SEMESTER 3

NAVAL ARCHITECTURE & SHIPBUILDING ENGINEERING

SEMESTER S3

MATHEMATICS FOR ELECTRICAL SCIENCE AND PHYSICAL SCIENCE – 3

(Common to B & C Groups)

Course Code	**GYMAT301**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Basic knowledge in complex numbers.	**Course Type**	Theory

Course Objectives:

1. To introduce the concept and applications of Fourier transforms in various engineering fields.
2. To introduce the basic theory of functions of a complex variable, including residue integration and conformal transformation, and their applications

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fourier Integral, From Fourier series to Fourier Integral, Fourier Cosine and Sine integrals, Fourier Cosine and Sine Transform, Linearity, Transforms of Derivatives, Fourier Transform and its inverse, Linearity, Transforms of Derivative. **(Text 1: Relevant topics from sections 11.7, 11.8, 11.9)**	**9**
2	Complex Function, Limit, Continuity, Derivative, Analytic functions, Cauchy-Riemann Equations (without proof), Laplace's Equations, Harmonic functions, Finding harmonic conjugate, Conformal mapping, Mappings of $w= z^2$, $w=e^z$, $w= \frac{1}{z}$, $w= sinz$. **(Text 1: Relevant topics from sections 13.3, 13.4, 17.1, 17.2, 17.4)**	**9**

3	Complex Integration: Line integrals in the complex plane (Definition & Basic properties), First evaluation method, Second evaluation method, Cauchy's integral theorem (without proof) on simply connected domain, Independence of path, Cauchy integral theorem on multiply connected domain (without proof), Cauchy Integral formula (without proof). **(Text 1: Relevant topics from sections 14.1, 14.2, 14.3)**	**9**
4	Taylor series and Maclaurin series, Laurent series (without proof), Singularities and Zeros – Isolated Singularity, Poles, Essential Singularities, Removable singularities, Zeros of Analytic functions – Poles and Zeros, Formulas for Residues, Residue theorem (without proof), Residue Integration- Integral of Rational Functions of $cos\theta$ and $sin\theta$. **(Text 1: Relevant topics from sections 15.4, 16.1, 16.2, 16.3, 16.4)**	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Determine the Fourier transforms of functions and apply them to solve problems arising in engineering.	**K3**
CO2	Understand the analyticity of complex functions and apply it in conformal mapping.	**K3**
CO3	Compute complex integrals using Cauchy's integral theorem and Cauchy's integral formula.	**K3**
CO4	Understand the series expansion of complex function about a singularity and apply residue theorem to compute real integrals.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Advanced Engineering Mathematics	Erwin Kreyszig	John Wiley & Sons	10^{th} edition, 2016

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Complex Analysis	Dennis G. Zill, Patrick D. Shanahan	Jones & Bartlett	3rd edition, 2015
2	Higher Engineering Mathematics	B. V. Ramana	McGraw-Hill Education	39th edition, 2023
3	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	44th edition, 2018
4	Fast Fourier Transform - Algorithms and Applications	K.R. Rao, Do Nyeon Kim, Jae Jeong Hwang	Springer	1st edition, 2011

SEMESTER S3

FLUID MECHANICS FOR NAVAL ARCHITECTS

Course Code	**PCNST302**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hr. 30 Mins
Prerequisites (if any)	Basic Calculus, Physics	**Course Type**	Theory

Course Objectives:

1. Understand basic fluid properties, their physical significance and units and to enable students appreciate that basic laws govern phenomena in the domain of the discipline.
2. Discern principles of fluid mechanics.
3. To help students know that an equation exists that can potentially solve all fluid problems.
4. To impart awareness that a ship's design calls for measures to countervail action of fluid forces.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fluids and liquids. Continuum. Liquids and their properties (density, specific weight, specific volume, specific gravity. viscosity), Newton's law of viscosity. Newtonian fluids, non-Newtonian fluids. Effect of temperature and pressure on viscosity, effect of viscosity on floating bodies, surface tension and its effect on ships, vapour pressure and cavitation, pressure at a point in a fluid, influence of depth of fluid on pressure, pressure measurement, hydrostatic forces on submerged bodies, metacentre, determination of metacentric height.	11

2	Fluid kinematics: Langrangian method, Eulerian method, velocity and acceleration components of a fluid particle, types of flow and flow lines, conservation of mass, rate of flow, Continuity equation and its derivation, circulation and vorticity, velocity potential, stream function, relations between the functions. Fluid Dynamics: Euler's equation of motion, Bernoulli's equation for ideal and real fluid, application of BE to Venturimeter, momentum equation, moment of momentum equation.	**11**
3	Viscous flow of incompressible fluids, laminar flow, turbulent flow, Reynold's experiment, Reynolds number, Navier-Stokes equation, laminar flow through pipes, frictional loss in pipe for laminar and turbulent flows. Characteristics of turbulent flow, boundary layer approximation, boundary layer procedure applied to laminar boundary layer on a flat plate, displacement thickness, turbulent flat plate boundary layer, Momentum integral technique for boundary layers on flat plate.	**11**
4	External flow, drag and lift on foils, friction and pressure drag, flow separation, flow over flat plate, drag and friction coefficient, flow over cylinders, effect of surface roughness, application to drag on ship's hull, magnus effect. Six-dof motions of a floating body. CFD: Basics, introduction to solution of a simple problem	**11**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
1. 2 Questions from each module. 2. Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	1. Each question carries 9 marks. 2. Two questions will be given from each module, out of which 1 question should be answered. 3. Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To describe basic concepts in moderate width (what fluid/liquid is, fluid properties like density, specific gravity, specific weight with emphasis on viscosity, pressure)	**K2**
CO2	To identify hydrostatic forces on submerged surfaces and discuss buoyancy, stability and flotation of bodies in liquids	**K2**
CO3	To solve real engineering problems in fluid kinematics and kinetics and apply principles of mass, energy and momentum	**K3**
CO4	To interpret boundary layer, flow separation, and forces exerted by flowing fluid on a body and, 6-dof motions of floating vessel.	**K3**

Note: *K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fluid Mechanics: Fundamentals and Applications	Yunus A Cengel John M Cambala	Tata McGraw Hill Publishing Company Ltd: New Delhi	Edition 2, 2010
2	Fluid Mechanics	Frank M White	Tata McGraw Hill Publishing Company, Ltd: New Delhi	Edition 7, 2008
3	Fluid Mechanics, Hyrdaulic Machines	R. K Rajput	S Chand & Co Ltd	Edition 6, 2010
4	Fluid Mechanics and its Applications	Vijay Gupta	New Age International (P) Ltd Pub.	Edition 2, 2011
5	Ship Hydrostatics and Stability	Adrian Biran	Butterworth Heinemann	Edition 2, 2011
6	Mechanics of Fluids	Merie C Potter	Cengage Learning, N Delhi	Edition 5, 2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Mechanics of Fluids	Bernard Massey	Nelson Thomas	Edition 7, 1990
2	Engineering Fluid Mechanics	Graebel W. P.	Taylor and Francis	Edition 1 Indian Print , 2011
3	Fluid Mechanics	Piyush K Kundu, Ira M Cohen	Academia Press	Edition 4, 2008
4	Fluid Mechanics with Engineering Applications	J Frabzino	McGraw Hill	Edition 10, 2002

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/105103192 https://nptel.ac.in/courses/112105171
2	https://nptel.ac.in/courses/105103192 https://nptel.ac.in/courses/112105171
3	https://nptel.ac.in/courses/105103192 https://nptel.ac.in/courses/112105171
4	https://nptel.ac.in/courses/105103192 https://nptel.ac.in/courses/112105171

SEMESTER S3

SOLID MECHANICS FOR NAVAL ARCHITECTS

Course Code	**PCNST303**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Engineering Mechanics	**Course Type**	Theory

Course Objectives:

1. Explain the behaviour of different types of solids made of different materials and having different cross-sections under various loading conditions
2. Explain the concepts of bending moment and shear stress in different types of beams
3. Explain the concepts of stresses in beams, beam deflection and buckling phenomenon in long columns
4. Explain the concept of torsion and buckling

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Basics in Mechanics of Solids:** Types of Loads; Stress, Strain and their types. **Stress-Strain Concepts:** Hooke's Law; Stress-Strain relationship for mild steel- Elastic Limit; Yield point; Bars of varying sections; Bars of composite sections; Temperature Stresses; Poisson's Ratio; Working Stress; Factor of safety; Volumetric strain; Modulus of elasticity; Modulus of rigidity; Bulk Modulus; Relationship between the elastic constants.	11

2	**Bending Moment and Shear Force:** Definitions; Shear force and bending moment; Beams and Loads; Sign conventions; Shear force and Bending Moment Diagrams for Cantilever, simply supported and Overhanging beams with various types of loading (Point load, Distributed load, Couples).	**11**
3	**Stresses in Beams:** Simple bending; Theory of Simple Bending; Assumptions in Simple Bending; Neutral axis; Section Modulus; Flexural rigidity; Stresses in symmetrical sections; Bending Stress Distribution. **Shear Stress:** Shear stress distribution in beams; Assumptions; Shear stress distribution for rectangular, circular, triangular, I and T sections. **Principal Stresses and Strains**: Definition; Mohr's Circle.	**11**
4	**Beam Deflection:** Relation between curvature, slope and deflection. Double integration method. **Theory of Columns:** Introduction to columns; Buckling Theory; Euler's Formula for Long Columns; Assumptions and Limitations; Effect of End Conditions; Slenderness Ratio. **Thin-Walled Pressure Vessels:** Introduction; Biaxial Tension and Compression in Thin-Walled Pressure Vessels such as cylindrical and spherical. **Torsion:** Introduction to torsion; Theory of pure torsion; Torsion of Circular Shafts.	**11**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Assimilate the concepts on stress, strain, modulus of elasticity and the relationship between different elastic constants.	**K1**
CO2	Draw the bending moment diagram and shear force diagram for various types of beams under different boundary conditions and loading.	**K2**
CO3	Calculate the shear stress distribution under various cross –sections and determine principal stresses with the aid of equations and Mohr's circle.	**K2**
CO4	Conceive the concept on torsion and buckling and their applications.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									
CO2	3	3										
CO3	3	2										
CO4	3	2										
CO5	2	2	2									

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Strength of Materials	Bansal R. K	Lakshmi Publications	Edition 4, 2007
2	Strength of Materials Part 1	Timoshenko S. P.	D. Van Nostrand Company Inc .	Edition 3, 2002
3	Strength of Materials	S. Ramamrutham	Dhanpat Rai Publishing Company	Edition 16, 2008
4	Engineering Mechanics of Solids	E P Popov	Prentice-Hall of India Pvt Ltd	Edition 2, 1998 (Reprint 2019)

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Strength of Materials	S. S Bavikatti	Vikas Publishing House Pvt Ltd	Edition 4, 2014
2	Introduction to Solid Mechanics	Shames I. H., James M. Pitarresi	Pearson Education India	Edition 3, 2015
3	Analysis of Structures	V.N. Vazirani, M.M.Ratwan	Khanna Publishers	Edition 1, 2015
4	Mechanics of Materials	Punmia B. C. and A. K. Jain	Laxmi Publications (P) Ltd	Edition 1, 2017

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/105/104/105104160/
2	https://archive.nptel.ac.in/courses/105/104/105104160/
3	https://archive.nptel.ac.in/courses/105/104/105104160/
4	https://archive.nptel.ac.in/courses/105/104/105104160/

SEMESTER S3

SHIP STABILITY

Course Code	**PBNST304**	**CIE Marks**	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	**ESE Marks**	40
Credits	4	**Exam Hours**	2 Hr. 30 Mins
Prerequisites (if any)	PCNST205	**Course Type**	Theory

Course Objectives:

1. Apply naval architectural principles to transverse stability of ships and estimate GZ values of ships
2. Apply naval architectural principles to longitudinal stability of ships and compute trim of ships for various loading conditions
3. Understand the concepts of floodable length and damage stability of ships
4. Check the compliance of ships with the requirements of regulatory bodies and Classification Societies

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Transverse stability: - Centre of gravity of ship, Estimation of BM_T and GM_T, Stability at small angles, Effect of addition, removal and transference (lateral and vertical) of weight, Effect of suspended weights, Free surface effect, Wall sided formula. Large angle stability - Statical stability curve, characteristics of GZ curve, effect of changes in ship's breadth, freeboard and superstructure on GZ curve. Cross curves of stability, Methods for calculating GZ (Krylov, Prohaska, etc.), Dynamical stability – diagram of dynamical stability	9

2	Longitudinal stability: – Trim, longitudinal metacentre, estimation of BM_L and GM_L, longitudinal centre of flotation, trimming moment; trim calculations – addition, removal and transference of weight, effect of change of density of water, fresh water allowance	9
3	Flooding and Damage stability: - Watertight integrity, Bilging, Permeability, Margin line, Flooding calculation, Floodable length, Factor of Subdivision, Permissible length, Curves of floodable length and permissible length, Compartment Standard, Damage Stability – Calculations by Lost Buoyancy and Added Weight Methods, Deterministic and Probabilistic Approach.	9
4	Stability of ships while docking and grounding, Inclining experiment, Heeling Moments due to wind, shift of cargo, passengers, turning and nonsymmetrical accumulation of ice. Stability in waves, Recommendations of IMO, Classification Societies and government authorities, Intact and damage stability rules. Stability criteria in weather condition. Stability booklet	9

Suggestion on Project Topic

Course Assessment Method

(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	Total
5	**30**	**12.5**	**12.5**	**60**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 2 marks **(8x2 =16 marks)**	• 2 questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 2 sub divisions. • Each question carries 6 marks. **(4x6 = 24 marks)**	**40**

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Explain the transverse stability of ships and use standard methods to compute the GZ values of ships	**K3**
CO2	Explain the longitudinal stability of ships and compute trims of ships for various loading conditions	**K3**
CO3	Explain floodable length and damage stability calculations of ships.	**K3**
CO4	Analyse stability of ships and verify the compliance with rules/regulations /recommendations of regulatory bodies/Classification Societies.	**K4**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Naval Architecture	E. C. Tupper	Butterworth-Heinemann	Edition 5, 2013
2	Principles of Naval Architecture (Second Revision)	Edward V. Lewis (Editor)	The Society of Naval Architects and Marine Engineers	Edition 1, 1988
3	Basic Naval Architecture-Ship Stability	Philip A. Wilson	Springer	Edition 1, 2018
4	Ship Stability for Masters and Mates	C.B. Barrass & D.R. Derrett	Elsevier	Edition 7, 2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Basic Ship Theory	K. J. Rawson & E. C. Tupper	Butterworth-Heinemann	Edition 5, 2001
2	Ship Hydrostatics and Stability	Adrian B. Biran & Rubén López-Pulido	Butterworth-Heinemann	Edition 2, 2014
3	Contemporary Ideas on Ship Stability	D, Vassalos et. al	Elsevier	Edition 1, 2000
4	Statics and Dynamics of the Ship	V. Semyonov-Tyan-Shansky	Aalto University Publication Series, Science & Technology 6/2021	Edition 1, 2021

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/114105003
2	https://nptel.ac.in/courses/114105003
3	https://nptel.ac.in/courses/114105003
4	https://nptel.ac.in/courses/114105003

PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	**Practical**	**Presentation**
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		**30**

1. **Project Planning and Proposal (5 Marks)**

- Clarity and feasibility of the project plan
- Research and background understanding
- Defined objectives and methodology

2. **Contribution in Progress Presentation and Question Answer Sessions (4 Marks)**

- Individual contribution to the presentation
- Effectiveness in answering questions and handling feedback

3. **Involvement in the Project Work and Team Work (3 Marks)**

- Active participation and individual contribution
- Teamwork and collaboration

4. **Execution and Implementation (10 Marks)**

- Adherence to the project timeline and milestones
- Application of theoretical knowledge and problem-solving
- Final Result

5. **Final Presentation (5 Marks)**

- Quality and clarity of the overall presentation
- Individual contribution to the presentation
- Effectiveness in answering questions

6. **Project Quality, Innovation, and Creativity (3 Marks)**

- Overall quality and technical excellence of the project
- Innovation and originality in the project
- Creativity in solutions and approaches

SEMESTER S3

INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Course Code	GNEST305	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Mins.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Demonstrate a solid understanding of advanced linear algebra concepts, machine learning algorithms and statistical analysis techniques relevant to engineering applications, principles and algorithms.
2. Apply theoretical concepts to solve practical engineering problems, analyze data to extract meaningful insights, and implement appropriate mathematical and computational techniques for AI and data science applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to AI and Machine Learning**: Basics of Machine Learning - types of Machine Learning systems-challenges in ML- Supervised learning model example- regression models- Classification model example- Logistic regression-unsupervised model example- K-means clustering. Artificial Neural Network- Perceptron- Universal Approximation Theorem (statement only)- Multi-Layer Perceptron- Deep Neural Network- demonstration of regression and classification problems using MLP.(Text-2)	11

2	**Mathematical Foundations of AI and Data science**: Role of linear algebra in Data representation and analysis – Matrix decomposition- Singular Value Decomposition (SVD)- Spectral decomposition- Dimensionality reduction technique-Principal Component Analysis (PCA). (Text-1)	**11**
3	**Applied Probability and Statistics for AI and Data Science**: Basics of probability-random variables and statistical measures - rules in probability- Bayes theorem and its applications- statistical estimation-Maximum Likelihood Estimator (MLE) - statistical summaries- Correlation analysis- linear correlation (direct problems only)- regression analysis- linear regression (using least square method) (Text book 4)	**11**
4	**Basics of Data Science**: Benefits of data science-use of statistics and Machine Learning in Data Science- data science process - applications of Machine Learning in Data Science- modelling process- demonstration of ML applications in data science- Big Data and Data Science. (For visualization the software tools like Tableau, PowerBI, R or Python can be used. For Machine Learning implementation, Python, MATLAB or R can be used.)(Text book-5)	**11**

Course Assessment Method

(CIE: 40 marks , ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the concept of machine learning algorithms including neural networks and supervised/unsupervised learning techniques for engineering applications.	**K3**
CO2	Apply advanced mathematical concepts such as matrix operations, singular values, and principal component analysis to analyze and solve engineering problems.	**K3**
CO3	Analyze and interpret data using statistical methods including descriptive statistics, correlation, and regression analysis to derive meaningful insights and make informed decisions.	**K3**
CO4	Integrate statistical approaches and machine learning techniques to ensure practically feasible solutions in engineering contexts.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3								
CO2	3	3	3	3								
CO3	3	3	3	3								
CO4	3	3	3	3								
CO5	3	3	3	3								

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Linear Algebra	Gilbert Strang	Wellesley-Cambridge Press	6th edition, 2023
2	Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow	Aurélien Géron	O'Reilly Media, Inc.	2nd edition,2022
3	Mathematics for machine learning	Deisenroth, Marc Peter, A. Aldo Faisal, and Cheng Soon Ong	Cambridge University Press	1st edition. 2020
4	Fundamentals of mathematical statistics	Gupta, S. C., and V. K. Kapoor	Sultan Chand & Sons	9th edition, 2020
5	Introducing data science: big data, machine learning, and more, using Python tools	Cielen, Davy, and Arno Meysman	Simon and Schuster	1st edition, 2016

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Data science: concepts and practice	Kotu, Vijay, and Bala Deshpande	Morgan Kaufmann	2nd edition, 2018
2	Probability and Statistics for Data Science	Carlos Fernandez-Granda	Center for Data Science in NYU	1st edition, 2017
3	Foundations of Data Science	Avrim Blum, John Hopcroft, and Ravi Kannan	Cambridge University Press	1st edition, 2020
4	Statistics For Data Science	James D. Miller	Packt Publishing	1st edition, 2019
5	Probability and Statistics -The Science of Uncertainty	Michael J. Evans and Jeffrey S. Rosenthal	University of Toronto	1st edition, 2009
6	An Introduction to the Science of Statistics: From Theory to Implementation	Joseph C. Watkins	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.math.arizo	Preliminary Edition.

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/106/106106198/
2	https://archive.nptel.ac.in/courses/106/106/106106198/ https://ocw.mit.edu/courses/18-06-linear-algebra-spring-2010/resources/lecture-29-singular-value-decomposition/
3	https://ocw.mit.edu/courses/18-650-statistics-for-applications-fall-2016/resources/lecture-19-video/
4	https://archive.nptel.ac.in/courses/106/106/106106198/

SEMESTER S3

ECONOMICS FOR ENGINEERS

(Common to All Branches)

Course Code	**UCHUT346**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2.30
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Understanding of finance and costing for engineering operation, budgetary planning and control
2. Provide fundamental concept of micro and macroeconomics related to engineering industry
3. Deliver the basic concepts of Value Engineering.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Economics Concepts - Basic economic problems – Production Possibility Curve – Utility – Law of diminishing marginal utility – Law of Demand - Law of supply – Elasticity - measurement of elasticity and its applications – Equilibrium- Changes in demand and supply and its effects Production function - Law of variable proportion – Economies of Scale – Internal and External Economies – Cobb-Douglas Production Function	6
2	Cost concepts – Social cost, private cost – Explicit and implicit cost – Sunk cost - Opportunity cost - short run cost curves - Revenue concepts Firms and their objectives – Types of firms – Markets - Perfect Competition – Monopoly - Monopolistic Competition - Oligopoly (features and equilibrium of a firm)	6

3	Monetary System – Money – Functions - Central Banking –Inflation - Causes and Effects – Measures to Control Inflation - Monetary and Fiscal policies – Deflation Taxation – Direct and Indirect taxes (merits and demerits) - GST National income – Concepts - Circular Flow – Methods of Estimation and Difficulties - Stock Market – Functions- Problems faced by the Indian stock market-Demat Account and Trading Account – Stock market Indicators-SENSEX and NIFTY	**6**
4	Value Analysis and value Engineering - Cost Value, Exchange Value, Use Value, Esteem Value - Aims, Advantages and Application areas of Value Engineering - Value Engineering Procedure - Break-even Analysis - Cost-Benefit Analysis - Capital Budgeting - Process planning	**6**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
10	**15**	**12.5**	**12.5**	**50**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• Minimum 1 and Maximum 2 Questions from each module. • Total of 6 Questions, each carrying 3 marks **(6x3 =18marks)**	• 2 questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 2 sub divisions. • Each question carries 8 marks. **(4x8 = 32 marks)**	**50**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the fundamentals of various economic issues using laws and learn the concepts of demand, supply, elasticity and production function.	**K2**
CO2	Develop decision making capability by applying concepts relating to costs and revenue, and acquire knowledge regarding the functioning of firms in different market situations.	**K3**
CO3	Outline the macroeconomic principles of monetary and fiscal systems, national income and stock market.	**K2**
CO4	Make use of the possibilities of value analysis and engineering, and solve simple business problems using break even analysis, cost benefit analysis and capital budgeting techniques.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Managerial Economics	Geetika, Piyali Ghosh and Chodhury	Tata McGraw Hill,	2015
2	Engineering Economy	H. G. Thuesen, W. J. Fabrycky	PHI	1966
3	Engineering Economics	R. Paneerselvam	PHI	2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Economy	Leland Blank P.E, Anthony Tarquin P. E.	Mc Graw Hill	7^{TH} Edition
2	Indian Financial System	Khan M. Y.	Tata McGraw Hill	2011
3	Engineering Economics and analysis	Donald G. Newman, Jerome P. Lavelle	Engg. Press, Texas	2002
4	Contemporary Engineering Economics	Chan S. Park	Prentice Hall of India Ltd	2001

SEMESTER S3/S4

ENGINEERING ETHICS AND SUSTAINABLE DEVELOPMENT

Course Code	**UCHUT347**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Equip with the knowledge and skills to make ethical decisions and implement gender-sensitive practices in their professional lives.
2. Develop a holistic and comprehensive interdisciplinary approach to understanding engineering ethics principles from a perspective of environment protection and sustainable development.
3. Develop the ability to find strategies for implementing sustainable engineering solutions.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Fundamentals of ethics -** Personal vs. professional ethics, Civic Virtue, Respect for others, **Profession and Professionalism,** Ingenuity, diligence and responsibility, Integrity in design, development, and research domains, Plagiarism, a balanced outlook on law **-** challenges **-** case studies, **Technology and digital revolution-**Data, information, and knowledge, Cybertrust and cybersecurity, Data collection & management, **High technologies: connecting people and places-**accessibility and social impacts, **Managing conflict**, Collective bargaining, **Confidentiality**, Role of confidentiality in moral integrity, **Codes of Ethics**. **Basic concepts in Gender Studies -** sex, gender, sexuality, gender spectrum: beyond the binary, gender identity, gender expression, gender stereotypes, **Gender disparity and discrimination in education**,	**6**

	employment and everyday life, History of women in Science & Technology, Gendered technologies & innovations**, Ethical values and practices in connection with gender -** equity, diversity & gender justice, **Gender policy and women/transgender empowerment initiatives.**	
2	**Introduction to Environmental Ethics:** Definition, importance and historical development of environmental ethics, key philosophical theories (anthropocentrism, biocentrism, ecocentrism). **Sustainable Engineering Principles:** Definition and scope, triple bottom line (economic, social and environmental sustainability), life cycle analysis and sustainability metrics. **Ecosystems and Biodiversity:** Basics of ecosystems and their functions, Importance of biodiversity and its conservation, Human impact on ecosystems and biodiversity loss, An overview of various ecosystems in Kerala/India, and its significance. **Landscape and Urban Ecology:** Principles of landscape ecology, Urbanization and its environmental impact, Sustainable urban planning and green infrastructure.	**6**
3	**Hydrology and Water Management:** Basics of hydrology and water cycle, Water scarcity and pollution issues, Sustainable water management practices, Environmental flow, disruptions and disasters. **Zero Waste Concepts and Practices:** Definition of zero waste and its principles, Strategies for waste reduction, reuse, reduce and recycling, Case studies of successful zero waste initiatives. **Circular Economy and Degrowth:** Introduction to the circular economy model, Differences between linear and circular economies, degrowth principles, Strategies for implementing circular economy practices and degrowth principles in engineering. **Mobility and Sustainable Transportation:** Impacts of transportation on the environment and climate, Basic tenets of a Sustainable Transportation design, Sustainable urban mobility solutions, Integrated mobility systems, E-Mobility, Existing and upcoming models of sustainable mobility solutions.	**6**
4	**Renewable Energy and Sustainable Technologies:** Overview of renewable energy sources (solar, wind, hydro, biomass), Sustainable technologies in energy production and consumption, Challenges and opportunities in renewable energy adoption. **Climate Change and Engineering Solutions:** Basics of climate change science, Impact of climate change on natural and human systems, Kerala/India and the Climate crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. **Environmental**	**6**

	Policies and Regulations: Overview of key environmental policies and regulations (national and international), Role of engineers in policy implementation and compliance, Ethical considerations in environmental policy-making. **Case Studies and Future Directions:** Analysis of real-world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future.	

Course Assessment Method

(CIE: 50 marks, ESE: 50)

Continuous Internal Evaluation Marks (CIE):

Continuous internal evaluation will be based on individual and group activities undertaken throughout the course and the portfolio created documenting their work and learning. The portfolio will include reflections, project reports, case studies, and all other relevant materials.

- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. These groups can be the same ones they have formed in the previous semester.
- Activities are to be distributed between 2 class hours and 3 Self-study hours.
- The portfolio and reflective journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through various courses.

Sl. No.	Item	Particulars	Group/ Individual (G/I)	Marks
1	Reflective Journal	Weekly entries reflecting on what was learned, personal insights, and how it can be applied to local contexts.	I	5
2	Micro project (Detailed documentation of the project, including methodologies, findings, and reflections)	1 a) Perform an Engineering Ethics Case Study analysis and prepare a report 1 b) Conduct a literature survey on 'Code of Ethics for Engineers' and prepare a sample code of ethics	G	8
		2. Listen to a TED talk on a Gender-related topic, do a literature survey on that topic and make a report citing the relevant papers with a specific analysis of the Kerala context	G	5
		3. Undertake a project study based on the concepts of sustainable development* - Module II, Module III & Module IV	G	12
3	Activities	2. One activity* each from Module II, Module III & Module IV	G	15
4	Final Presentation	A comprehensive presentation summarising the key takeaways from the course, personal reflections, and proposed future actions based on the learnings.	G	5
		Total Marks		**50**

*Can be taken from the given sample activities/projects

Evaluation Criteria:

- **Depth of Analysis**: Quality and depth of reflections and analysis in project reports and case studies.
- **Application of Concepts**: Ability to apply course concepts to real-world problems and local contexts.
- **Creativity**: Innovative approaches and creative solutions proposed in projects and reflections.
- **Presentation Skills**: Clarity, coherence, and professionalism in the final presentation.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to apply the principles of engineering ethics in their professional life.	**K3**
CO2	Develop the ability to exercise gender-sensitive practices in their professional lives	**K4**
CO3	Develop the ability to explore contemporary environmental issues and sustainable practices.	**K5**
CO4	Develop the ability to analyse the role of engineers in promoting sustainability and climate resilience.	**K4**
CO5	Develop interest and skills in addressing pertinent environmental and climate-related challenges through a sustainable engineering approach.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						3	2	3	3	2		2
CO2		1				3	2	3	3	2		2
CO3						3	3	2	3	2		2
CO4		1				3	3	2	3	2		2
CO5						3	3	2	3	2		2

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Ethics in Engineering Practice and Research	Caroline Whitbeck	Cambridge University Press & Assessment	2nd edition & August 2011
2	Virtue Ethics and Professional Roles	Justin Oakley	Cambridge University Press & Assessment	November 2006
3	Sustainability Science	Bert J. M. de Vries	Cambridge University Press & Assessment	2nd edition & December 2023
4	Sustainable Engineering Principles and Practice	Bhavik R. Bakshi,	Cambridge University Press & Assessmen	2019
5	Engineering Ethics	M Govindarajan, S Natarajan and V S Senthil Kumar	PHI Learning Private Ltd, New Delhi	2012
6	Professional ethics and human values	RS Naagarazan	New age international (P) limited New Delhi	2006.
7	Ethics in Engineering	Mike W Martin and Roland Schinzinger,	Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi	4" edition, 2014

Suggested Activities/Projects:

Module-II

- Write a reflection on a local environmental issue (e.g., plastic waste in Kerala backwaters or oceans) from different ethical perspectives (anthropocentric, biocentric, ecocentric).
- Write a life cycle analysis report of a common product used in Kerala (e.g., a coconut, bamboo or rubber-based product) and present findings on its sustainability.
- Create a sustainability report for a local business, assessing its environmental, social, and economic impacts
- Presentation on biodiversity in a nearby area (e.g., a local park, a wetland, mangroves, college campus etc) and propose conservation strategies to protect it.
- Develop a conservation plan for an endangered species found in Kerala.
- Analyze the green spaces in a local urban area and propose a plan to enhance urban ecology using

native plants and sustainable design.

- Create a model of a sustainable urban landscape for a chosen locality in Kerala.

Module-III

- Study a local water body (e.g., a river or lake) for signs of pollution or natural flow disruption and suggest sustainable management and restoration practices.
- Analyse the effectiveness of water management in the college campus and propose improvements - calculate the water footprint, how to reduce the footprint, how to increase supply through rainwater harvesting, and how to decrease the supply-demand ratio
- Implement a zero waste initiative on the college campus for one week and document the challenges and outcomes.
- Develop a waste audit report for the campus. Suggest a plan for a zero-waste approach.
- Create a circular economy model for a common product used in Kerala (e.g., coconut oil, cloth etc).
- Design a product or service based on circular economy and degrowth principles and present a business plan.
- Develop a plan to improve pedestrian and cycling infrastructure in a chosen locality in Kerala

Module-IV

- Evaluate the potential for installing solar panels on the college campus including cost-benefit analysis and feasibility study.
- Analyse the energy consumption patterns of the college campus and propose sustainable alternatives to reduce consumption - What gadgets are being used? How can we reduce demand using energy-saving gadgets?
- Analyse a local infrastructure project for its climate resilience and suggest improvements.
- Analyse a specific environmental regulation in India (e.g., Coastal Regulation Zone) and its impact on local communities and ecosystems.
- Research and present a case study of a successful sustainable engineering project in Kerala/India (e.g., sustainable building design, water management project, infrastructure project).
- Research and present a case study of an unsustainable engineering project in Kerala/India highlighting design and implementation faults and possible corrections/alternatives (e.g., a housing complex with water logging, a water management project causing frequent floods, infrastructure project that affects surrounding landscapes or ecosystems).

SEMESTER S3

FLUID MECHANICS LAB

Course Code	**PCNSL307**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	PCNST302	**Course Type**	Lab

Course Objectives:

1. Apply knowledge in the area of fluid mechanics and conduct experiments.
2. Understand with the arrangements and conduct of experiments in the fluid mechanics laboratory environment.
3. Comprehend the factors responsible for variation between theoretical and experimental results pertaining to the domain of fluid mechanics.
4. Record and analyse the results obtaining and interpret

Expt. No.	Experiments
1	Pressure measurement using U –Tube Manometer, Pitot Tube, Flow Meter, etc.,
2	Determination of Metacentric Height and Radius of Gyration of Floating bodies
3	Experimental Verification of Bernoulli's Theorem
4	Determination of Darcy's Constant and Chezy's constant for Pipe flow
5	Determination of Critical Velocity in Pipe flow
6	Determination of Minor losses in Pipe flow
7	Determination of type of flow using Reynolds Number
8	Determination of Hydraulic Coefficients of Orifices under Constant Head method
9	Determination of Hydraulic Coefficients of Orifices under Time of Emptying method
10	Calibration of Venturimeter
11	Calibration of Orificemeter
12	Calibration of Water meter
13	Study the use of different types of Valves and pipe fittings

Course Assessment Method

(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

5. ***Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.***

6. ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify equipment and instruments used in determine fluid mechanics lab.	**K1**
CO2	Apply the theoretical Knowledge gained in the classroom and verify the same	**K3**
CO3	Compare different techniques and instruments for testing	**K1**
CO4	Record and analyse the results obtaining and interpret	**K4**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fluid Mechanics with Engineering Applications	J Frabzini	McGraw Hill	1997
2	Fluid mechanics and Machinery	Robert W Fox, Alan T McDonald, Philip J Pritchard.	John Wiley and sons	2015
3	Fluid Mechanics and Hydraulic Machines	Bansal R K	Lakshmi Publications	2011
4	Hydraulic and Fluid Mechanics including Hydraulic Machines	Modi P N and Seth S M	Standard book house New Delhi	Edition 20 2015
5	Fluid Mechanics	Frank M White	Tata McGraw Hill Publishing Company Ltd, New Delhi	Edition 7 2008

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fluid Mechanics Fundamentals and Applications	Yunus A Ceneger, John M. Cimbala.	McGraw Hill	2010
2	An introduction to Fluid dynamics	G K Batchelor	Cambridge University Press	1967
3	Fluid Flow hand book	Jamal M Saleh	McGraw Hill	2002
4	A working guide to process equipment	N P Lieberman, E T Lieberman	McGraw Hill	2022
5	Fluid Mechanics and its Applications	Vijay Gupta	New Age International (P) Ltd Pub.	Edition 2 2011

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/105103192 https://nptel.ac.in/courses/112105171
2	https://nptel.ac.in/courses/105103192 https://nptel.ac.in/courses/112105171
3	https://nptel.ac.in/courses/105103192 https://nptel.ac.in/courses/112105171
4	https://nptel.ac.in/courses/105103192 https://nptel.ac.in/courses/112105171

Continuous Assessment (25 Marks)

1. **Preparation and Pre-Lab Work (7 Marks)**

   - Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
   - Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. **Conduct of Experiments (7 Marks)**

   - Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
   - Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
   - Teamwork: Collaboration and participation in group experiments.

3. **Lab Reports and Record Keeping (6 Marks)**

   - Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
   - Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. **Viva Voce (5 Marks)**

   - Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**

    - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
    - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
    - Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
    - Creativity and logic in algorithm or experimental design.

2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**

    - Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. **Result with Valid Inference/Quality of Output (10 Marks)**

    - Accuracy of Results: Precision and correctness of the obtained results.
    - Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. **Viva Voce (10 Marks)**

    - Ability to explain the experiment, procedure results and answer related questions
    - Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. **Record (5 Marks)**

    - Completeness, clarity, and accuracy of the lab record submitted

SEMESTER S3

WELDING & MACHINE TOOLS LAB

Course Code	PCNSL308	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None / Course Code	Course Type	Lab

Course Objectives:

1. Apply knowledge in the area of ferrous and non ferrous welding
2. Prepare specified type of joint using various welding processes.
3. Understand with the arrangements and conduct of experiments in the welding and machine tool laboratory environment.
4. Prepare machined components for various engineering applications

Expt. No.	Experiments
1	Study of Precision tools and measuring instruments
2	Study of centre lathe
3	Performing various of operation in Lathe - Turning
4	Lathe - Groving, Taper turing and Step cutting
5	Lathe - Thread cutting
6	Study of Machine tools - Shaper, Planner, Sloter, and Milling Machine
7	Study of different types of welding and ailed instruments.
8	Prepare a single V Butt joint using arc welding
9	Prepare a lap joint using arc welding
10	Prepare a butt joint using TIG welding
11	Prepare a butt joint using MIG welding
12	Study of Gas welding Equipment and operations

Course Assessment Method

(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

7. ***Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.***

8. ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify different types of welding.	**K2**
CO2	Prepare specified type of joint using various welding processes.	**K3**
CO3	Understand with the arrangements and conduct of experiments in the welding and machine tool laboratory environment.	**K1**
CO4	Prepare machined components for various engineering applications	**K1**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Text Book of Welding Technology	O P Khanna	Dhanpat Rai	Edition 2, 2015
2	The Welding of Aluminium and its Alloys	Gene Mathers	CRC Press/Woodhead Pub	Edition 1, 2015
3	Machine Tool Design	Acharkn N	McGraw Hill	Edition 4, 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Workshop Technology	Chapman	CBS VOLI,II,III	2007
2	Workshop Technology	Hajra Choudary	Vol I , II	1988

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/114105004
2	https://nptel.ac.in/courses/114105004
3	https://nptel.ac.in/courses/114105004
4	https://nptel.ac.in/courses/112105233

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

1. Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
2. Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
3. Teamwork: Collaboration and participation in group experiments

3. Lab Reports and Record Keeping (6 Marks)

1. Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
2. Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (5 Marks)

1. Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

7. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

1. Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
2. Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.

3. Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
4. Creativity and logic in algorithm or experimental design.

8. Conduct of Experiment/Execution of Work/Programming (15 Marks)

1. Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

9. Result with Valid Inference/Quality of Output (10 Marks)

1. Accuracy of Results: Precision and correctness of the obtained results.
2. Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

10. Viva Voce (10 Marks)

1. Ability to explain the experiment, procedure results and answer related questions
2. Proficiency in answering questions related to theoretical and practical aspects of the subject.

11. Record (5 Marks)

1. Completeness, clarity, and accuracy of the lab record submitted

SEMESTER 4

NAVAL ARCHITECTURE & SHIPBUILDING ENGINEERING

SEMESTER S4

MATHEMATICS FOR PHYSICAL SCIENCE– 4

Course Code	**GCMAT401**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Basic calculus.	**Course Type**	Theory

Course Objectives:

1. To familiarize students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science.
2. To provide the students with the basics of various numerical methods to develop problem solving skills used in various engineering disciplines.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Random variables, Discrete random variables and their probability distributions, Cumulative distribution function, Expectation, Mean and variance, Binomial distribution, Poisson distribution, Poisson distribution as a limit of the binomial distribution, Joint pmf of two discrete random variables, Marginal pmf, Independent random variables, Expected value of a function of two discrete variables. **[Text 1: Relevant topics from sections 3.1 to 3.4, 3.6, 5.1, 5.2]**	9
2	Continuous random variables and their probability distributions, Cumulative distribution function, Expectation, Mean and variance, Uniform, Normal and Exponential distributions, Joint pdf of two Continuous random variables, Marginal pdf, Independent random variables, Expectation value of a function of two continuous variables. **[Text 1: Relevant topics from sections 3.1, 4.1, 4.2, 4.3, 4.4, 5.1,5.2]**	9

3	Confidence Intervals, Confidence Level, Confidence Intervals and One-side confidence intervals for a Population Mean for large and small samples (normal distribution and *t*-distribution), Hypotheses and Test Procedures, Type I and Type II error, *z* Tests for Hypotheses about a Population Mean (for large sample), *t* Test for Hypotheses about a Population Mean (for small sample), Tests concerning a population proportion for large and small samples. **[Text 1: Relevant topics from 7.1, 7.2, 7.3, 8.1, 8.2, 8.3, 8.4]**	**9**
4	Newton-Raphson Method, Gauss Elimination Method ,Gauss - Jordan Method, Numerical solution of ordinary differential equations-Euler's method, Modified Euler's method, Runge - Kutta method of 2^{nd} Order, Numerical solution of Laplace equation –Jacobi's Method, Curve Fitting by Method of Least Squares - Straight lines, Parabola. **(Text 2: Relevant topics from sections 2.5,4.2,7.5,8.4,8.5,9.4)**	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Understand the concept, properties and important models of discrete random variables and to apply in suitable random phenomena.	**K3**
CO2	Understand the concept, properties and important models of continuous random variables and to apply in suitable random phenomena.	**K3**
CO3	Estimate population parameters, assess their certainty with confidence intervals, and test hypotheses about population means and proportions using *z*-tests and the one-sample *t*-test.	**K3**
CO4	Apply numerical methods to find solutions of linear system of equations, ordinary differential equations and Laplace equations.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Probability and Statistics for Engineering and the Sciences	Devore J. L	Cengage Learning	9th edition, 2016
2	Introductory Methods of Numerical Analysis	S SSastry	PHI Learning Pvt Limited	5th edition, 2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Probability, Random Variables and Stochastic Processes,	Papoulis, A. &Pillai, S.U.,	McGraw Hill.	4th edition, 2002
2	Introduction to Probability and Statistics for Engineers and Scientists	Ross, S. M.	Academic Press	6th edition, 2020
3	Numerical methods for Engineers	Steven C. Chapra, Raymond P. Canale	McGraw Hill Education	8th edition, 2021

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/117/105/117105085/
2	https://archive.nptel.ac.in/courses/117/105/117105085/
3	https://archive.nptel.ac.in/courses/117/105/117105085/
4	https://archive.nptel.ac.in/courses/111/107/111107105/

SEMESTER IV

SHIP RESISTANCE

Course Code	**PCNST402**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)		**Course Type**	Theory

Course Objectives:

1. Understand the flow around a ship and various components of resistance of ships.
2. Discern dimensional analysis in marine hydrodynamics and laws of comparison
3. Estimate effective power of ships using statistical / methodical series / model tests.
4. Understand the principles of operation of various high speed crafts and prediction of power requirement of such crafts.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Flow around a ship, ship wave system, Components of ship resistance, Viscous resistance, Viscous pressure resistance, Form factor, Hull roughness, Wave making resistance – pressure resistance, interference effects, wave breaking resistance, bulbous bows and their effects. Air and wind resistance, Resistance of appendages.	11
2	Dimensional analysis. Laws of comparison – geometrical, kinematical and dynamical similarity, Newton‘s, Froude‘s and Reynold‘s law, model-ship correlation.	11
3	Model testing – tank testing facilities, testing, prediction of resistance from model tests, extrapolation, Froude‘s concept, Determination of resistance from series test results - Guldhammer-Harvald‘s method, statistical prediction of resistance – Holtrop & Mennen method, effect of hull form on resistance	11

4	Added resistance in waves; Resistance in restricted waterways – resistance in shallow water, resistance in canals. Unconventional craft and power prediction - planning crafts, multi-hull vessels, hovercrafts/SES, hydrofoil craft	**11**

Course Assessment Method

(CIE: 40 marks , ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the flow around a ship and various components of resistance of ships.	**K1**
CO2	Discern dimensional analysis in marine hydrodynamics and laws of comparison	**K2**
CO3	Estimate effective power of ships using statistical /methodical series / model tests.	**K3**
CO4	Understand the principles of operation of various high speed crafts and prediction of power requirement of such crafts.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Ship Resistance and Propulsion – Practical Estimation of Propulsive Power	Antony F. Moland, Stephen R. Turnock	Cambridge University Press	Edition 1, 2011
2	Principles of Naval Architecture series – Ship Resistance and flow	John Letcher, Randolph Paulling	SNAME, New Jersey	Edition 3, 2009
3	Resistance and Propulsion of Ships	Harvald S. A	John Wiley & Sons	Edition 1, 1983
4	Fundamentals of Ship Hydrodynamics – Fluid Mechanics, Ship Resistance and Propulsion	Lothar Birk	JohnWiley & Sons Ltd	Edition 1, 2019
5	Ship Resistance and Propulsion – Practical Estimation of Propulsive Power	Antony F. Moland, Stephen R. Turnock	Cambridge University Press	Edition 1, 2011
6	Principles of Naval Architecture series – Ship Resistance and flow	John Letcher, Randolph Paulling	SNAME, New Jersey	Edition 3, 2009

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Mitigation of Hydrodynamic Resistance - Methods to Reduce Hydrodynamic Drag	Marc Perlin, Steven Ceccio	World Scientific Publishing Co. Pte. Ltd, Singapore	Edition 1, 2015
2	Basic Ship Theory Vol II	K J Rawson, E C Tupper	Butterworth-Heinemann Ltd	Edition 5, 2001
3	Practical Ship Hydrodynamics	Volker Bertram	Butterworth-Heinemann Ltd	Edition 1, 2000
4	Hydrodynamics of High-Speed Vehicles	O M Faltinsen	Cambridge University Press	Edition 1, 2005

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/114106026
2	https://nptel.ac.in/courses/114106026
3	https://nptel.ac.in/courses/114106026
4	https://nptel.ac.in/courses/114106026

SEMESTER S4

ANALYSIS OF STRUCTURES

Course Code	**PCNST403**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	PCNST303	**Course Type**	Theory

Course Objectives:

1. Enable to differentiate between a determinate and indeterminate structures and also to analyze continuous beams with and without settlement.
2. Perform step by step procedure involved in Moment Distribution Method, Accumulate knowledge on Principle of Virtual Work and basic theorems in structural analysis.
3. Understand the concepts of vibration of continuous system such as rod, string, beam, shaft, principles of plastic theory and its applications in structural analysis
4. Remember basic dynamics, understand the basic principles of structural dynamics and apply the same to simple structures.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to structural analysis, Determinate and Indeterminate structures, Static and Kinematic indeterminancy, Force and displacement method of analysis, Clapeyron's Theorem of Three Moments, Analysis of beams with different support condition and support settlement.	11
2	Moment Distribution method: Beams and Rigid Jointed Frames (with and without sway); Effect of support settlement. Strain Energy Methods: Principle of virtual work: Castigliano's Theorems, Clerk Maxwell's Reciprocal Theorem.	11
3	Vibrations Continuous Systems: Vibration of strings and rods; Vibration of beams: Vibration of shafts. Introduction to plastic analysis: Assumptions of plastic theory, Plastic	11

	Hinge, Shape Factor, Load Factor, Mechanism of Failure	
4	Structural dynamics: Introduction - degrees of freedom - equation of motion, D'Alembert's principle-dampingfree response of damped and undamped systems- logarithmic decrement-- single degree of freedom systems subjected to harmonic load - transient and steady state responses, simple portal frame problems	**11**

Course Assessment Method

(CIE: 40 marks , ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Enable to differentiate between a determinate and indeterminate structures and also to analyze continuous beams with and without settlement.	**K2**
CO2	Perform step by step procedure involved in Moment Distribution Method, Accumulate knowledge on Principle of Virtual Work and basic theorems in structural analysis.	**K1**
CO3	Understand the concepts of vibration of continuous system such as rod, string, beam, shaft, principles of plastic theory and its applications in structural analysis	**K2**
CO4	Remember basic dynamics, understand the basic principles of structural dynamics and apply the same to simple structures.	**K1**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Structural Analysis –in theory and practice	Alan Williams	Butterworth-Heinemann	Edition 1, 2008
2	Basic Structural Analysis	C. S. Reddy	Tata McGraw-Hill	Edition 3, 2011
3	Structural Dynamics	Mario Paz	Springer	Edition 6, 2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Strength of Materials and Theory of Structures	Punmia B.C. and Jain A.K	Laxmi Publications (P) Ltd	Edition 2, 2005
2	Theory of Structures	Timoshenko & Young	McGraw Hill Publications	Edition 1, 1965
3	Theory of vibrations	V. P. Singh	Dhanpat Rai and Co (P) Ltd	2010
4	Dynamics of structures	Clough R.W. and Penzein	Tata McGraw Hill	

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/105105166
2	https://nptel.ac.in/courses/105105166
3	https://nptel.ac.in/courses/101102090
4	https://nptel.ac.in/courses/105106151

SEMESTER S4

SHIP PROPULSION

Course Code	PBNST404	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCNST205	Course Type	Theory

Course Objectives:

1. Discern thrust development mechanism by screw propellers and its geometry.
2. Understand hull-propulsion interaction and resulting efficiencies and cavitation.
3. Be competent in the fundamentals of propulsion system design and propeller drawing as a project
4. Understand special types of propulsion systems and propeller strength.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Propeller as a thrust producing mechanism, Screw propeller, screw propeller geometry, sections, construction details. Propeller theories- Momentum theory, Blade element theory, Dimensional analysis	9
2	Interaction between Hull and propeller- Wake and wake fraction, Resistance augmentation and thrust deduction, propulsive efficiency in open water and behind conditions, hull efficiency, quasi propulsive coefficient, transmission efficiency; Powering Cavitation-Types, Cavitation Number, Effects of cavitation, Prevention of cavitation	9
3	Design of propellers-Propeller families and series; Open water tests, Presentation of data, Design charts- Kt-Kq, Bp-δ, T-J, P-J charts, Use of charts in propeller design including selection of prime movers and optimisation, propeller drawing. **Design project report and drawing**	9

	submission.	
4	Special types of propulsion systems **-** Shrouded propellers, Controllable Pitch propellers, Super cavitating propellers, Water jet propulsion, Vertical axis propellers, Sail, Paddle wheels, Electromagnetic propulsion etc. Ship standardisation trials.Propeller materials, propeller strength	**9**

Course Assessment Method

(CIE: 60 marks , ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**30**	**12.5**	**12.5**	**60**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 2 marks **(8x2 =16marks)**	• Each question carries 6 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 2 sub divisions. **(4x6 = 24 marks)**	**40**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Discern thrust development mechanism by screw propellers and its geometry.	**K1**
CO2	Understand hull-propulsion interaction and resulting efficiencies and cavitation.	**K2**
CO3	Be competent in the fundamentals of propulsion system design and propeller drawing as a project	**K3**
CO4	Understand special types of propulsion systems and propeller strength.	**K2**

Note: *K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Basic Ship Propulsion	Ghose P. & Gokarn R.P	Knowledge World Publishers Pvt Ltd	Edition 1, 2015
2	Ship Resistance and Propulsion – Practical Estimation of Propulsive Power	Antony F. Moland, Stephen R. Turnock	Cambridge University Press	Edition 1, 2011
3	Marine Propellers and Propulsion	S Carlton	Elsevier Ltd.	Edition 4, 2019
4	Resistance and Propulsion of Ships	Harvald S. A	John Wiley & Sons	Edition 1, 1983
5	Fundamentals of Ship Hydrodynamics - Fluid Mechanics, Ship Resistance and Propulsion	Lothar Birk	JohnWiley & Sons Ltd	Edition 1, 2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Principles of Naval Architecture series – Propulsion	Justin E K, Jacques B H	SNAME, New Jersey	Edition 3, 2010
2	Basic Ship Theory Vol II	K J Rawson, E C Tupper	Butterworth-Heinemann Ltd	Edition 5, 2001
3	Practical Ship Hydrodynamics	Volker Bertram	Butterworth-Heinemann Ltd	Edition 1, 2000
4	Hydrodynamics of High-Speed Vehicles	O M Faltinsen	Cambridge University Press	Edition 1, 2005

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/114105047
2	https://nptel.ac.in/courses/114105047
3	https://nptel.ac.in/courses/114105047
4	https://nptel.ac.in/courses/114105047

PBL Course Elements			
L: Lecture (3 Hrs.)	**R: Project (1 Hr.), 2 Faculty Members**		
	Tutorial	**Practical**	**Presentation**
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews,Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity		
Sl. No	**Evaluation for**	**Allotted Marks**
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
	Total	**30**

1. **Project Planning and Proposal (5 Marks)**

   - Clarity and feasibility of the project plan
   - Research and background understanding
   - Defined objectives and methodology

2. **Contribution in Progress Presentation and Question Answer Sessions (4 Marks)**

   - Individual contribution to the presentation
   - Effectiveness in answering questions and handling feedback

3. **Involvement in the Project Work and Team Work (3 Marks)**

   - Active participation and individual contribution
   - Teamwork and collaboration

4. **Execution and Implementation (10 Marks)**

   - Adherence to the project timeline and milestones
   - Application of theoretical knowledge and problem-solving
   - Final Result

5. **Final Presentation (5 Marks)**

- Quality and clarity of the overall presentation
- Individual contribution to the presentation
- Effectiveness in answering questions

6. Project Quality, Innovation, and Creativity (3 Marks)

- Overall quality and technical excellence of the project
- Innovation and originality in the project
- Creativity in solutions and approaches

SEMESTER S4

MECHANICAL ENGINEERING FOR SHIP DESIGN

Course Code	**PENST411**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	GCEST104 Part 1	**Course Type**	Theory

Course Objectives:

1. Understand the materials used in ship construction and for the main and auxiliary machinery systems onboard.
2. Study the material properties and heat treatment
3. Have an overview on thermodynamics and basic theories of heat transfer
4. Understand the various IC engines and their working.
5. Select a best suited engine for a particular application

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Materials for shipbuilding. Metallic materials and their properties. Production of shipbuilding steel. Various grades. Iron carbon diagram, TTT diagram, Heat treatment, Protection from corrosion. Ferrous and non ferrous alloys Non-metallic materials - Composites, Ceramics, Rubber and polymer.	9
2	Material testing. Destructive and non-destructive Cold and hot working of Metals and alloys. Failure of components and failure analysis. Stress strain curve. Elements of fracture mechanics. Griffiths crack theory. Fatigue Crack propagation. Selection of materials for various ship building applications.	9
3	Modes of heat transfer, Basics of Conduction, Convection and Radiation. Heat exchangers, different types, Performance of heat exchangers, Aspects of heat exchanger design.	9

4	Internal Combustion Engine. CI and SI engines, Performance evaluation of IC Engines, Testing of IC Engines and Heat balance. Multi cylinder engines Morse Test, Marine Engines.Engine Lubrication, Cooling System, Ignition system and Fuels	**9**

Course Assessment Method

(CIE: 40 marks , ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Able to explain the various types of shipbuilding materials and their specifications	**K1**
CO2	Identify best suited material for the construction of structure and components of a ship. Also for the main and auxiliary machinery systems onboard	**K2**
CO3	Understand basic features of thermal systems of a ship using fundamental principles of thermodynamics.	**K2**
CO4	Recognize various types of IC engines used in ship	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Material Science and Engineering	P S Gill	S K Kataria & Sons	Edition 1, 2015
2	Strength of Materials	Sadhu Singh	Khanna Publishers	Edition 9, 2009
3	Heat and Mass Transfer	D S Kumar	S K Kataria & Sons	Edition 9, 2015
4	Fundamentals of Metal Fatigue Analysis	Julie A B, Jess J C, James L H	Prentice Hall	Edition 1, 1990

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Deformation and Fracture Mechanics of Engineering Materials	Richard W Hertzberg	John Wiley & Sons	Edition 4, 1995
2	Metal Fatigue in Engineering	H O Fuchs R I Stephens	John Wiley & Sons	Edition 1, 1980
3	Practical Fracture Mechanics in Design	Alexander Blake	Marcel Dekker, Inc.	Edition 1, 1996
4	Thermal Engineering	A S Sarao	Satya Prakashan	Edition 4, 1987

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://dituniversity.digimat.in/nptel/courses/video/114105029/ https://nptel.ac.in/courses/114105029
2	https://nptel.ac.in/courses/114105029
3	https://nptel.ac.in/courses/113107078
4	https://nptel.ac.in/courses/113107078

SEMESTER S4

MARINE POLLUTION, CONTROL AND RECOVERY SYSTEMS

Course Code	PENST412	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)		Course Type	Theory

Course Objectives:

1. Understand different sources of marine pollution including ships and floating structures, their impact on the marine environment.
2. Select suitable methods to control the marine pollution in different operating conditions
3. Apply various strategies and methods for marine pollution recovery to minimise environmental impact.
4. Understand role of various international and regional rules and regulations for marine environmental protection in design of ships.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Definition of Marine Pollution, Types of Marine Pollution, Various Sources of Marine Pollution, Marine Pollution in the Coastal Zone, Pollution from ships and offshore assets Concerns and Consequences of Marine Pollution - Global Warming, Sea Level Changes, Carbon Emissivity and Green Shipping Biodiversity	9
2	Prevention of air and water pollution from Ships, Emissions from Ships Engines, Fuel Oil Quality, Requirements for Survey and Issuance of International Air Pollution Prevention Certificate (IAPP), Oil Pollution, Segregated Ballast Tanks, Oily Water Separator, Ballast Water Management (BWM) Convention	9
3	Introduction to Marine Oil Pollution Recovery Systems: Types of Recovery Systems, Skimming Systems, Oil storage system, Treatment of pollutant	9

	after recovery.	
4	IMO Marine Engine Regulations, Requirements for Survey and Issuance of International Air Pollution Prevention Certificate (IAPP), Energy Efficiency Design Index (EEDI), Ship Energy Efficiency Management Plan (SEEMP), Survey and Issuance of International Sewage Pollution Prevention Certificates (ISPP)	**9**

Course Assessment Method

(CIE: 40 marks , ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand different sources of marine pollution including ships and floating structures, their impact on the marine environment.	**K1**
CO2	Select suitable methods to control the marine pollution in different operating conditions	**K2**
CO3	Apply various strategies and methods for marine pollution recovery to minimise environmental impact.	**K2**
CO4	Understand role of various international and regional rules and regulations for marine environmental protection in design of ships.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Marine Pollution	Judith S Weis	Oxford University Press	Edition 1, 2014
2	Marine Pollution	R.B. Clark, C. Frid, M. Atttrill	Oxford University Press	Edition 4, 1997
3	Marine Pollution	Icardo Beiras	Elsevier	Edition 1, 2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	The International Convention for the Prevention of Pollution from Ships (MARPOL) 1973		International Maritime Organisation	As Amended
2	The International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004		International Maritime Organisation	As Amended
3	Resolution MEPC.378(80) - Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species		International Maritime Organisation	As Amended
4	The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009		International Maritime Organisation	As Amended

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/103107215
2	https://nptel.ac.in/courses/103107215
3	https://nptel.ac.in/courses/103107215
4	https://nptel.ac.in/courses/103107215

SEMESTER S4

INLAND WATER TRANSPORTATION

Course Code	**PENST413**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3-0-0-0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	PCNST205	**Course Type**	Theory

Course Objectives:

1. Discern the national regulations, different components of inland water transport systems, different types of vessels and their characteristics for National waterways in India.
2. Identify the hull forms suitable in inland water transport and understand standard procedures and formulae to estimate the stability, resistance and propulsion characteristics of inland vessels.
3. Understand the general arrangement of inland vessels and various equipment, systems and outfit items on board
4. Identify the materials used for inland vessel construction and understand the methods and standards of construction of inland vessel.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	The Inland Vessels Act 2021, Inland Waterways, their importance and characteristics, Components of Inland Water Transport, Inland Water Authority of India, Classification of Inland Waterways, Kerala Inland Vessels Rules. Vessel types - self-propelled vessels and dumb vessels, Intermodal transportation with sea, road and rail	9
2	Dimensional Restrictions of waterways, bridges, bends, locks and gates, design using empirical relations, development of hull forms - chine and round bilge, multihull, weight estimation, stability, heel test. Resistance and propulsion of inland vessels, shallow water effect - determination of shallow water resistance. special features – tunnels, shrouded propeller.	9

3	General arrangement, Passenger accommodation, cargo handling & equipment, onboard systems – piping systems, fire fighting appliances, life saving appliances. Super structure arrangements, mooring and anchoring.	**9**
4	Structural design – Class rules for inland vessels, local rules and KIV Act 2021, structural design and analysis of bottom, sides, decks, bulkheads etc, materials of construction, methods of construction and production technologies.	**9**

Course Assessment Method

(CIE: 40 marks , ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Discern the national regulations, different components of inland water transport systems, different types of vessels and their characteristics for National waterways in India.	**K1**
CO2	Identify the hull forms suitable in inland water transport and understand standard procedures and formulae to estimate the stability, resistance and propulsion characteristics of inland vessels.	**K2**
CO3	Understand the general arrangement of inland vessels and various equipment, systems and outfit items on board	**K2**
CO4	Identify the materials used for inland vessel construction and understand the methods and standards of construction of inland vessel.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Design of Contemporary Inland Waterway Vessels	Dejan R, Aleksandar S, Nikola M, Milorad M, Benjamin F	Springer Nature, Switzerland	Edition 1, 2021
2	Rules & Regulations for the Construction and Classification of Inland Waterways Vessels – July 2022		Indian Register of Shipping	Edition 4, 2022
3	River – Sea Vessel notification, Directorate General Shipping, Govt of India		Govt of India	2013

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Kerala Inland Vessel Rules, 2021		Directorate of Ports, Govt. of Kerala.	Revision 1, 2021
2	Recommendations on Harmonized Europe- Wide Technical Requirements for Inland Navigation Vessels, Resolution No. 61		Economic Commission for Europe, Inland Transport Committee, United Nations	2011
3	Future Challenges for Inland Navigation	Christa sys, Therry Vanelslander	University press Antwerp	2011

SEMESTER S4

SHIPBUILDING MATERIALS, CORROSION PREVENTION AND PROTECTION

Course Code	**PENST414**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3-0-0-0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)		**Course Type**	Theory

Course Objectives:

1. Discern the Evolution of Shipbuilding materials
2. Understand types of corrosion of ship structures
3. Discern effective methods of material preservation and corrosion prevention
4. Understand the measures to be taken in design stage to minimise corrosion in ships.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to different types of materials used in shipbuilding, Material fabrication and service requirement, Classification society requirements, Types of shipbuilding quality steels, Mild steels, normal strength steels (A, B, D, E classes), High Tensile Steels (HTS) grades, High Strength Low Alloy (HSLA), Aluminium alloys, alloy designation, welding requirements, Strength of aluminium compared to steel, Composition of aluminium alloys used in ship building, Advantages of using aluminium over steel in ship building.	9
2	Types of Corrosion in Marine Environment, Corrosion Identification, Factors affecting Corrosion. Types of steel and tendency of corrosion in various types of steel, corrosion of Titanium and Nickel alloys, Copper and Copper based alloys, Zinc, Aluminium and its alloys. Corrosion on propeller, marine machinery and deck fittings.	9

3	Material storage and preservation in shipyard, treatment of steel in shipyards. degreasing, weathering, mechanical surface cleaning, pickling, blast cleaning, flame cleaning. rust converters, chemical pre-treatment and comparison of pre-treatment methods. Paint schemes in ships. classification of paints- common paint vehicles, drying oils, oleo-resins, alkyd resins, polymerizing chemicals and bitumen. Role of constituents of paints. suitability of each for various applications. typical paint schemes for underwater areas, boot top above water, weather decks, superstructures and tanks interiors	**9**
4	Corrosion control - importance of corrosion protection, measures to minimise corrosion, corrosion control by design, corrosion inhibitors. cathodic protection- mechanism of cathodic protection, sacrificial anode, design of sacrificial anode system for ships, advantages and disadvantages of sacrificial anode system. impressed current cathodic protection system in ships	**9**

Course Assessment Method

(CIE: 40 marks , ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Discern the evolution of shipbuilding materials, and transition from wood to modern materials.	**K1**
CO2	Differentiate various types of corrosion of ship structures	**K2**
CO3	Implement effective methods of material preservation and corrosion prevention	**K2**
CO4	Use the measures to be taken in design stage to minimise corrosion in ships.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Material Science and Engineering	P.S.Gill	S K Kataria & Sons	Edition 1 2015
2	Marine Corrosion and Cathodic Protection	Chris Coogan	CRC Press	
3	Corrosion Control for Offshore Structures	Ramesh Singh	Gulf Publishing Company	Edition 1, 2014
4	Corrosion Engineering	Fontana M. G, Greene N. D	McGraw Hill,	Edition 2, 1978.

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Corrosion and Protection of Steels in Marine Environments: State-of-the-Art and Emerging Research Trends	Philippe Refait Igor Chaves (Eds)	MDPI	Edition 1, 2022
2	Corrosion of Constructional Steels in Marine and Industrial Environment	Jayanta Kumar Saha	Springer	Edition 1, 2013
3	Designing Cathodic Protection Systems for Marine structures and vehicles	Harvey P Hack	SNAME	2000
4	Developments in Marine Corrosion	A Campbell, N. Campbell, F C Walsh	Royal Society of Chemistry	1998

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/113101098
2	https://nptel.ac.in/courses/113101098
3	https://nptel.ac.in/courses/113101098
4	https://nptel.ac.in/courses/113107078

SEMESTER S4

SHIP CONVERSION TECHNOLOGY

Course Code	**PENST415**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	5/3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	PCNST205 PBNST304	**Course Type**	Theory

Course Objectives:

1. Discern the basic concepts about conversion technology of ships
2. Illustrate the engine room layout, outfit, revised length original length etc
3. Design the modified propeller and outfit items
4. Select the main engine based on the revised powering calculations and revised shaft length

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic ship parameters including existing ship stability condition, principal particulars of the ship, general arrangement drawing of the ship.Fixation of the revised dimensions based on the cargo capacity and redesignated functions, layout general arrangement, including engine room lay out, deck plans, water tight bulk head arrangements, fore peak and aft peak arrangements, anchor and anchor handling arrangements, computation new displacement.	9
2	Form coefficients for new dimensions, mid ship section design, revised functions of stability criteria, cross curves stability, statical stability curves, damaged stability, sea keeping manoeuvring, rudder design, steering gear arrangement etc.	9

3	Shape of sectional area curve, bow and forward section forms, bulbous bow design, stern forms, conventional method of lines design, propeller clearances, propeller design, model testing, structural design, outfitting production (hull), outfitting production (machinery).	**9**
4	Selection of main engine based on the revised powering and shaft calculations, hull-propeller interaction, ship resistance under trial conditions, additional resistance under service condition, rudder design.	**9**

Course Assessment Method (CIE: 40 marks,ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	***Internal Ex***	***Evaluate***	***Analyse***	***Total***
5	15	10	10	40

Criteria for Evaluation(Evaluate and Analyse): 20 marks

Criteria for evaluation:

1. ***Problem Definition (K4 - 4 points)***
    a. *Clearly defines the conversion problem.*
    b. *Examine and identifies relevant contextual factors (constraints, resources, objectives).*
2. ***Problem Analysis (K4 - 4 points)***
    a. *Break-down and presents a well-reasoned solution approach based on SWBS.*
    b. *Compare and justify the proposed solutions with technical evidence and financial reasoning.*
3. ***Evaluate (K5 - 4 points)***
    a. *Thoroughly evaluate the proposed solutions for ship conversion.*
    b. *Compares trade-offs, advantages, and disadvantages.*

c. *Considers feasibility and practical implications.*

4. ***Design Implementation (K5 - 4 points)***

   a. *Select the most feasible solution by implementing the proposed solutions.*

   b. *Successfully translates the chosen solution into drawings and documents.*

5. ***Conclusion (K4- 2 points, K5 – 2 points)***

   a. *Summarizes findings and insights. State which solution is most appropriate for the problem.* ***(K4)***

   b. *Reflects critical thinking and informed decision-making.* ***(K5)***

Scoring:

1. ***Accomplished (4 points)****: Exceptional analysis, clear implementation, and depth of understanding.*
2. ***Competent (3 points)****: Solid performance with minor areas for improvement.*
3. ***Developing (2 points)****: Adequate effort but lacks depth or clarity.*
4. ***Minimal (1 point)****: Incomplete or significantly flawed.*

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 2 questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. • Each question carries 9 marks. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Discern the basic concepts about conversion technology of ships	**K1**
CO2	Illustrate the engine room layout, outfit, revised length original length etc	**K2**
CO3	Design the modified propeller and outfit items	**K4**
CO4	Select the main engine based on evaluation of the revised powering calculations and revised shaft length	**K5**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High),* **-***: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Ship Design and Construction	Thomas Lamb (Ed.)	The Society of Naval Architects and Marine Engineers	Edition 1, 2003
2	Elsevier Ocean Engineering Book Series- Volume 1 (Practical Ship Design)	D. G. M. Watson	Elsevier	Edition 1, 1998
3	Ship Design- Methodologies of Preliminary Design	Apostolos Papanikolaou	Springer	Edition 1, 2014
4	Ship Repairing - Analyses and Estimates	Arun Kr Dev, Makaraksha Saha, George Bruce	Springer Series on Naval Architecture, Marine Engineering, Shipbuilding and Shipping Vol 12	Edition 1, 2022

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	The Maritime Engineering Reference Book	Anthony F. Molland (Ed)	Elsevier	Edition1, 2008
2	Design Principles of Ships and Marine Structures	S. C. Misra	Taylor & Francis	Edition 1, 2016
3	Computational Ship Design	Myung-Il Roh& Kyu-Yeul Lee	Springer	Edition 1, 2018
4	Ship Construction and Welding	Nisith R. Mandal	Springer Series on Naval Architecture, Marine Engineering, Shipbuilding and Shipping 2	Edition 1, 2017

SEMESTER S4

ECONOMICS FOR ENGINEERS

(Common to All Branches)

Course Code	**UCHUT346**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Understanding of finance and costing for engineering operation, budgetary planning and control
2. Provide fundamental concept of micro and macroeconomics related to engineering industry
3. Deliver the basic concepts of Value Engineering.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Economics Concepts - Basic economic problems – Production Possibility Curve – Utility – Law of diminishing marginal utility – Law of Demand - Law of supply – Elasticity - measurement of elasticity and its applications – Equilibrium- Changes in demand and supply and its effects Production function - Law of variable proportion – Economies of Scale – Internal and External Economies – Cobb-Douglas Production Function	6

2	Cost concepts – Social cost, private cost – Explicit and implicit cost – Sunk cost - Opportunity cost - short run cost curves - Revenue concepts Firms and their objectives – Types of firms – Markets - Perfect Competition – Monopoly - Monopolistic Competition - Oligopoly (features and equilibrium of a firm)	**6**
3	Monetary System – Money – Functions - Central Banking –Inflation - Causes and Effects – Measures to Control Inflation - Monetary and Fiscal policies – Deflation Taxation – Direct and Indirect taxes (merits and demerits) - GST National income – Concepts - Circular Flow – Methods of Estimation and Difficulties - Stock Market – Functions- Problems faced by the Indian stock market-Demat Account and Trading Account – Stock market Indicators- SENSEX and NIFTY	**6**
4	Value Analysis and value Engineering - Cost Value, Exchange Value, Use Value, Esteem Value - Aims, Advantages and Application areas of Value Engineering - Value Engineering Procedure - Break-even Analysis - Cost-Benefit Analysis - Capital Budgeting - Process planning	**6**

Course Assessment Method

(CIE: 40 marks , ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Case study/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
10	**15**	**12.5**	**12.5**	**50**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• Minimum 1 and Maximum 2 Questions from each module. • Total of 6 Questions, each carrying 3 marks **(6x3 =18marks)**	• 2 questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 2 sub divisions. • Each question carries 8 marks. **(4x8 = 32 marks)**	**50**

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Understand the fundamentals of various economic issues using laws and learn the concepts of demand, supply, elasticity and production function.	**K2**
CO2	Develop decision making capability by applying concepts relating to costs and revenue, and acquire knowledge regarding the functioning of firms in different market situations.	**K3**
CO3	Outline the macroeconomic principles of monetary and fiscal systems, national income and stock market.	**K2**
CO4	Make use of the possibilities of value analysis and engineering, and solve simple business problems using break even analysis, cost benefit analysis and capital budgeting techniques.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Managerial Economics	Geetika, Piyali Ghosh and Chodhury	Tata McGraw Hill,	2015
2	Engineering Economy	H. G. Thuesen, .J.Fabrycky	PHI	1966
3	Engineering Economics	R. Paneerselvam	PHI	2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Economy	Leland Blank P.E, Anthon Tarquin P. E.	Mc Graw Hill	7TH Edition
2	Indian Financial System	Khan M. Y.	Tata McGraw Hill	2011
3	Engineering Economics and analysis	Donald G. Newman, Jerome P. Lavelle	Engg. Press, Texas	2002
4	Contemporary Engineering Economics	Chan S. Park	Prentice Hall of India Ltd	2001

SEMESTER S3/S4
ENGINEERING ETHICS AND SUSTAINABLE DEVELOPMENT

Course Code	**UCHUT347**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Equip with the knowledge and skills to make ethical decisions and implement gender-sensitive practices in their professional lives.
2. Develop a holistic and comprehensive interdisciplinary approach to understanding engineering ethics principles from a perspective of environment protection and sustainable development.
3. Develop the ability to find strategies for implementing sustainable engineering solutions.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Fundamentals of ethics -** Personal vs. professional ethics, Civic Virtue, Respect for others, **Profession and Professionalism,** Ingenuity, diligence and responsibility, Integrity in design, development, and research domains, Plagiarism, a balanced outlook on law **-** challenges **-** case studies, **Technology and digital revolution-**Data, information, and knowledge, Cybertrust and cybersecurity, Data collection & management, **High technologies: connecting people and places-**accessibility and social impacts, **Managing conflict**, Collective bargaining, **Confidentiality**, Role of confidentiality in moral integrity, **Codes of Ethics**. **Basic concepts in Gender Studies -** sex, gender, sexuality, gender spectrum: beyond the binary, gender identity, gender expression, gender stereotypes, **Gender disparity and discrimination in education**, employment and everyday life, History of women in Science & Technology, Gendered technologies & innovations**, Ethical values and practices in connection with gender -** equity, diversity & gender justice, **Gender policy and women/transgender empowerment initiatives.**	**6**
2	**Introduction to Environmental Ethics:** Definition, importance and historical development of environmental ethics, key philosophical theories	**6**

	(anthropocentrism, biocentrism, ecocentrism). **Sustainable Engineering Principles:** Definition and scope, triple bottom line (economic, social and environmental sustainability), life cycle analysis and sustainability metrics. **Ecosystems and Biodiversity:** Basics of ecosystems and their functions, Importance of biodiversity and its conservation, Human impact on ecosystems and biodiversity loss, An overview of various ecosystems in Kerala/India, and its significance. **Landscape and Urban Ecology:** Principles of landscape ecology, Urbanization and its environmental impact, Sustainable urban planning and green infrastructure.	
3	**Hydrology and Water Management:** Basics of hydrology and water cycle, Water scarcity and pollution issues, Sustainable water management practices, Environmental flow, disruptions and disasters. **Zero Waste Concepts and Practices:** Definition of zero waste and its principles, Strategies for waste reduction, reuse, reduce and recycling, Case studies of successful zero waste initiatives. **Circular Economy and Degrowth:** Introduction to the circular economy model, Differences between linear and circular economies, degrowth principles, Strategies for implementing circular economy practices and degrowth principles in engineering. **Mobility and Sustainable Transportation:** Impacts of transportation on the environment and climate, Basic tenets of a Sustainable Transportation design, Sustainable urban mobility solutions, Integrated mobility systems, E-Mobility, Existing and upcoming models of sustainable mobility solutions.	**6**
4	**Renewable Energy and Sustainable Technologies:** Overview of renewable energy sources (solar, wind, hydro, biomass), Sustainable technologies in energy production and consumption, Challenges and opportunities in renewable energy adoption. **Climate Change and Engineering Solutions:** Basics of climate change science, Impact of climate change on natural and human systems, Kerala/India and the Climate crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. **Environmental Policies and Regulations:** Overview of key environmental policies and regulations (national and international), Role of engineers in policy implementation and compliance, Ethical considerations in environmental policy-making. **Case Studies and Future Directions:** Analysis of real-world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future.	**6**

Course Assessment Method
(CIE: 50 marks , ESE: 50)

Continuous Internal Evaluation Marks (CIE):

Continuous internal evaluation will be based on individual and group activities undertaken throughout the course and the portfolio created documenting their work and learning. The portfolio will include reflections, project reports, case studies, and all other relevant materials.

- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. These groups can be the same ones they have formed in the previous semester.
- Activities are to be distributed between 2 class hours and 3 Self-study hours.
- The portfolio and reflective journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through various courses.

Sl. No.	Item	Particulars	Group/ Individual (G/I)	Marks
1	Reflective Journal	Weekly entries reflecting on what was learned, personal insights, and how it can be applied to local contexts.	I	5
2	Micro project (Detailed documentation of the project, including methodologies, findings, and reflections)	1 a) Perform an Engineering Ethics Case Study analysis and prepare a report 1 b) Conduct a literature survey on 'Code of Ethics for Engineers' and prepare a sample code of ethics	G	8
		2. Listen to a TED talk on a Gender-related topic, do a literature survey on that topic and make a report citing the relevant papers with a specific analysis of the Kerala context	G	5
		3. Undertake a project study based on the concepts of sustainable development* - Module II, Module III & Module IV	G	12
3	Activities	2. One activity* each from Module II, Module III & Module IV	G	15
4	Final Presentation	A comprehensive presentation summarising the key takeaways from the course, personal reflections, and proposed future actions based on the learnings.	G	5
		Total Marks		**50**

*Can be taken from the given sample activities/projects

Evaluation Criteria:

- **Depth of Analysis**: Quality and depth of reflections and analysis in project reports and case studies.
- **Application of Concepts**: Ability to apply course concepts to real-world problems and local contexts.
- **Creativity**: Innovative approaches and creative solutions proposed in projects and reflections.
- **Presentation Skills**: Clarity, coherence, and professionalism in the final presentation.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to apply the principles of engineering ethics in their professional life.	**K3**
CO2	Develop the ability to exercise gender-sensitive practices in their professional lives	**K4**
CO3	Develop the ability to explore contemporary environmental issues and sustainable practices.	**K5**
CO4	Develop the ability to analyse the role of engineers in promoting sustainability and climate resilience.	**K4**
CO5	Develop interest and skills in addressing pertinent environmental and climate-related challenges through a sustainable engineering approach.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						3	2	3	3	2		2
CO2		1				3	2	3	3	2		2
CO3						3	3	2	3	2		2
CO4		1				3	3	2	3	2		2
CO5						3	3	2	3	2		2

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Ethics in Engineering Practice and Research	Caroline Whitbeck	Cambridge University Press & Assessment	2nd edition & August 2011
2	Virtue Ethics and Professional Roles	Justin Oakley	Cambridge University Press & Assessment	November 2006
3	Sustainability Science	Bert J. M. de Vries	Cambridge University Press & Assessment	2nd edition & December 2023
4	Sustainable Engineering Principles and Practice	Bhavik R. Bakshi,	Cambridge University Press & Assessmen	2019
5	Engineering Ethics	M Govindarajan, S Natarajan and V S Senthil Kumar	PHI Learning Private Ltd, New Delhi	2012
6	Professional ethics and human values	RS Naagarazan	New age international (P) limited New Delhi	2006.
7	Ethics in Engineering	Mike W Martin and Roland Schinzinger,	Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi	4" edition, 2014

Suggested Activities/Projects:

Module-II

- Write a reflection on a local environmental issue (e.g., plastic waste in Kerala backwaters or oceans) from different ethical perspectives (anthropocentric, biocentric, ecocentric).
- Write a life cycle analysis report of a common product used in Kerala (e.g., a coconut, bamboo or rubber-based product) and present findings on its sustainability.
- Create a sustainability report for a local business, assessing its environmental, social, and economic impacts
- Presentation on biodiversity in a nearby area (e.g., a local park, a wetland, mangroves, college campus etc) and propose conservation strategies to protect it.
- Develop a conservation plan for an endangered species found in Kerala.
- Analyze the green spaces in a local urban area and propose a plan to enhance urban ecology using native plants and sustainable design.
- Create a model of a sustainable urban landscape for a chosen locality in Kerala.

Module-III

- Study a local water body (e.g., a river or lake) for signs of pollution or natural flow disruption and suggest sustainable management and restoration practices.
- Analyse the effectiveness of water management in the college campus and propose improvements - calculate the water footprint, how to reduce the footprint, how to increase supply through rainwater harvesting, and how to decrease the supply-demand ratio
- Implement a zero waste initiative on the college campus for one week and document the challenges and outcomes.
- Develop a waste audit report for the campus. Suggest a plan for a zero-waste approach.
- Create a circular economy model for a common product used in Kerala (e.g., coconut oil, cloth etc).
- Design a product or service based on circular economy and degrowth principles and present a business plan.
- Develop a plan to improve pedestrian and cycling infrastructure in a chosen locality in Kerala

Module-IV

- Evaluate the potential for installing solar panels on the college campus including cost-benefit analysis and feasibility study.
- Analyse the energy consumption patterns of the college campus and propose sustainable alternatives to reduce consumption - What gadgets are being used? How can we reduce demand using energy-saving gadgets?
- Analyse a local infrastructure project for its climate resilience and suggest improvements.
- Analyse a specific environmental regulation in India (e.g., Coastal Regulation Zone) and its impact on local communities and ecosystems.
- Research and present a case study of a successful sustainable engineering project in Kerala/India (e.g., sustainable building design, water management project, infrastructure project).
- Research and present a case study of an unsustainable engineering project in Kerala/India highlighting design and implementation faults and possible corrections/alternatives (e.g., a housing complex with water logging, a water management project causing frequent floods, infrastructure project that affects surrounding landscapes or ecosystems).

SEMESTER S4

STRENGTH OF MATERIALS LAB

Course Code	**PCNSL407**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	PCNST303	**Course Type**	Lab

Course Objectives:

1. Apply knowledge in the area of testing of materials and components of structural elements experimentally.
2. Understand with the arrangements and conduct of experiments in the Material Testing laboratory environment.
3. Able to comprehend the factors responsible for variation between theoretical and experimental results pertaining to the domain of Material Science.
4. Undertake the testing of materials when subjected to different types of loading.

Expt. No.	Experiments
1	Tests on Open Coiled Spring
2	Tests on Close Coiled Spring
3	Bending Test on Wooden Beams Using U. T. M.
4	Verification of Clerk Maxwell's Law of Reciprocal Deflection
5	Torsion Pendulum test for MS Wires
6	Torsion Pendulum test for Aluminium Wires
7	Torsion Pendulum test for Brass Wires
8	Tension Test Using on MS rod
9	Torsion Test on M S rod

10	Impact Test Using Izod Apparatus
11	Impact Test Using Charpy Apparatus
12	Double Shear Test on MS rod

Course Assessment Method

(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	**25**	**20**	**50**

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	**15**	**10**	**10**	**5**	**50**

- ***Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.***
- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply knowledge in the area of testing of materials and components of structural elements experimentally.	**K3**
CO2	Understand with the arrangements and conduct of experiments in the Material Testing laboratory environment.	**K1**
CO3	Able to comprehend the factors responsible for variation between theoretical and experimental results pertaining to the domain of Material Science.	**K1**
CO4	Undertake the testing of materials when subjected to different types of loading.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Strength of Materials	Bansal R. K	Lakshmi Publications	Edition 4, 2007
2	Strength of Materials Part 1	Timoshenko S. P.	D. Van Nostrand Company Inc .	Edition 3, 2002
3	Strength of Materials	S. Ramamrutham	Dhanpat Rai Publishing Company	Edition 16, 2008
4	Engineering Mechanics of Solids	E P Popov	Prentice-Hall of India Pvt Ltd	Edition 2, 1998 (Reprint 2019)

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Strength of Materials Lab Manual	Anand Jayakumar A	Notion Press	2020
2	Applied Strength of Materials forEngineering Technology	Barry Dupen	Indiana University – Purdue University Fort Wayne	2016

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/105103192 https://nptel.ac.in/courses/112105171
2	https://nptel.ac.in/courses/105103192 https://nptel.ac.in/courses/112105171
3	https://nptel.ac.in/courses/105103192 https://nptel.ac.in/courses/112105171
4	https://nptel.ac.in/courses/105103192 https://nptel.ac.in/courses/112105171

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (5 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER S4

MEASUREMENTS LAB

Course Code	PCNSL408	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)		Course Type	Lab

Course Objectives:

1. Acquire knowledge in the field of measurement
2. Provide an exposure to the fundamentals of metrology
3. Understand the need of precision measurement and measuring instruments
4. Find out the possible errors in measurement

Expt. No.	Experiments
1	Measurement of tool angles of single point cutting tool using tool makers microscope
2	Measurement of thread parameters using profile projector
3	Evaluation of straightness error using autocollimator, sprite level, straight edge etc.,
4	Calibration and determination of uncertainties of Tachometers and stroboscopes
5	Calibration of temperature using thermo- couple equipment
6	Experiments on limit and fits.
7	Measurement of vibration using vibration analyzer
8	Study of different types of dial indicators - stands and holders for dial gauges
9	Study and determination of area using planometer
10	Polishing, etching and determination of grain size and micro structure studies using optical microscope
11	Study and use of different types of comparators.
12	Angular measurement using Sine bar

Course Assessment Method

(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- ***Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.***
- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify equipment and instruments used in measurements lab.	K1
CO2	Apply the theoretical Knowledge gained in the classroom and verify the same	K3
CO3	Compare different techniques and instruments for measurement	K1
CO4	Find out the possibility of error in measurement	K4

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Practical engineering metrology	SharpKWB	Sir Issac Pitman and Sons Ltd.,	First edition 1970
2	Fits Tolerance and engineering measurements volume III	Tarasevigh Y and Yavosih E	Forgn language publishng house	1963
3	Theory and design of mechanical measurements	Figiliola, Richard S and Beasley Donald E	John Wiley and sons	2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Measurements	Collett C V and Hope A D	ELBS/Longman	2011
2	Metology for engineers	Shotbolt C R Gayler J F W	ELBS	1990

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

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3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted