 programs).
10. Social connect and responsibilities.
11. Plantation and adoption of plants. Know your plants.
12. Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs).
13. Govt. school Rejuvenation and helping them to achieve good infrastructure.

AND ONENSS – CAMP @ College /University /Stateor Central GovtLevel /NGO's /General Social Camps Students have to take up anyone activity on the above said topics and have to prepare content for awareness and technical contents for implementation of the projects and have to present strategies for implementation of the same. Compulsorily students have to attend one camp. CIE will be evaluated based on their presentation, approach and implementation strategies.	
Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the importance of his / her responsibilities towards society.
CO2:	Analyze the environmental and societal problems/issues and will be able to design solutions for the same.
CO3:	Evaluate the existing system and to propose practical solutions for the same for sustainable development.
CO4:	Implement government or self-driven projects effectively in the field.

PHYSICAL EDUCATION [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER - III**			
Course Code:	**P22PED309**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**100**
Total Number of Teaching Hours:		**SEE Marks:**	**-**

Fitness Components Speed Strength Endurance Agility Flexibility	Meaning and Importance, Fit India Movement, Definition of fitness, Components of fitness, Benefits of fitness, Types of fitness and Fitness tips. Practical Components: Speed, Strength, Endurance, Flexibility, and Agility KABADDI A. Fundamental skills 1. Skills in Raiding: Touching with hands, Use of leg-toe touch, squat leg thrust, side kick, mule kick, arrow fly kick, crossing of baulk line. Crossing of Bonus line. 2. Skills of holding the raider: Various formations, catching from particular position, different catches, catching formation and techniques. 3. Additional skills in raiding: Escaping from various holds, techniques of escaping from chain formation, offense and defense. 4. Game practice with application of Rules and Regulations. B. Rules and their interpretations and duties of the officials.
Kho kho	A. Fundamental skills 1. Skills in Chasing: Sit on the box (Parallel & Bullet toe method), Get up from the box (Proximal & Distal foot method), Give Kho (Simple, Early, Late & Judgment), Pole Turn, Pole Dive, Tapping, Hammering, Rectification of foul. 2. Skills in running: Chain Play, Ring play and Chain & Ring mixed play. 3. Game practice with application of Rules and Regulations. B. Rules and their interpretations and duties of the officials.
Kabaddi	A. Fundamental skills 1. Skills in Raiding: Touching with hands, Use of leg-toe touch, squat leg thrust, side kick, mule kick, arrow fly kick, crossing of baulk line. Crossing of Bonus line. 2. Skills of holding the raider: Various formations, catching from particular position, different catches, catching formation and techniques. 3. Additional skills in raiding: Escaping from various holds, techniques of escaping from chain formation, offense and defense. 4. Game practice with application of Rules and Regulations. B. Rules and their interpretations and duties of the officials

YOGA

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER - III

Course Code:	**P22YOG309**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**100**
Total Number of Teaching Hours:		**SEE Marks:**	**-**

Course objectives:

1) To enable the student to have good health.
2) To practice mental hygiene.
3) To possess emotional stability.
4) To integrate moral values.
5) To attain higher level of consciousness.

The Health Benefits of Yoga

The benefits of various yoga techniques have been supposed to improve

- body flexibility,
- performance,
- stress reduction,
- attainment of inner peace, and
- self-realization.

The system has been advocated as a complementary treatment to aid the healing of several ailments such as

- coronary heart disease,
- depression,
- anxiety disorders,
- asthma, and
- extensive rehabilitation for disorders including musculoskeletal problems and traumatic brain injury.

The system has also been suggested as behavioral therapy for smoking cessation and substance abuse (including alcohol abuse).

If you practice yoga, you may receive these physical, mental, and spiritual benefits:

- Physical

1. Improved body flexibility and balance
2. Improved cardiovascular endurance (stronger heart)
3. Improved digestion
4. Improved abdominal strength
5. Enhanced overall muscular strength
6. Relaxation of muscular strains
7. Weight control
8. Increased energy levels
9. Enhanced immune system

- Mental

1. Relief of stress resulting from the control of emotions
2. Prevention and relief from stress-related disorders

3. Intellectual enhancement, leading to improved decision-making skills • Spiritual 1. Life with meaning, purpose, and direction 2. Inner peace and tranquility 3. Contentment
Yoga, its origin, history and development. Yoga, its meaning, definitions. Different schools of yoga, Aim and Objectives of yoga, importance of prayer Yogic practices for common man to promote positive health Rules to be followed during yogic practices by practitioner Yoga its misconceptions, Difference between yogic and non yogic practices Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar12 count, 2 rounds Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits of each asana Different types of Asanas a. Sitting 1. Padmasana 2. Vajrasana b. Standing 1. Vrikshana 2. Trikonasana c. Prone line 1. Bhujangasana 2. Shalabhasana d. Supine line 1. Utthitadvipadasana 2. Ardhahalasana

Additional Mathematics - I [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – III (Lateral Entry: Common to all branches)			
Course Code:	**P22MDIP301**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**2-2-0**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**-**

Course Learning Objectives: The mandatory learning course P21MATDIP31 viz., Additional Mathematics-I aims to provide basic concepts of complex trigonometry, vector algebra, differential & integral calculus, vector differentiation and various methods of solving first order differential equations.

UNIT-I	
Complex Trigonometry: Complex Numbers: Definitions & properties. Modulus and amplitude of a complex number, Argand's diagram, De-Moivre's theorem (without proof). Vector Algebra: Scalar and vectors. Vectors addition and subtraction. Multiplication of vectors (Dot and Cross products). Scalar and vector triple products-simple problems **Self-study components:** De-Moivre's theorem (without proof). Roots of complex number - Simple problems.	**12Hrs**
UNIT-II	
Differential Calculus: Polar curves –angle between the radius vector and the tangent pedal equation- Problems. Taylors series and Maclaurin's series expansions- Illustrative examples. Partial Differentiation: Elimentary problems. Euler's theorem for homogeneous functions of two variables. Total derivatives-differentiation of composite and implicit function. **Self-study components**: Review of successive differentiation. Formulae for n^{th} derivatives of standard functions- Liebnitz's theorem (without proof). Application to Jacobians, errors & approximations.	**10Hrs**
UNIT-III	
Integral Calculus: reduction formulae for $sin^n x$, $cos^n x$, and $sin^m x cos^m x$ and evaluation of these with standard limits-Examples. Applications of integration to area, length of a given curve, volume and surface area of solids of revolution. **Self-study components**: Differentiation under integral sign (Integrals with constants limits)-Simple problems.	**10Hrs**
UNIT-IV	
Vector Differentiation: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl and Laplacian (Definitions only). **Self-study components**: Solenoidal and irrotational vector fields-Problems.	**10Hrs**
UNIT - V	
Ordinary differential equations (ODE's): Introduction-solutions of first order and first degree differential equations: homogeneous, exact, linear differential equations of order one and equations reducible to above types **Self-study components:** Applications of first order and first degree ODE's - Orthogonal trajectories of Cartesian and polar curves. Newton's law of cooling, R-L circuits- Simple illustrative examples from engineering field.	**10Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Demonstrate the fundamental concepts –in complex numbers and vector algebra to analyze the problems arising in related area of engineering field.
CO2:	Identify – partial derivatives to calculate rate of change of multivariate functions
CO3:	Apply - the acquired knowledge of integration and differentiation to evaluate double and triple integrals to compute length surface area and volume of solids of revolution and indentify velocity, acceleration of a particle moving in a space
CO4:	Find analytical solutions by solving first order ODE's which arising in different branches of engineering.

Text Book:

- B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, New Delhi, 43rd Ed., 2015.

Reference books:

1. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed., 2015.
2. N.P.Bali and Manish Goyal: Engineering Mathematics, Laxmi Publishers,7th Ed., 2007.

Additional Communicative English – I

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – III

Course Code:	**P22HDIP307**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**0:2:0**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**-**

Module-1

Introduction to Communication Skills **6 Hours**

Introduction to communication, Meaning and process, Channels of communication, Elements of communication, Barriers to effective communication. Activities - Making introductions, Sharing personal information, Describing feelings and opinions.

Module-2

Listening Skills I **4 Hours**

Hearing vs. Listening, Types of listening, Determinants of good listening, Active listening process, Barriers to listening, Activities - Listening for pronunciation practice, Listening for personal communication, Listening for communication - language functions

Module-3

Speaking Skills I **6 Hours**

Basics of speaking, Elements and Functions of speaking, Structuring your speech, Focusing on fluency, Homographs and Signpost words. Activities – Free Speech and Pick and Speak

Module-4

Reading Skills I **4 Hours**

Developing reading as a habit, Building confidence in reading, improving reading skills, Techniques of reading - skimming and scanning. Activities - understanding students' attitudes towards reading, countering common errors in reading, developing efficiency in reading.

Writing Skills I **4 Hours**

Improving writing skills, Spellings and punctuation, Letter and Paragraph writing. Activity – Writing your personal story

Module-5

Body Language and Presentation Skills **6 Hours**

Elements of body language, Types, Adapting positive body language, Cultural differences in body language. 4 Ps in presentations, Overcoming the fear of public speaking, Effective use of verbal and nonverbal presentation techniques. Activity – Group presentations

Course Outcomes: On completion of this course, students will be able to,

CO 1: Understand the role of communication in personal and professional success

CO 2: Comprehend the types of technical literature to develop the competency of students to apprehend the nature of formal communication requirements.

CO 3: Construct grammatically correct sentences to strengthen essential skills in speaking & writing and to develop critical thinking by emphasizing cohesion and coherence

CO 4: Demonstrate effective individual and teamwork to accomplish communication goals.

Textbooks and Reference Books:

1. Communication Skills by Sanjay Kumar and Pushpa Lata, Oxford University Press - 2015.
2. Everyday Dialogues in English by Robert J. Dixson, Prentice-Hall of India Ltd., 2006.
3. Developing Communication Skills by Krishna Mohan& Meera Banerjee (Macmillan)
4. The Oxford Guide to Writing and Speaking, John Seely, Oxford.
5. English Language Communication Skills - Lab Manual cum Workbook by Rajesh Kumar Singh, Cengage learning India Pvt Limited – 2018

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1												2			
CO2										2					
CO3										2					
CO4									2						
CO									**2**	**2**		**2**			

APPLIED MATHEMATICAL METHODS [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – IV (COMMON TO CV, ME, IP, AU)**			
Course Code:	**P22MA401A**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**2-2-0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives:

1	**Familiarize** the importance of calculus of complex functions associated in dual plane, best fit curves and regression lines, random variables and probability distributions, solutions of ordinary differential equations by using power series.
2	**Apply** C-R equations to find analytic, potential, stream functions, evaluate complex integrals, properties of regression lines, probability functions to analyse distributions, solve differential equations by power series method.

Unit	Syllabus content	No. of hours	
		Theory	Tutorial
I	**Calculus of complex functions**: Introduction to complex variables. Definitions- limit, continuity, differentiability and Analytic functions of f(z) : Cauchy- Riemann equations in Cartesian and polar forms (no proof)-Harmonic function and Problems. Applications to flow problems. Construction of analytic functions when $u \text{ or } v \text{ or } u \pm v$ are given- Milne-Thomson method. Conformal transformations: Introduction. Discussion of transformations for $W = z^2$, $W = e^z$, $W = z + 1/z \;\; z \neq 0$ **Self-Study:** Derivation of Cauchy- Riemann equation in Cartesian and polar form	06	02
II	**Complex integration:** Bilinear Transformations- Problems, line integrals of complex function. Cauchy's theorem, Cauchy's integral formula. Taylor's and Laurent's series (Statements only)- illustrative examples. Singularities, poles and residues with examples, Cauchy's Residues Theorem (statement only)- Illustrative examples. **Self-Study:**– Contour integration Type-I & Type-II problems	06	02
III	**Statistical Methods:** **Statistics:** Brief review of measures of central tendency and dispersion. Moments, skewness and kurtosis. **Curve Fitting:** Curve fitting by the method of least squares, fitting the curves of the forms $y = ax +$, $y = ab^x$ $and\ y = ax^2 + bx + c$. **Correlation and regression**: Karl Pearson's coefficient of correlation and rank correlation- problems, Regression analysis, lines of regression and problems. **Self-Study**: Fit a curve of the form $y = a + bx$, $y = a + bx + cx^2$	06	02
IV	**Probability and Distribution:** **Random variables and Probability Distributions:** Review of random variables. Discrete and continuous random variables-problems. Binomial, Poisson, Exponential and Normal distributions (with usual notation of mean and variance)-: problems.	06	02

	Joint Probability Distributions : Introduction, Joint probability and Joint distribution of discrete random variables and continuous random variables **Self-study:** Geometric and Gamma distributions- problems.		
V	**Special functions:** Power series solution of a second order ODE, Series solution- Frobenius method. Series solution of Bessel's differential equation leading to $J_n(x)$. Expansions for $J_{1/2}(x)$ and $J_{-1/2}(x)$. Series solutions of Legendre's differential equation leading to $P_n(x)$-Legendre's polynomials - simple illustrative examples **Self study:** Basics of Series solutions of ODE's; analytic, singular point and basic recurrence relations.	06	02

COURSE OUTCOMES: On completion of the course, student should be able to:	
CO1	**Understand** fundamental concepts in calculus of complex functions, statistics, probability and special functions.
CO2	Apply tools taught to analyze transformations arising in engineering field and evaluate complex integrals and draw statistical inferences
CO3	**Analyze** problems in engineering field by employing special functions, complex functions and statistical methods.
CO4	**Evaluate** integrals of complex functions, regression and correlation coefficient, probability of a discrete and continuous variable, series solution of special differential equations.

TEACHING - LEARNING PROCESS: Chalk and Talk, power point presentation, animations, videos.

TEXT BOOKS

1. B.S. Grewal, Higher Engineering Mathematics (44th Edition 2018), Khanna Publishers, New Delhi.
2. E. Kreysizig, Advanced Engineering Mathematics, John Wiley and sons, 10th Ed. (Reprint) 2016.

REFERENCE BOOKS

1. V. Ramana: Higher Engineering Mathematics, McGraw –Hill Education,11th Ed..
2. H. C. Taneja, Advanced Engineering Mathematics, Volume I & II, I.K. International Publishing House Pvt. Ltd., New Delhi.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,Reprint, 2010.

ONLINE RESOURCES

1. http://www.nptel.ac.in
2. https://en.wikipedia.org
3. https://ocw.mit.edu/courses/18-03sc-differential-equations-fall-2011/
4. https://ocw.mit.edu/courses/18-06sc-linear-algebra-fall-2011/
5. https://math.hmc.edu/calculus/hmc-mathematics-calculus-online-tutorials/differential-equations/first-order-differential-equations/

QUESTION PAPER PATTERN (SEE)	
PART-A	PART-B
One question from each unit carrying two marks each	Answer any **TWO** sub questions for maximum 18 marks from each unit

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**2**										
CO2	**2**	**3**										
CO3	**3**	**2**										
CO4	**2**	**3**										
Strength of correlation: Low-1, Medium- 2, High-3												

APPLIED THERMODYNAMICS

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – IV

Course Code: P22ME402	**Semester: IV**	**L-T-P: 3-0-0**	**Credits: 03**
Contact Period - Lecture: 40Hrs.	**Exam: 3 Hrs.**	**Weightage: CIE: 50%;**	**SEE: 50%**

Course Learning Objectives:

The objectives of this course are to,

- Apply thermodynamic concepts to understand the working of air standard and vapor power cycles.
- Determine the performance of air standard and vapor power cycles.
- Describe the working of mechanical systems involving compressors, refrigerators and IC engines.
- Determine the performance parameters of systems involving compressors, refrigerators and IC engines.

Course Content

UNIT-I

Air Standard Cycles: Otto cycle and Diesel cycle: P-V and T-S diagrams, description and efficiencies. Comparison of Otto and Diesel cycles. Brayton cycle for gas turbine power plants. Deviations of practical gas turbine cycles from ideal cycles. Modified Brayton cycle like inter-cooling, reheating and regeneration. Numerical Problems.

9 Hrs

Self study component: P-V and T-S diagrams, description of Dual cycle, Sterling cycle, Atkinson cycle.

UNIT-II

Vapour Power Cycles: Carnot vapour power cycle and its performance. Simple Rankine cycle: description, T-S diagram and expression for efficiency. Comparison of Carnot and Rankine cycles. Effects of operating parameters on the performance of simple Rankine cycle. Deviation of simple Rankine cycle from Ideal cycles. Reheat Cycle, Ideal regenerative cycle and practical regenerative cycles with open and closed type feed water heaters, Numerical Problems.

9 Hrs

Self study component: Ideal cycles for jet propulsion, turbo jet cycle, turbo jet, ram jet and turbo prop engines.

UNIT-III

Reciprocating Air Compressors: Working of single stage reciprocating air compressors, Work input using P-V diagram and steady flow analysis. Effect of clearance volume on volumetric efficiency, isothermal and mechanical efficiencies. Multistage compression, advantages of multistage compression. Expression for optimum intermediate pressure with perfect and imperfect inter cooling. Numerical Problems.

7 Hrs

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

UNIT-IV

Refrigeration: Introduction, Units of refrigeration and COP, Refrigerants and Properties of good refrigerants, refrigerating effect, capacity, power required to drive the compressor. Analysis of Mechanical vapor compression refrigeration systems with T-s and P-h diagrams, effect of sub-cooling and super-heating. numerical problems. **Psychrometry**: Psychrometric properties, relations, processes, chart, summer and winter air conditioning systems, numerical problems.

8 Hrs

Self study component: Vapor absorption refrigeration system and steam jet refrigeration

UNIT-V

Testing of I.C. Engines: Testing of SI and CI engines. Performance factors, basic testing factors and basic measurements for engine performance. Indicated power, friction power: Willian's line method, Morse test and motoring test. Brake power: principle of mechanical, hydraulic and eddy current dynamometers. Fuel consumption: volumetric type. Air consumption: Air box method to determine air consumption. Heat balance sheet and related numerical problems.

7 Hrs

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

Text Books

1. P.K.Nag**, "Basic and Applied Thermodynamics",** Tata McGraw Hill, 2nd Edition 2009, ISBN: 9780070151314.
2. Yunus A. Çengel Michael A. Boles**, "Thermodynamics–An engineering approach",** Tata McGraw Hill, 6th edition, 2007, ISBN: 9780073305370.

Reference Books

1. Gordon J. Van Wylen, **"Fundamentals of Classical Thermodynamics",** John Wiley and Sons Canada, Limited, 3rd edition, 1988, ISBN: 9780471610762.
2. D B Spalding and E H Cole**, "Engineering Thermodynamics**", Arnold 1973, 3rd edition, ISBN: 9780713132991.
3. R K Rajput, "**Engineering Thermodynamics**", Laxmi Publications, 4th Edition, ISBN: 9788131800584.
4. S Domkundwar,C P Kothandaraman and V Domkundwar **" A course in Thermal Engineering",** Dhanpat Rai and Co, 2004, ISBN: 9788177000214.
5. M.L.Mathurand R.P.Sharma, **"Internal Combustion Engines",** Dhanpat Rai & Co, 2010, ISBN: 9788189928469.
6. Mahesh M Rathore, **"Thermal Engineering",** Tata McGraw Hill, 1st Edition, 2010 ISBN: 9780070681132.
7. Ganesan, **"Internal Combustion Engines",** Tata McGraw Hill, 4th edition, 2012, ISBN: 9781259006197.

e-Resources

1. https://www.youtube.com/watch?v=LUZrZJJ7zNQ
2. https://www.youtube.com/watch?v=lhilSmE2Ee0&list=PL6Qggk0O9yRItYPKm51jEnZoM-mSOM4XA&index=2
3. https://www.youtube.com/watch?v=V3Cc_TkJh6Q&list=PL6Qggk0O9yRItYPKm51jEnZoM-mSOM4XA&index=3

Course Outcomes: At the end of the course, students will be able to,

1. **Apply** the knowledge of thermodynamics to describe the different thermodynamic cycles.
2. **Apply** the basic principles of thermodynamics to describe the working of mechanical systems involving various power producing and power absorbing machines.
3. **Analyze** the performance of air standard cycles and vapor power cycles.
4. **Analyze** the performance parameters of air compressors, refrigerators and I C engines.

Course Articulation Matrix															
Course Outcomes		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	
CO1	**Apply** the knowledge of thermodynamics to describe the different thermodynamic cycles.	**3**													
CO2	**Apply** the basic principles of thermodynamics to describe the working of mechanical systems involving various power producing and power absorbing machines.	**3**													
CO3	**Analyze** the performance of air standard cycles and vapor power cycles.		**3**												
CO4	**Analyze** the performance parameters of air compressors, refrigerators and I C engines.		**3**												

SEE- Course Assessment Plan

COs	**Marks Distribution**					**Total Marks**	**Weightage (%)**
	Unit I	**Unit II**	**Unit III**	**Unit IV**	**Unit V**		
CO1	2+9	2+9				22	22%
CO2			2+9	2+9	2+9	33	33%
CO3	9	9				18	18%
CO4			9	9	9	27	27%
	20	20	20	20	20	100	
Application =55% Analysis = 45%							

MECHANICS OF MATERIALS

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – IV

Course Code: P22ME403	**Semester: IV**	**L-T-P: 3-0-0**	**Credits: 03**
Contact Period - Lecture: 40 Hrs.	**Exam: 3 Hrs.**	**Weightage: CIE:50%; SEE:50%**	

Course Learning Objectives:

The objectives of this course are to,

- Understand the basic concepts of stress, strain and deformation of mechanical elements subjected to axial, bending and torsional loads.
- Analyze shear force, bending moment in beams and crippling load in columns.

Course Content

UNIT-I

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

7 Hrs

Self study component: Rectangularbar with continuously varying section, volumetric strain.

UNIT-II

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

8 Hrs

Self study component: Strain on inclined plane due to normal stress in X and Y directions.

UNIT-III

Shear force and Bending Moment Diagrams (SFD and BMD): Types of beams, loads and supports, shear force and bending moment, sign conventions, point of contraflexure, and relationship between load intensity, shear force and bending moment. SFD and BMD for different beams subjected to concentrated loads, uniformly distributed load, uniformly varying load and inclined loads.

8 Hrs

Self study component: Applications of beams.

UNIT-IV

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. Bending stresses in beams of uniform section. Shearing stresses in beams, shear stress across rectangular, I and T sections. (Moment of Inertia to be provided for numerical problems). **Deflection of Beams**: Introduction, Differential equation of deflection; Flexural rigidity, Macaulay's method for simply supported beams with point load and UDL.

9 Hrs

Self study component: Beam of uniform strength-uniform beam of rectangular section replaced by beam of constant depth and width.

UNIT-V

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. **Columns:** Introduction to Columns, Euler theory for axially loaded elastic long columns, Euler equation for columns with Both ends hinged and Both ends fixed, Limitations of Euler's theory, Rankine's formula.

8 Hrs

Self study component: Euler equation for one end fixed and other end is free, and one end fixed and the other end is hinged.

Text Books

1. S. S. Bhavikatti, "**Strength of Materials**", Vikas Publication House-Pvt Ltd, 2nd edition, 2000, ISBN: 8125901647.
2. S. S. Rattan, **"Strength of Materials",** Tata McGraw-Hill, New Delhi, 2nd Edition, 2011, ISBN: 9780071072564.

Reference Books

1. James M. Gere, Stephen P. Timoshenko, **"Mechanics of Materials",** CBS Publishers and Distributers Delhi. ISBN: 978-9390219421, 2016.
2. W.A. Nash, **"Strength of Materials",** Schaum's Outline Series, 4th Edition, 2007, ISBN: 9780070466173.
3. Dr. R. K. Bansal, **"Strength of Materials",** Laxmi Publication, New Delhi, 5th Edition, 2007, ISBN: 9788131808146.
4. Ferdinand P Beer, E Russell Johnston, JR., John T DeWolf adapted by N Shivaprasad and S Krishnamurthy, **"Mechanics of Materials",** Tata McGraw-Hill.
5. Dr. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, **"Mechanics of Materials",** Laxmi Publications, New Delhi. 2002.

e-Resources

1.https://www.youtube.com/watch?v=GkFgysZC4Vc&list=PL27C4A6AEA552F9E6&ab_channel=nptelhrd
2. https://www.youtube.com/watch?v=vC8h1RF-KYs&ab_channel=IITDelhiJuly2018
3.https://www.youtube.com/watch?v=tao5K9Kihrs&ab_channel=IITDelhiJuly2018
4.https://www.youtube.com/watch?v=pN8zj44_DoY&ab_channel=Mechanicsofsolids
5.https://www.youtube.com/watch?v=1txkFwWWYds&t=759s&ab_channel=StructuralAnalysis-I
6.https://www.youtube.com/watch?v=CnONQoxubLw&ab_channel=nptelhrd
7.https://www.youtube.com/watch?v=wJWt0dcgafs&ab_channel=nptelhrd

Course Outcomes: At the end of the course, students will be able to;

1. **Apply** the concepts of normal stresses, strain, shear stress, bending stress torsional stress and buckling stress in mechanical components.
2. **Apply** the fundamentals of thermal stress and compound stresses in bars of uniform and compound section.
3. **Analyse** the uniform, stepped, compound bars, beams for different cross section and columns.
4. **Analyse** the beams for deflection using Macaulay's method.

Course Articulation Matrix															
Course Outcomes		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Apply** the concepts of normal stresses, strain, shear stress, bending stress torsional stress and buckling stress in mechanical components.	3													
CO2	**Apply** the fundamentals of thermal stress and compound stresses in bars of uniform and compound section.	3													
CO3	**Analyse** the uniform, stepped, compound bars, beams for different cross section and columns.		3												
CO4	**Analyse** the beams for deflection using Macaulay's method.		3												

SEE- Course Assessment Plan

COs	**Marks Distribution**					**Total Marks**	**Weightage (%)**
	Unit I	**Unit II**	**Unit III**	**Unit IV**	**Unit V**		
CO1	2+9			2+9	2+9	33	33%
CO2		2+9	2+9			22	22%
CO3	9	9	9			27	27%
CO4				9	9	18	18%
	20	20	20	20	20	100	
Application =55% Analysis = 45%							

MANUFACTURING PROCESS-II

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – IV

Course Code: P22ME404	**Semester: IV**	**L-T-P: 3-0-2**	**Credits: 04**
Total Theory Teaching Hours: 40 **Total Laboratory Hours: 24**	**Exam: 3 Hrs.**	**Weightage: CIE: 50 %;SEE: 50%**	

Course Learning Objectives:

The objectives of this course are to,

- Understand the basic metal forming processes of forging, rolling, extrusion, drawing, sheet metal forming and powder metallurgy.
- Give complete insight regarding the mechanical equipment and operations involved to fulfil various applications.

Course Content

UNIT-I

Introduction to Metal Working: Classification of metal working processes, characteristics of wrought products, advantages and limitations of metal working processes. Effect of parameters in metal forming process-Temperature, strain rate, friction and lubrication, hydrostatic pressure in metal working, Deformation zone geometry, workability of materials, residual stresses in wrought products.

8 Hrs

Self study component: Concepts of biaxial and triaxial stresses, plane stress and plane strain.

UNIT-II

Forging and Rolling: Classification of forging processes, forging machines and equipments, Forging die-design parameters. Material flow lines in forging. Forging defects, Residual stresses in forging, advantages and dis-advantages of forging. Classification of Rolling processes. Rolling mills, Defects in rolled products, Rolling variables roll camber.

8 Hrs

Self study component: Hand forging equipments and operations.

UNIT-III

Extrusion and Drawing: Types of Extrusion, Extrusion variables, Extrusion dies. Seamless tube extrusion, Lubrication in Extrusion, Deformation of metal flow in extrusion, Defects in extruded products. Drawing equipment, Elements of drawing Die, dead zone formation, drawing variables, Tube drawing-classification of tube drawing.

8 Hrs

Self study component: Extrusion of brittle metals.

UNIT-IV

Sheet Metal Forming: Sheet metal forming methods, Dies and Punches-classification of dies. Open back inclinable press, Limiting drawing ratio in drawing, Forming limit criterion, Defects in deep drawn products. High energy rate forming (HERF) - Explosive forming, electro magnetic forming, electro hydraulic forming.

8 Hrs

Self study component: Parameters affecting drawability.

UNIT-V

Powder Metallurgy: Basic steps in powder metallurgy, methods of powder production, Characteristics of metal powder. Conditioning and blending powders, Compacting metal powders, Sintering-sintering mechanism, Isostatic pressing, types of isostatic pressing, finishing operations of powder metallurgy parts, advantages, disadvantages and applications of powder metallurgy.

8 Hrs

Self study component: Safety and environmental aspects of powder metallurgy.

Practical Content

24 Hrs

1. Use of forging tools and equipments.
2. Preparing model involving upsetting, drawing and bending operations, along with length and volume calculations.
   i. Model-I
   ii. Model-II
   iii. Model-III
3. Use of sheet metal tools and equipments.
4. Preparing sheet metal model.
   i. Model-I
   ii. Model-II
   iii. Model-III
5. Demonstration on extrusion honing process.
6. Demonstration of forming the parts from metallic powders.

Text Books

1. George E. Dieter, "**Mechanical Metallurgy",** Tata Mc Graw Hill Education, 3rd Edition, 2013, ISBN**:** 9781259064791.
2. Serope Kalpak Jain and Stevan R. Schmid, **"Manufacturing Engineering and Technology",** Pearson Education, 4th Edition, 2014, ISBN: 978-9332535800.

Reference Books

1. J.T. Black, Ronald A. Kohser, "**Materials and Processes in manufacturing",** Wiley, 11th Edition, 2011, ISBN: 978-0470924679.
2. G. W. Rowe, "**Principles of Industrial metal working process",** CBS Publisher, 1st Edition, 2005, ISBN: 978-8123904283.
3. Amitabha Ghosh and Asok Kumar Mallik, "**Manufacturing Science",** East-West press Pvt. Ltd., 2010, ISBN: 978-8176710633.
4. Sadhu Singh, "**Theory of Plasticity and Metal Forming Processes",** Khanna Publishers, 2003, ISBN: 978-8174090508.

Course Outcomes: At the end of the course, students will be able to,

1. **Apply** the concept of metal forming processes, types and applications.
2. **Apply** the knowledge of metal forming processes for production of engineering parts.
3. **Analyse** the various process parameters in metal forming processes.
4. **Make use of** experimental data for writing a report as an **individual** or **as a team** member to **communicate** effectively.

e-Resources

1. http://nptel.ac.in/courses/112107145/
2. https://youtu.be/yGKym19qxiM
3. https://youtu.be/Xf08dgnlwXg
4. https://youtu.be/9RtAis5pnq

Course Articulation Matrix

Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Apply** the concept of metal forming processes, types and applications.	3													

CO2	**Apply** the knowledge of metal forming processes for production of engineering parts.	3													
CO3	**Analyse** the various process parameters in metal forming processes.		3												
CO4	**Make use of** experimental data for writing a report as an **individual** or **as a team** member to **communicate** effectively.									3	3				

SEE- Course Assessment Plan

COs	**Marks Distribution**					**Total Marks**	**Weightage (%)**
	Unit I	**Unit II**	**Unit III**	**Unit IV**	**Unit V**		
CO1	2+9			2+9		22	22%
CO2	9	2+9	2+9		2+9	42	42%
CO3		9	9	9	9	36	36%
CO4	**Note: Assessment only in CIE**						
	20	20	20	20	20	100	100%
Application =64% Analysis = 36%							

MECHANICAL MEASUREMENTS AND METROLOGY
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – IV

Course Code: P22ME405	**Semester: IV**	**L-T-P: 3-0-2**	**Credits: 04**
Total Theory Teaching Hours: 40 **Total Laboratory Hours: 24**	**Exam: 3 Hrs.**	**Weightage: CIE:50%; SEE:50%**	

Course Learning Objectives:

The objectives of this course are to,

- The basic concepts of measurement and metrology, and strengthening their knowledge about advancements in system of limits, fits, tolerances and gauging of mechanical elements.
- The various measuring equipment's and use of this in industry for quality inspection.

Course Content

UNIT-I

Basic Concepts of Measurement and Metrology: Definition and significance of measurement, Generalized measurement system, Performance characteristics of measuring instruments (Only static characteristics), Inaccuracy of Measurements, Definition and objectives of metrology. Standards, Line and end standard, Wave length standard, Transfer from line to end standard. Slip gauges, Wringing phenomena, Numerical problems on building of slipgauges and calibration of end bars.

8 Hrs

Self study component: Imperial standard yard and International Prototype meter

UNIT-II

System of Limits, Fits, Tolerances and Gauging: Definition of tolerance, specification in assembly, Principle of interchangeability and selective assembly. Concept of limits of size and tolerances, Compound tolerances, accumulation of tolerances. Definition of fits, types of fits. Hole basis system and shaft basis system, Geometric dimensioning and tolerancing. Classification of gauges, Basic concept of design of gauges (Taylor's principles), wear allowance on gauges. Types of gauges -plain plug gauge, ring gauge, snap gauge, gauge materials, numerical problems on gauge design

8 Hrs

Self study component: Limit gauges for tapers.

UNIT-III

Comparators: Characteristics and classification of comparators. Mechanical comparators- Johnson Mikrokator, Sigma Comparators, Optical Comparators -principles, Zeiss ultra-optimeter, Electric and Electronic Comparators, LVDT, Pneumatic Comparators, Solex Comparator. Back Pressure gauges, **Surface Roughness and Metrology of Screw Thread:** Surface roughness terminology, Methods of measuring surface roughness, Taylor-Hobson Talysurf, Analysis of surface traces, Measurement of basic elements of thread, worked examples.

8 Hrs

Self study component: Measurements of alignment using Autocollimator

UNIT-IV

Transducers: Introduction, Transfer efficiency, classification of transducers. Mechanical Transducers: diaphragms, bellows. Electrical transducers: sliding contact resistive type, capacitive transducer, Piezo-Electric transducer. **Signal Conditioning:** Inherent problems in Mechanical systems, Electrical intermediate modifying devices, Input circuitry-simple current sensitive circuit, Electronic amplifiers, Filters, Types of filters, telemetry.

8 Hrs

Self study component: Applications of Transducers.

UNIT-V

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

strain gauges. **Measurement of Force:** Introduction, Proving ring. **Measurement of Torque:** Introduction, Hydraulic dynamometer. **Measurement of Pressure**: Introduction, McLeod gauge, Pirani Gauge. **Temperature Measurement**: Thermocouple, Laws of thermocouple, Thermocouple materials.

8 Hrs

Self study component: Pyrometers, Optical pyrometers.

Practical Content

24 Hrs

1. Calibration of measuring instruments.
2. Measurement of angle using Sine bar and Sine Centre.
3. Measurements using Profile Projector.
4. Measurements using Toolmaker's Microscope.
5. Measurement of alignment using Autocollimator.
6. Calibration of LVDT.
7. Measurements of Surface roughness using Tally surf.
8. Mechanical Comparator.
9. Measurement of Screw threads parameters using floating carriage.
10. Measurement of cutting tool forces using drill tool Dynamometer.

Text Books

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

Reference Books

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

e-Resources

1. https://youtu.be/HpIEeBtJupY
2. https://youtu.be/-_qz8_sbhwY
3. https://youtu.be/uAntebtIgCY
4. https://youtu.be/rbk28swIiHU
5. https://youtu.be/OcbkOvjZujU
6. https://youtu.be/fbk0_nPNUTE
7. https://youtu.be/zmxjlFEcCUM
8. https://youtu.be/Hi7NUJdznc0
9. https://youtu.be/2vgkxHe_24g
10. https://youtu.be/TyM28gmhJcc

Course Outcomes: At the end of the course, students will be able to,

1. **Apply** fundamentals of metrology and measurement
2. **Design** tolerances and fits for selected product quality
3. **Analyze** appropriate method and instruments for inspection of various mechanical systems.
4. **Make use of** experimental data for writing a report as an **individual** or **as a team** member to **communicate** effectively.

Course Articulation Matrix

Course Outcomes		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Apply** fundamentals of metrology and measurement.	3													
CO2	**Design** tolerances and fits for selected product quality.			3											
CO3	**Analyze** appropriate method and instruments for inspection of various mechanical systems.		3												
CO4	**Make use of** experimental data for writing a report as an **individual** or **as a team** member to **communicate** effectively.									3	3				

SEE- Course Assessment Plan

COs	Marks Distribution					Total Marks	Weightage (%)
	Unit I	**Unit II**	**Unit III**	**Unit IV**	**Unit V**		
CO1	2+9	2+9	2+9	2+9	2+9	55	55%
CO2		9				9	9%
CO3	9		9	9	9	36	36%
CO4	**Note: To be assessed only in CIE**						
	20	20	20	20	20	100	100%
Application =55% Design=9% Analysis = 36%							

FLUID MEASUREMENT AND MACHINERY LABORATORY

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – IV

Course Code: P22MEL406	**Semester: IV**	**L-T-P: 0-0-2**	**Credits: 1**
Contact Period-Lecture: 30(P) Hrs.	**Exam: 3 Hrs.**	**Weightage: CIE:50%; SEE:50%**	

Course Learning Objectives:

The objectives of this course are to,

- Understand the basic measurement techniques of fluid flow.
- Evaluate the performance of vanes, turbines, pumps, compressor and blower.
- Provide training to students to enhance their practical skills.
- Develop team qualities and ethical principles.

Course Content

PART-A **10 Hrs**

Exp-1 Calibration of Venturi meter and determination of its co-efficient of discharge.

Exp-2 Calibration of Orifice meter and determination of its co-efficient of discharge.

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

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

Exp-5 Determination of Vane efficiency (Coefficient of impact) for different vanes.

PART-B **20 Hrs**

Exp-6 Performance test on Pelton wheel Turbine.

Exp-7 Performance test on Centrifugal Pump.

Exp-8 Performance test on Reciprocating Pump.

Exp-9 Performance test on Two Stage Reciprocating Air Compressor.

Exp-10 Performance test on Air Blower.

Reference Books

1. Dr. Jagadish Lal, **"Fluid Mechanics and Hydraulics",** Metropolitan Book Co. Pvt .Ltd, New Delhi, 2002, ISBN: 9788120002722.
2. Dr. R.K.Bansal, "**Fluid mechanics and hydraulic machines",** Laxmi publications Ltd., New Delhi, 9th Edition, 2015, ISBN: 9788131808153.

Course Outcomes: At the end of the course, students will be able to,

1. **Apply** Bernoulli's principle to determine flow rate, pressure changes for flow through pipes and **examine** the fluid flow rate in an open channel.
2. **Compare** the effect of friction in pipes of different materials.
3. **Analyse** the performance parameters of vanes, turbine, pumps, compressor and blower.
4. **Make use of** experimental data for writing a report as an **individual** or **as a team** member to **communicate** effectively.

Course Articulation Matrix															
Course Outcomes		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Apply** Bernoulli's principle to determine flow rate, pressure changes for flow through pipes and **examine** the fluid flow rate in an open channel.	3	2		1										
CO2	**Compare** the effect of friction in pipes of different materials.	3	1		1										
CO3	**Analyse** the performance parameters of vanes, turbine, pumps, compressor and blower.	3	3		2										
CO4	**Make use of** experimental data for writing a report as an **individual** or **as a team** member to **communicate** effectively.									3	3				

SEE- Course Assessment Plan

COs	**Marks Distribution**			**Total Marks**	**Weightage (%)**
	Part A	**Part B**	**Viva- Voce**		
CO1	8			8	16%
CO2	7			7	14%
CO3		25		25	50%
CO4			10	10	20%
	15	25	10	50	
Application =16% Analysis = 64% Communication =20%					

EMPLOYABILITY ENHANCEMENT SKILLS - IV [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – IV for Civil, Mech, IP & Automobile Branches only			
Course Code:	**P22HSMC407A**	**Credits:**	**01**
Teaching Hours/Week (L:T:P)	**0:2:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**30**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Calculations involving simple and compound interest, averages, alligations & mixtures, proportions, variations and partnership.
- Explain concepts behind logical reasoning modules of series, coding & decoding, seating and data arrangements.
- Develop problem solving through Python language.

UNIT – I		**06 Hours**
Quantitative Aptitude: Simple and Compound Interest, Averages. **Logical Reasoning:** Series, Coding & Decoding.		
Self-study component:	Mensuration	
UNIT – II		**06 Hours**
Quantitative Aptitude: Alligations and Mixtures, Ratios, Proportions and Variations. **Logical Reasoning:** Seating Arrangement, Data Arrangement.		
Self-study component:	Types of cryptarithm	
UNIT – III		**06 Hours**
Quantitative Aptitude: Partnership. **Verbal Ability:** Sentence Completion, Ordering of Sentences.		
Self-study component:	Game based assessments	
UNIT – IV	**PYTHON - I**	**06 Hours**
Python Basics: The print statement, Comments, Python Data Structures and Data Types, String Operations in Python, Simple Input & Output, Simple Output Formatting, Operators in Python **Python Program Flow:** Indentation, The If statement and its' related statement, An example with if and it's related statement, The while loop, The for loop, The range statement, Break & Continue, Assert, Examples for looping. **Functions and Modules:** Create your own functions, Function parameters, Variable Arguments, Scope of a Function, Function Documentations, Lambda Functions & map, n Exercise with functions, Create a Module, Standard Modules.		
Self-study component:	List-like types	

UNIT – V	PYTHON - II	06 Hours

Exceptions Handling: Errors, Exception handling with try, handling Multiple Exceptions, Writing your own Exception.
File Handling: File handling Modes, Reading Files, Writing & Appending to Files, Handling File Exceptions, The with statement.
Classes in Python: New Style Classes, Creating Classes, Instance Methods, Inheritance, Polymorphism, Exception Classes & Custom Exceptions.
Generators and Iterators: Iterators, Generators, The Functions any and all, With Statement, Data Compression

Self-study component:	Debugging

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Solve the problems based on simple and compound interests, averages, alligations & mixtures, ratios, proportions, variations and partnerships.	Applying	L3
CO2	Solve logical reasoning problems based on seating arrangements, data arrangement and verbal ability skills of sentence corrections and ordering of sentences.	Applying	L3
CO3	Apply suitable programming constructs of Python language and / or suitable data structures to solve the given problem.	Analyzing	L4
CO4	Design and Develop solutions to problems using functions.	Analyzing	L4

Text Book(s):

1. Python Programming: Using Problem Solving Approach by Reema Thareja.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015
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.

Reference Book(s):

1. Al Sweigart, "Automate the Boring Stuff with Python", 1st Edition, No Starch Press, 2015.
2. Quantitative Aptitude by Arun Sharma, McGraw Hill Education Pvt Ltd.

Web and Video link(s):

- Learn Python by example - https://www.learnbyexample.org/python/
- Learn Python - https://www.learnpython.org/
- Python tutor: Visualize code in Python - https://pythontutor.com/visualize.html#mode=edit

COURSE ARTICULATION MATRIX (EMPLOYABILITY ENHANCEMENT SKILLS - IV – P22HSMC407)												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											2
CO2	2											2
CO3	2	2										
CO4	2	2										

Internship - I [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – IV			
Course Code:	**P22INT409**	**Credits:**	**02**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**-**
Total Number of Teaching Hours:	**-**	**SEE Marks:**	**100**

All the students registered to II year of BE shall have to undergo a mandatory internship of 02 weeks during the intervening vacation of II and III semesters or III and IV semester. Internship shall include Inter / Intra Institutional activities. A Semester End Examination (Presentation followed by question-answer session) shall be conducted during IV semester and the prescribed credit shall be included in IV semester. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequent Semester End Examination after satisfying the internship requirements. (The faculty coordinator or mentor has to monitor the students' internship progress and interact to guide them for the successful completion of the internship.)

PHYSICAL EDUCATION [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER - IV			
Course Code:	**P22PED409**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**-**	**SEE Marks:**	**-**

Fitness Components	**Track Events**
Athletics Track- Sprints Jumps- Long Jump Throws- Shot Put	1.1. Starting Techniques: Standing start and Crouch start (its variations) use of Starting Block. 1.2. Acceleration with proper running techniques. 1.3. Finishing technique: Run Through, Forward Lunging and Shoulder Shrug. **Long Jump**: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick) and Landing **Shot put**: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique.
Kho kho	A. **Fundamental skills** 1. Service: Under arm service, Side arm service, Tennis service, Floating service. 2. Pass: Under arm pass, Over head pass. 3. Spiking and Blocking. 4. Game practice with application of Rules and Regulations B. **Rules and their interpretation and duties of officials**.
Throw ball Athletics Track- 110 &400 Mtrs Hurdles Jumps- High Jump Throws- Discuss Throw	A. **Fundamental skills:** Overhand service, Side arm service, two hand catching, one hand overhead return,side arm return. B. **Rules and their interpretations and duties of officials** **110 Mtrs and 400Mtrs**: Hurdling Technique :Lead leg Technique, Trail leg Technique ,Side Hurdling, Over the Hurdles Crouch start (its variations) use of Starting Block. Approach to First Hurdles, In Between Hurdles, Last Hurdles to Finishing. **High jump**: Approach Run, Take-off, Bar Clearance (Straddle) and Landing. **Discus Throw**: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle).

YOGA [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER - IV			
Course Code:	**P22YOG409**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**-**	**SEE Marks:**	**-**

Course objectives:

6) To enable the student to have good health.
7) To practice mental hygiene.
8) To possess emotional stability.
9) To integrate moral values.
10) To attain higher level of consciousness.

The Health Benefits of Yoga

The benefits of various yoga techniques have been supposed to improve

- body flexibility,
- performance,
- stress reduction,
- attainment of inner peace, and
- self-realization.

The system has been advocated as a complementary treatment to aid the healing of several ailments such as

- coronary heart disease,
- depression,
- anxiety disorders,
- asthma, and
- extensive rehabilitation for disorders including musculoskeletal problems and traumatic brain injury.

The system has also been suggested as behavioral therapy for smoking cessation and substance abuse (including alcohol abuse).

If you practice yoga, you may receive these physical, mental, and spiritual benefits:

- Physical

10. Improved body flexibility and balance
11. Improved cardiovascular endurance (stronger heart)
12. Improved digestion
13. Improved abdominal strength
14. Enhanced overall muscular strength
15. Relaxation of muscular strains
16. Weight control
17. Increased energy levels
18. Enhanced immune system

- Mental

4. Relief of stress resulting from the control of emotions
5. Prevention and relief from stress-related disorders
6. Intellectual enhancement, leading to improved decision-making skills

- Spiritual

4. Life with meaning, purpose, and direction
5. Inner peace and tranquility
6. Contentment

Patanjali's Ashtanga Yoga, its need and importance.
Yama :Ahimsa, satya, asteya, brahmacarya, aparigraha
Niyama :shoucha, santosh, tapa, svaadhyaya, Eshvarapranidhan
Suryanamaskar12 count- 4 rounds of practice
Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits of each asana
Different types of Asanas
a. Sitting 1. Sukhasana
2. Paschimottanasana
b. Standing 1. Ardhakati Chakrasana
2. Parshva Chakrasana
c. Prone line 1. Dhanurasana
d. Supine line 1. Halasana
2. Karna Peedasana
Meaning, importance and benefits of Kapalabhati.
40 strokes/min 3 rounds
Meaning, Need, importance of Pranayama. Different types. Meaning by name, technique, precautionary measures and benefits of each Pranayama
Pranayama – 1. Suryanuloma –Viloma 2. Chandranuloma-Viloma 3. Suryabhedana
4. Chandra Bhedana 5. Nadishodhana

Additional Mathematics - II [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – IV (Lateral Entry: Common to all branches)			
Course Code:	**P22MDIP401**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**2-2-0**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**-**

Course Objectives: The mandatory learning course**:** **P21MATDIP401** viz., **Additional Mathematics-II** aims to provide essential concepts of linear algebra, introductory concepts of second & higher order differential equations along with various techniques/ methods to solve them, Laplace & inverse Laplace transforms and elementary probability theory.

UNIT-I	
Linear Algebra: Introduction - Rank of matrix by elementary row operations - Echelon form of a matrix. Consistency of system of linear equations - Gauss elimination method. Gauss-Jordan and LU decomposition methods. Eigen values and Eigen vectors of a square matrix. **Self-study Components**: Application of Cayley-Hamilton theorem (without proof) to compute the inverse of a matrix-Examples.	**10 Hrs**
UNIT-II	
Higher order ODE's: Linear differential equations of second and higher order equations with constant coefficients. Homogeneous /non-homogeneous equations. Inverse differential operators. and variation of parameters. Solution of Cauchy's homogeneous linear equation and Legendre's linear differential equation. **Self-study Components**: Method of undetermined coefficients	**14 Hrs**
UNIT-III	
Multiple Integrals: Double and triple integrals-region of integration. Evaluation of double integrals by change of order of integration. Vector Integration: Vector Integration: Integration of vector functions. Concept of a line integrals, surface and volume integrals. Green's, Stokes's and Gauss theorems (without proof) problems. **Self-study Components**: Orthogonal curvilinear coordinates.	**10 Hrs**
UNIT-IV	
Laplace transforms: Laplace transforms of elementary functions. Transforms of derivatives and integrals, transforms of periodic function and unit step function-Problems only. Inverse Laplace transforms: Definition of inverse Laplace transforms. Evaluation of Inverse transforms by standard methods. **Self-study Components**: Application to solutions of linear differential equations and simultaneous differential equations..	**12Hrs**
UNIT-V	
Probability: Introduction. Sample space and events. Axioms of probability. Addition and multiplication theorems. Conditional probability – illustrative examples. **Self-study Components**: State and prove Bayes's theorem	**06Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Apply matrix theory for solving systems of linear equations in the different areas of linear algebra.
CO2:	Solve second and higher order differential equations occurring in of electrical circuits, damped/un-damped vibrations.
CO3:	Identify - the technique of integration evaluate double and triple integrals by change of variables, and vector integration technique to compute line integral
CO4:	Explore the basic concepts of elementary probability theory and, apply the same to the problems of decision theory,

Text Book:

- B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, New Delhi, 43rd Ed., 2015.

Reference books:

1. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed., 2015.
2. N.P.Bali and Manish Goyal: Engineering Mathematics, Laxmi Publishers,7th Ed., 2007.

Additional Communicative English - II [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – IV			
Course Code:	**P22HDIP407**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**0:2:0**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**30**	**SEE Marks:**	**-**

Module-1

Listening Skills II — **2 Hours**

Levels of listening, Active listening, Techniques of listening. Activity: Listening for main ideas and Listening for specific information

Speaking Skills II — **6 Hours**

Language of discussion – Giving opinion, agreeing / disagreeing, asking questions, making suggestions. Sentence stress – content and structure words, Speaking situations, Intonations and Summarizing skills

Module-2

Reading Skills II — **2 Hours**

Guessing meaning from the context, Understanding graphical information, Summarizing. Activity: Book review

Writing Skills II — **4 Hours**

Linkers and connectives, Sentence and paragraph transformation, Mind mapping techniques, Letter writing, Essay writing

Module-3

Email Etiquette — **4 Hours**

Parts of an email, Writing an effective subject line, email language and tone. Activity: Email writing practice - Scenario based emails

Group Presentations — **2 Hours**

Group presentations by the students

Module-4

Goal Setting — **2 Hours**

Defining goals, types of goals, Establishing SMART goals, Steps in setting goals, Goal setting activity

Individual Presentations — **4 Hours**

Individual presentation by the students

Module-5

Teamwork — **4 Hours**

Defining teams, Team vs. Group, Benefits and challenges of working in teams, Stages of team building, Building effective teams, Case studies on teamwork

Course Outcomes: On completion of this course, students will be able to,

CO 1: Understand the role of communication in personal and professional success

CO 2: Comprehend the types of technical literature to develop the competency of students to apprehend the nature of formal communication requirements.

CO 3: Construct grammatically correct sentences to strengthen essential skills in speaking & writing and to develop critical thinking by emphasizing cohesion and coherence

CO 4: Demonstrate effective individual and teamwork to accomplish communication goals.

Textbooks and Reference Books:

1. Communication Skills by Sanjay Kumar and Pushpa Lata, Oxford University Press - 2015.
2. Everyday Dialogues in English by Robert J. Dixson, Prentice-Hall of India Ltd., 2006.
3. Developing Communication Skills by Krishna Mohan& Meera Banerjee (Macmillan)
4. The Oxford Guide to Writing and Speaking, John Seely, Oxford.
5. English Language Communication Skills - Lab Manual cum Workbook by Rajesh Kumar Singh, Cengage learning India Pvt Limited – 2018
6. The 7 habits of highly effective people by Stephen R Covey, Simon & Schuster – 2020
7. You Are the Team: 6 Simple Ways Teammates Can Go from Good to Great by Michael G. Rogers

CO – PO – PSO Matrix

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
CO1												2			
CO2										2					
CO3										2					
CO4									2						
CO									**2**	**2**		**2**			