Course code	Course Name	L-T-P-Credits	Year of Introduction
EE214	ELECTRICAL TECHNOLOGY AND INSTRUMENTATION	3-0-0-3	2016

Prerequisites: Nil

Course Objectives:

- To impart understanding of the basic working principles of DC and AC machines.
- To impart understanding of the basic principles of instrumentation and its applications.

Syllabus:

DC Generator- Load Characteristics; DC Motors- Speed & Torque, Performance Characteristics; 3ph Induction Motors-Torque Equation, Characteristics; Alternators- Construction; Regulation- Transformers, Regulation Efficiency; Instrumentation- Calibration, Errors; Transducer Classification.

Expected Outcome:

Upon successful completion of the course, the student will be able to:

i. Understand the basic working principle, construction, types, performance characteristics and applications of DC generators, DC motors and induction motors.
ii. Understand the basic working principle, construction, types, EMF equation, voltage regulation, EMF, MMF methods to determine the voltage regulation of alternators.
iii. Understand the basic working principle, construction, types, equivalent circuit, losses, efficiency, regulation and applications of transformers and predetermine their efficiency by conducting OC and SC.
iv. Understand the basic principles of instrumentation, measurement standards and types of errors in instruments and measurements and its applications.

Text Books:

- Dr. P. S. Bimbra; Electrical Machinery; Khanna Publishers.
- J. B. Gupta; Theory and principles of Electrical Machines; S. K.Kataria and Sons Tex.

Reference Books:

- A.K.Sawhney; Electrical and Electronic Measurements and Instrumentation; DhanpatRai.
- Alexander Langsdorf A. S.; Theory of AC Machinery; Mc-Graw Hill.
- James.W.Dally, William.F. Riley, Kenneth G. McConnell; Instrumentation for Engineering Measurement.
- Say M.G.; Performance and Design of AC Machines; ELBS.
- William D. Cooper, A.D. Helfrick; Electronic Instrumentation and Measurement Techniques; Prentice Hall.

Course Plan

Module	Content	Hours	Sem. Exam Marks
I	**D.C. Generator:** O.C.C. ; Condition for Self Excitation; Field Critical Resistance; Critical Speed; Load Characteristics of	7	15%

	Generators; *Losses*; Power Flow Diagram; Efficiency, Condition for Maximum Efficiency; *Applications*.		
II	**D.C. Motors:** Back EMF; Speed and Torque Equation; Starting, Testing of D.C. Motors, Brake Test; Swinburne's Test; Performance and operating characteristics of Shunt, Series and Compound Motors; *Applications.*	7	15%
FIRST INTERNAL EXAM			
III	**Three Phase Induction Motor**: Production of Rotating Magnetic Field; Torque Equation; Torque Slip Characteristics, Equivalent Circuit; *Application*. Single Phase Induction Motor: Different Types; *Application.*	7	15%
IV	**Alternators**: *Construction Details*, Type; EMF Equation (Winding Factor need not be derived); Synchronous Impedance; Regulation by EMF and MMF Method.	7	15%
SECOND INTERNAL EXAM			
V	**Transformer**: *Construction*, *Working*, *Types*, EMF Equation, No Load Current; Equivalent Circuit; Phasor Diagram, Regulation, Efficiency, Determination of Regulation and Efficiency from O.C. and S.C. tests; *Cooling of Transformer*; Applications.	7	20%
VI	**Introduction to Instrumentation and its Applications:** Classification of Instruments; Standards and Calibration; Errors in Instruments and Measurements; Classification of Transducers; Strain Gauges; *L.V.D.T. (Linear Variable Differential Transformer)*, Mc.Leod Gauge, Pirani Gauge, Hot-wire Anemometers; Constant Temperature and Constant Current Methods.	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

PART A

- Answer all 8 questions of 3 marks each.
- 1 question each from modules I to IV and 2 questions each from modules V & VI.

PART B

- Answer any 2 full questions out of 3 for each module.
- Each question from module I to IV carries 6 marks.
- Each question from module V & VI carries 7 marks.
- Each full question can have maximum of 4 sub questions, if needed.

Course code	Course Name:	L-T-P-Credits	Year of Introduction
ME237	WELDING AND MACHINE TOOLS LAB	0-0-3-1	2016

Prerequisite: Nil

Course Objectives:

- Provide practical experience on various machining operations using Lathe.
- Familiarization with basics of welding.
- Provide practical experience in carrying out welding.

List of Exercises/ Experiments (Minimum 10 are mandatory)

(a). Machine Tools:

1. Study of Precision Tools and Measuring Instruments.
   Equipment: Vernier Calliper, Micrometer, Surface Plate, Surface Gauge, Slip Gauge, Screw Pitch Gauge, Feeler Gauge, Dial Gauge, Sine Gauge, Plug Gauge, Straight edge Gauge.

2. Study of Nomenclature of Single Point Cutting Tool.
   Equipment: HSS Single point cutting tool.

3. Study of Centre Lathe.
   Equipment: Centre Lathe.

To perform following lathe operations on a work piece for given dimensions :

4. Plane Turning.
   Equipment: HSS Single point cutting tool (V-tool), Tool holder, Surface gauge, steel rule, outside calliper, Jenny calliper, and Vernier calliper.

5. Step Turning.
   Equipment: HSS Single point cutting tool (V-tool), Parting tool, Tool holder, Surface gauge, steel rule, outside calliper, Jenny calliper, and Vernier calliper.

6. Grooving.
   Equipment: HSS Single point cutting tool (V-tool), Parting tool, Tool holder, Surface gauge, steel rule, outside calliper, Jenny calliper, and Vernier calliper.

7. Taper Turning.
   Equipment: HSS Single point cutting tool (V-tool), Tool holder, Surface gauge, steel rule, outside calliper, Jenny calliper, Vernier calliper and double end spanner.

8. Thread Cutting.
   Equipment: HSS Single point cutting tool (V-tool), Tool holder, Surface gauge, steel rule, outside calliper, Jenny calliper, Vernier calliper Centre gauge and thread pitch gauge.

(b) Welding:

9. Study of Welding Equipment and Procedures.
   Equipment: MMAW, MIG, TIG, SAW.

10. To study various types of welding joints and practice edge preparation.
    Equipment: Butt joint, Lap joint, T-Joint, Corner joint, Workpiece, File/Grinder, Wirebrush.

11. To Prepare a Single V-Butt Joint using Arc Welding Process.
    Equipment: Arc welding machine, Mild steel work pieces, Mild steel Electrodes, Electrode holder, Ground clamp, Flat nose tong, Face shield, Apron, Hand gloves, work table, Bench vice, Rough flat file, steel rule, wire brush, Try square, Bell peen hammer, chipping hammer, chisel, grinding machine.

12. To Prepare a Lap Joint using Arc Welding Process.
    Equipment: Arc Welding Machine, Mild Steel Work Pieces, Mild Steel Electrodes, Electrode Holder, Ground Clamp, Face Shield, Apron, Hand Gloves, Work Table, Bench Vice, Rough Flat File, Try Square, Bell Peen Hammer, Chipping Hammer, Chisel, Grinding Machine.

13. To Prepare a T Joint using Arc Welding Process
    Equipment: Arc Welding Machine, Mild Steel Work Pieces, Mild Steel Electrodes, Electrode Holder, Ground Clamp, Face Shield, Apron, Hand Gloves, Work Table, Bench Vice, Rough Flat File, Try Square, Bell Peen Hammer, Chipping Hammer, Chisel, Grinding Machine.

14. To prepare a Butt Joint Using TIG Welding Process.
    Equipment: TIG Welding Machine, Welding Cable With Earth Clamps, Gas Cooled TIG Welding Torch, Inert Argon Gas Hose Pipe, Tungsten Rod, Flow Meter, Mild Steel Work Pieces, Face Shield, Apron, Hand Gloves, Work Table, Bench Vice, Rough Flat File, Try Square, Ball Peen Hammer, Chipping Hammer, Chisel, Grinding Machine.

15. To prepare a Lap Joint Using TIG Welding Process.
    Equipment: TIG Welding Machine, Welding Cable With Earth Clamps, Gas Cooled TIG Welding Torch, Inert Argon Gas Hose Pipe, Tungsten Rod, Flow Meter, Mild Steel Work Pieces, Face Shield, Apron, Hand Gloves, Work Table, Bench Vice, Rough Flat File, Try Square, Bell Peen Hammer, Chipping Hammer, Chisel, Grinding Machine.

16. To Prepare a Butt Joint using MIG Welding Process.
    Equipment: MIG Welding Machine, Welding Cable With Earth Clamps, MIG Welding Torch, CO_2 Gas Flow Meter with Preheater, Contact Tips, Input Gas Hose Pipes, Mild Steel Work Pieces, Face Shield, Apron, Hand Gloves, Work Table, Bench Vice, Rough Flat File, Try Square, Bell Peen Hammer, Chipping Hammer, Chisel, Grinding Machine.

17. To Prepare a Lap Joint using MIG Welding Process.
    Equipment: MIG Welding Machine, Welding Cable With Earth Clamps, MIG Welding Torch,

CO_2 Gas Flow Meter With Preheater, Contact Tips, Input Gas Hose Pipes, Mild Steel Work Pieces, Face Shield, Apron, Hand Gloves, Work Table, Bench Vice, Rough Flat File, Try Square, Bell Peen Hammer, Chipping Hammer, Chisel, Grinding Machine.

18. To Prepare a T Joint using MIG Welding Process.
    Equipment: MIG Welding Machine, Welding Cable With Earth Clamps, MIG Welding Torch, CO_2 Gas Flow Meter With Preheater, Contact Tips, Input Gas Hose Pipes, Mild Steel Work Pieces, Face Shield, Apron, Hand Gloves, Work Table, Bench Vice, Rough Flat File, Try Square, Bell Peen Hammer, Chipping Hammer, Chisel, Grinding Machine.

19. Demonstration of Submerged Arc Welding Process.
    Equipment: Power Source, Welding Head Trolley, Welding Clamp With Earth Clamp, Welding Cable With Earth Lug, Control Cable, Track, Contact Tip, Contact Pole, Flux Hose, Flux Hopper .

Expected Outcome:

After successful completion of the course, the student will be able to:

i. Machine the given specimen to required dimension using Lathe.
ii. Demonstrate the principle of operation of MMAW, TIG, MIG & SAW.
iii. Prepare specified type of joint using various welding processes.

Text Book(s):

1. O.P Khanna; Welding Technology; Dhanpat Rai Publications.
2. Acharkan. N.; Machine Tool Design Vol. 1 to 4, MIR Publication.
3. Chapman; Workshop Technology, Vol II, ELBS.

Course code	Course Name:	L-T-P-Credits	Year of Introduction
ME238	ADVANCED MACHINE TOOLS LAB	0-0-3-1	2016

Prerequisite: Nil

Course Objectives:

- Introduction to various Machining process.
- To familiarization with the fundamentals of CNC Machine.
- To introduce the student to CNC operations.

List of Exercises/ Experiments (Minimum 10 are mandatory)

1. Bolt Making on Lathe Machine
   Equipment: Cutting Saw, Center Lathe, Pedestal Grinder, HSS Tool Bit And Straight Or Right Hand Tool Holder, Center Drill, Live Center, Stock and Die, Metal Work Vice.

2. Study of Drilling Machines.
   Equipment: Radial Drilling Machine.

3. Study of Nomenclature of Drill Bit.
   Equipment: Drill Bit.

4. To Drill the Given Work Piece as Required.
   Equipment: Mild Steel Work Piece, Drill Bit, Lot Drill Bit, Drill Chuck.

5. Study of Shaping Machines.
   Equipment: Shaper Machine.

6. To Perform V- Machining on the Given Work Piece.
   Equipment: Shaper Machine, Punching Machine, Steel Rule, Hammer, Shaper Tool, Try Square.

7. To Perform U-Cut on the Given Work Piece.
   Equipment: Shaper machine, Steel rule, Hammer, Shaper tool, Try Square.

8. Study of Slotting Machines
   Equipment: Slotter.

9. To make a Slot on the Given Work Piece.
   Equipment: Slotting Machine, Steel rule, Hammer, Shaper tool, Try Square.

10. To Cut External Key Way Using Slotter.
    Equipment: Slotting Machine, Steel Rule, Hammer, Shaper Tool, Try Square.

11. Study of Milling Machines.
    Equipment: Milling Machine.

12. To Perform Plane Milling Operation on the Given Specimen.
    Equipment: Milling Machine, Work Piece, Steel Ruler.

13. To Make Spur Gear on a Given Work Piece.
    Equipment: Steel Rule, Milling Cutter, Spanner, Mandrel, Dog Carrier.

14. To make Bevel Gear on a Work Piece.
    Equipment: Steel Rule, Milling Cutter, Spanner, Mandrel, Dog Carrier.

15. Study and Demonstration of CNC Machine.
    Equipment: CNC Machine.

16. To Program and Run Milling Operation Using CNC Machine.
    Equipment: CNC Machine, Computer.

17. To Program and Execute Turning Operation Using CNC Lathe.
    Equipment: CNC Machine, Computer.

18. Study of Cutting Process.
    Equipment: Variety of Cutting Equipment.

19. Study of CNC Plasma Arc Cutting (working principle and procedure only).

Course Outcome:

Upon successful completion of the course, the student will be able to :

i. Machine the given work piece to specified dimensions.
ii. Understand the fundamentals of CNC machining.

Text Book(s):

- Chapman; Workshop Technology, Vol II; ELBS.
- HMT; Production Technology; Tata McGraw Hill.
- Yoram Koren; Numerical Control of Machine Tools; McGraw-Hill.
- Acharkan. N.; Machine Tool Design Vol. 1 to 4; MIR Publication.

Course No:	Course Name:	L-T-P-Credits	Year of Introduction
SB201	MECHANICS OF SOLIDS	3-1-0-4	2016

Prerequisites: -Nil

Course Objectives:

1. To impart understanding of the basic principles and foundations of Solid Mechanics.
2. To give an ability to calculate stresses and deformations of objects under external loadings.
3. To impart the ability to apply basic principles of Solid Mechanics to solve engineering problems.

Syllabus:

Stress and Strain – Elastic Constants - Bending Moment and Shear Force Diagram – Stresses in Beams – Bending Stress – Shear Stress – Deflection of Beams - Thin Walled Pressure Vessels – Torsion in Circular Shafts – Theory of Columns- Principal Stresses- Failure criterion.

Expected Outcome:

At the end of the course students will be able to**:**

1. Understand the stresses and deformations caused by externally applied forces.
2. Calculate elastic constants for a given material.
3. Draw the bending moment and shear force diagram for a given beam and loads.
4. Calculate the stresses and its distribution over the crossection for a beam.
5. Plot the elastic curve of a beam.
6. Understand the concept of torsion and its application.
7. Apply the buckling theory for the analysis of columns.

Text Books:

- Bansal R. K; Strength of Materials; Lakshmi Publications; New Delhi.
- Timoshenko S. P.; Strength of Materials Part 1; D. Van Nostrand Company Inc .New York.

Reference Books:

- S. Ramamrutham, R. Narayan; Strength of Materials; Dhanpat Rai Publishing Company.
- S. S Bavikatti; Strength of Materials; Vikas Publishing House Pvt Ltd., New Delhi.
- Shames I. H., Pitarresi, James. M; Introduction to Solid Mechanics; Prentice Hall of India.

Course Plan:

Module	Content	Hours	Sem. Exam Marks
I	**Basics:** Introduction to Mechanics of Solids; Types of Loads and Stresses; Definition of Uniaxial, Biaxial and Triaxial State of Stresses.	3	15%
	Stress and Strain: Tension, Compression and Shear; Uniaxial Stresses; Hooke's Law of Material Behaviour; Bar of Varying Cross section; Composite bar; Temperature Stresses; Poisson's Ratio; Stress - Strain Diagram; Working Stress, Factor of Safety; Volumetric Strain, Elastic Moduli and relationship between them.	6	

II	**Bending Moment and Shear Force**: Introduction to Types of Supports; Beams and Loads, Shear Force and Bending Moment Diagrams for Various Types of Statically Determinate Beams with Various Loading Combinations (Cantilever, Simply Supported and Overhanging Beams); Relation between Load, Shear Force and Bending Moment.	8	15%
FIRST INTERNAL EXAM			
III	**Stresses in Beams:** Theory of Simple Bending, Assumptions; Section Modulus, Flexural Rigidity; Stresses in Symmetrical Sections; Bending Stress Distribution.	5	15%
	Shear Stress: Shear stress Distribution in Beams, Assumptions; Stress in Various Cross Sections.	4	
IV	**Deflection:** Differential Equation of the Elastic Curve; Slope and Deflection of Beams by Method of Successive Integration; Moment Area Theorem.	8	15%
SECOND INTERNAL EXAM			
V	**Thin Walled Pressure Vessels:** Introduction**;** Biaxial Tension and Compression in Thin Walled Pressure Vessels (Cylindrical and Spherical).	4	20%
	Torsion: Introduction to Torsion - Torsion of Circular Shafts; Shear Stresses, Shear Deformation, Strain Energy.	4	
VI	**Theory of Columns:** Introduction to Columns; Buckling Theory, Euler's Formula for Long Columns, Assumptions and Limitations, Effect of End Conditions, Slenderness Ratio.	6	20%
	Combined Stresses: Principal Stresses and Planes, Mohr's Circle Representation of Stress in 2D problems. **Combined Loads:** *Failures (Fracture, Yielding, Loss of Stability) - Hypothesis of Failure.*	8	
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

PART A

- Answer all 8 questions of 3 marks each.
- 1 question each from modules I to IV and 2 questions each from modules V & VI.

PART B

- Answer any 2 full questions out of 3 for each module.
- Each question from module I to IV carries 6 marks.
- Each question from module V & VI carries 7 marks.
- Each full question can have maximum of 4 sub questions, if needed.

Course code	Course Name	L-T-P-Credits	Year of Introduction
SB202	RESISTANCE AND PROPULSION OF SHIPS	3-1-0-4	2016

Prerequisites: -Nil

Course Objectives:

1. To be familiar with the concept of Resistance and Propulsion of ships.
2. To be familiar with prediction of Resistance of ships, and to estimate machinery power to attain the specified speed.
3. To impart knowledge on various types of marine propellers and to familiarize with design.

Syllabus:

Introduction to Resistance and Propulsion of Ships, Components of Ship Resistance, Laws of Comparison, Viscous Resistance, Wave Making Resistance; Other Resistance Components, Model Testing, Determination of Resistance from Series Test Results; Propeller as a Thrust Producing Mechanism, Screw Propeller, Propeller Theories, Interaction Between Hull and Propeller, Cavitation; Design of Propellers, Open Water Tests , Self-Propulsion Tests, Design Charts, Selection of Engine Power, Propeller Strength, Model Testing of Propellers; Resistance Calculation, Model Ship Correlation, Propeller Design, Ship Standardization Trials, Resistance of Advanced Marine Vehicles, Special Types of Propellers.

Expected Outcome:

Upon successful completion of the course, the student will be able to :

1. Understand various components of resistance of ships.
2. Predict resistance of ships using statistical / methodical series / model tests and estimate effective power.
3. Understand the geometry of screw propeller, various propeller theories and interaction between hull & propeller.
4. Understand the phenomena of cavitation and its effects of propellers.
5. Design propeller using various methodical series/ design charts/ model experiments.
6. Understand the principle of operation of various unconventional propulsive devices, and resistance of high speed marine crafts.

Text Books:

- J.P. Ghose, R.P. Gokarn; Basic Ship Propulsion.
- Eric Tupper; Introduction to Naval Architecture.

Reference Books:

- D.G.M. Watson; Practical Ship Design; Elsevier Ocean Engineering Book Series.
- Lewis, E.U.; Principles of Naval Architecture, SNAME, New Jersey, U.S.A.
- Rawson and Tupper; Basic Ship Theory; Butterworth-Heinemann.
- Lars Larsson & Hoyte C.; Principles of Naval Architecture.
- Raven; Ship Resistance & Flow; The Society of Naval Architects and Marine Engineers.
- Neil Bose; Marine Powering Prediction and Propulsors; The Society of Naval Architects and Marine Engineers.

- Barnaby K.; Basic Naval Architecture.
- H. Schneekluth; V. Bertram; Ship Design for Efficiency and Economy.

Course Plan

Module	Content	Hours	Sem. Exam Marks
I	**Introduction-** Resistance of Ships, Components of Ship Resistance	2	15%
	Dimensional Analysis- Geometrical, Dynamical and Kinematical Similarity, Laws of Comparison- Model-Ship Correlation.	3	
	Viscous Resistance– Turbulent Plate Friction and Plate Resistance, Viscous Pressure Resistance, Influence of Curvature of Ship's Hull, Form Factor, Hull Roughness and its Influence on Frictional Resistance.	2	
	Wave Making Resistance– Ship Wave System, Interference Effects, Theoretical Calculation of Wave Making Resistance, Wave Breaking Resistance, Bulbous Bow and its Effects.	2	
II	**Other Components of Resistance-** Air and Wind Resistance, Appendage Resistance, Added Resistance in Waves; Resistance in Restricted Waterways– Resistance in Shallow Water, Resistance in Canals.	3	15%
	Model Testing– Modern Tank Testing Facilities, Prediction of Resistance from Model Tests, Tank Wall Effect.	3	
	Determination of Resistance from Test Results – Residuary Resistance, Effect of Hull Form on Resistance, Taylor Series, Series 60, B S R A Series, S S P A Series, Etc.; Statistical Analysis of Resistance Data, Holtrop & Mennen's Method, Guldhammer And Harvald's Method.	3	
FIRST INTERNAL EXAM			
III	**Introduction to Powering of Ships-** Propeller as a Thrust Producing Mechanism; Screw Propeller- Propeller Geometry, Sections, Propeller Drawing, Construction Details.	3	15%
	Law Of Similitude Of Propeller, Propeller Theories- Momentum Theory, Blade Element Theory, Circulation Theory.	3	
	Interaction Between Hull and Propeller-Wake and Wake Fraction, Resistance Augment and Thrust Deduction Factor, Propulsive Efficiency in Open Water and Behind Conditions, Hull Efficiency, Quasi Propulsive Coefficient, Transmission Efficiency.	3	
	Cavitation- Introduction, Types, Cavitation Number, Effects of Cavitation, Prevention of Cavitation, Design for Minimum Cavitation, Cavitation Tests.	2	
IV	Design of Propellers- Propeller Families and Series; Kt-Kq Diagrams; Design Charts- Bp-Δ, T-J, P-J Charts, Use of Charts in Propeller Design and Performance Study.	6	15%

	Propeller Strength- Materials and their Qualities, Strength Calculation.	2	
	Model Testing Of Propellers- Test Facilities, Laws of Comparison, Open Water Tests, Self- Propulsion Tests, Ship Standardization Trials.	3	
SECOND INTERNAL EXAM			
V	**Special Types of Propellers**- Shrouded Propellers– Action of Propeller in a Nozzle, Wake Fraction and Thrust Deduction Fraction in Nozzles, Load Factor of Nozzles, Design of Propeller Nozzle System, Design Charts.	8	20%
	Controllable Pitch Propellers- Advantages, Special Features in Geometry, Design Aspects.		
VI	**Super Cavitating Propellers**, Application.	3	20%
	Other Propulsion Devices- Vertical Axis Propellers, Water Jet Propulsion, Sail, Paddle Wheels, Electromagnetic Propulsion.		
	High Speed Craft and Advanced Marine Vehicles- Introduction, Types; Resistance of Planing Crafts, Catamarans, SWATH, Hydrofoil Crafts.	5	
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum marks : 100 Time : 3 hours

PART A

- Answer all 8 questions of 3 marks each.
- 1 question each from modules I to IV and 2 questions each from modules V & VI.

PART B

- Answer any 2 full questions out of 3 for each module.
- Each question from module I to IV carries 6 marks.
- Each question from module V & VI carries 7 marks.
- Each full question can have maximum of 4 sub questions, if needed.

Course No:	Course Name:	L-T-P-Credits	Year of Introduction
SB203	MECHANICS OF FLUIDS	3-1-0-4	2016

Prerequisites: -Nil

Course Objectives:

1. To provide a foundation in the fundamentals of fluid mechanics.
2. To provide practice in the analytical formulation of fluid mechanics problems.
3. To introduce the theory of surface gravity waves.
4. To introduce computational fluid dynamics.

Syllabus:

Basics- Properties of Fluids-Fluid Pressure- Pressure Measurement- Hydrostatic Forces on Surfaces-Buoyancy & Floatation-Fluid Kinematics-Flow Visualization - Fluid Dynamics –Viscous Incompressible Flows-Turbulent Flow Through Pipes-Flow around submerged bodies-Gravity Waves-Introduction to Computational Fluid Dynamics.

Expected Outcome:

Upon successful completion of the course, the student will be able to

1. determine the hydrostatic forces on submerged plane and curved surfaces.
2. understand buoyancy and stability
3. determine velocity, pressure and acceleration in incompressible and inviscid flows.
4. understand rotational and irrotational flows, stream functions and velocity potentials.
5. know the use of flow visualization techniques.
6. demonstrate understanding of laminar and turbulent flows through pipes, losses in pipes and solve simple problems.
7. demonstrate understanding of external fluid flow and the concepts of drag and lift.
8. demonstrate basic understanding of gravity waves and calculate wave parameters from given data.
9. demonstrate understanding of the fundamental concepts in computational fluid dynamics.

Text Books:

- Yunus A. Cenegel, John M. Cimbala; Fluid Mechanics- Fundamentals and Applications (in SI Units); McGraw Hill.
- Bansal R.K, Fluid Mechanics and Hydraulic Machines (SI Units); Laxmi Publications.

Reference Books:

- Pijush K. Kundu, Ira M. Cohen – Fluid Mechanics; Elsevier.
- S K Som, C Biswas; Indtroduction to Fluid Mechanics and Fluid Machines; Tata McGraw Hill.
- Frank M. White; Fluid Mechanics; Tata McGraw Hill.
- Kothandaraman C.P, Rudramoorthy R., Fluid Mehanics & Machinery; New Age Publishers.

Course Plan

Module	Content	Hours	Sem. Exam Marks
I	**Basics:** Fluids, *Application areas of Fluid Mechanics*, No-Slip condition, Brief History, Classification of Fluid Flows-Viscid, Inviscid; Internal, External; Compressible, Incompressible; Laminar, Turbulent; Natural, Forced; Steady, Unsteady; 1,2 & 3-D Flows; System & Control Volume.	3	15%

	Properties of Fluids: Property- Intensive & extensive properties; Principle of Continuum; Density & Specific gravity; Viscosity-Dynamic Viscosity, Newtonian & Non Newtonian Fluids, Viscosity & Momentum Transfer, Effect of Temperature on Viscosity, Significance of Kinematic Viscosity; Surface Tension; Compressibility & Bulk Modulus; Vapour Pressure-partial pressure, Cavitation.	3	
II	**Fluid Pressure:** Pressure at a point, Pascal's Law, Pressure Variation in a fluid at rest, Absolute, Gauge, Atmospheric and Vacuum Pressures.	1	15%
	Pressure Measurement (Theory Only)**:** *Manometers – Piezometer, U-Tube Manometer, Single Column Manometer; Differential Manometers- U-Tube Differential Manometer, Inverted U Tube Differential Manometer.*	1	
	Hydrostatic Forces on Surfaces: Total Pressure and Centre of Pressure; Vertical Plane Surface Submerged in Liquid; Horizontal Plane Surface Submerged in Liquid; Inclined Plane Surface Submerged in Liquid; Curved Surface Submerged in Liquid.	3	
	Buoyancy and Floatation: Buoyancy, Centre of Buoyancy; Metacentre-Metacentric Height, Analytical Method for Metacentric Height; Conditions of Equilibrium of Floating and Submerged Bodies- Stability of a Submerged Body, Stability of a Floating Body; Experimental Method for Determination of Metacentric Height; Oscillation of a Floating Body.	5	
FIRST INTERNAL EXAM			
III	**Fluid Kinematics:** Introduction; Lagrangian & Eulerian Method of Describing Fluid Motion; Rate of Flow; Continuity Equation in 1-D-Simple Numericals; Continuity Equation in 3-D; Velocity & Acceleration- Local Acceleration and Convective Acceleration	2	15%
	Velocity Potential Function and Stream Function; Equipotential Line; Line of Constant Stream Function; Flow Net; Relation Between Stream Function and Velocity Potential Function.	2	
	Types of Fluid Motion-Linear Translation, Linear Deformation, Angular Deformation, Pure Rotation; Vorticity; Vortex Flow- Forced Vortex Flow, Free Vortex Flow, Equation of motion for Vortex Flow, Equation of Forced Vortex Flow- Numerical Problems, Equation of Free Vortex Flow.	3	
	Flow Visualization: Streamlines & Streamtubes; Pathlines; Streaklines; Timelines; Refractive Flow Visualization Techniques; Surface Flow Visualization Techniques.	1	
IV	**Fluid Dynamics:** Introduction; Equations of Motion; Euler's Equation of Motion; Bernoulli's Equation from Euler's Equation, Assumptions made in the derivation of Bernoulli's Equation –Numerical Problems; Bernoulli's Equation for Real Fluid- Numerical Problems; The Momentum Equation, Moment of Momentum Equation – Numerical	7	15%

	Problems.		
SECOND INTERNAL EXAM			
V	**Viscous Incompressible Flows:** Introduction; Reynolds's Number; General Viscosity Law & Assumptions; Navier Stokes Equations; Flow of Viscous Fluid Through Circular Pipe – Numerical Problems; Flow of Viscous Fluid Between Two Parallel Plates- Numerical Problems; Loss of Head Due to Friction in Viscous Flow.	5	20%
	Turbulent Flow Through Pipes: Introduction; Reynold's Experiment; Frictional Loss in Pipe Flow; Hydrodynamically Smooth & Rough Boundaries; Resistance of Smooth & Rough Pipes; Loss of Energy in Pipes; Loss of Energy Due to Friction- Numerical Problems; Minor Energy Losses- Theory Only.	3	
	External Flow: Boundary Layer Flow –Laminar Boundary Layer, Turbulent Boundary Layer, Laminar Sub Layer, Boundary Layer Thickness; Separation of Boundary Layer; Force Exerted by a Flowing Fluid on a Stationary Body; Expression for Drag & Lift- Numerical Problems; Drag on a Sphere; Drag on a Cylinder; Development of Lift on a Circular Cylinder – Flow Pattern around cylinder when constant circulation is imparted to the cylinder, Flow over Cylinder due to constant circulation, Lift force acting on rotating Cylinder, Drag force acting on rotating cylinder, Expression for lift coefficients of rotating cylinder, Location of stagnation points in uniform flow field; Development of Lift on an Airfoil.	6	
VI	**Gravity Waves:** The wave Equation; Wave Parameters; Surface Gravity Waves; Features of Surface Gravity Waves- Pressure change due to wave motion, Particle path and streamline, Energy Considerations; Approximations for Deep and Shallow water.	9	20%
	Introduction to Computational Fluid Dynamics: Introduction and Fundamentals; Solution Procedure.	2	
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

PART A

- Answer all 8 questions of 3 marks each.
- 1 question each from modules I to IV and 2 questions each from modules V & VI.

PART B

- Answer any 2 full questions out of 3 for each module.
- Each question from module I to IV carries 6 marks.
- Each question from module V & VI carries 7 marks.
- Each full question can have maximum of 4 sub questions, if needed.

Course code	Course Name	L-T-P-Credits	Year of Introduction
SB204	STABILITY OF SHIPS AND SUBMARINES	3-1-0-4	2016

Prerequisites: -Nil

Course Objectives:

1. To impart the basic principles and conditions of stability of ships.
2. To familiarise solving of Naval Architectural stability problems.
3. To familiarise stability considerations of submerged bodies.

Syllabus:

Introduction to Stability of Ships; Initial Stability- Transverse Stability; Longitudinal Stability; Stability at Large Angles; Dynamical Stability, Inclining Experiment, Cross Curves of Stability; Damaged Stability and Calculation by Lost Buoyancy and Added Weight Methods; Recommendations of Classification Societies and Government Authorities; Stability of Submarines.

Expected Outcome:

On successful completion of the course, the student will be able to:

1. Understand the equilibrium conditions of stability of ships.
2. Solve ship stability problems using numerical integrations methods.
3. Read and understand ship stability booklet meeting IMO Stability criteria.
4. Understand the purpose and procedure of inclining experiment.
5. Provide subdivision and solve trim calculations.
6. Understand the stability problem of submarines.

Text Books:

- Rawson and Tupper; Basic Ship Theory; Butterworth-Heinemann.
- D.R. Derret; Ship Stability for Masters and Mates 5E; Butterworth-Heinemann.

Reference Books:

- Eric Tupper, Introduction to Naval Architecture.
- Lewis, E.U.; Principles of Naval Architecture, SNAME, New Jersey, U.S.A.
- D. Vassalos et al 2000; Contemporary Ideas on Ship Stability; Elsevier Science Ltd.
- A.B. Biran; Ship Hydrostatics and Stability; Butterworth-Heinemann.
- Colin S. Moore; Edited by J. Randolph Paulling (2010); Principles of Naval Architecture Series: Intact Stability, The Society of Naval Architects and Marine Engineers.
- H. Schneekluth and V. Bertram; Ship Design for Efficiency and Economy.

Course Plan

Module	Content	Hours	Sem. Exam Marks
I	**Introduction to Stability of Ships-** Potential Energy and Equilibrium.	1	15%
	Equilibrium Conditions- Stable Unstable, Neutral Conditions; Stability Terms.	2	
	Equivolume Inclinations- Shift of C.O.B. due to Inclinations, C.O.B Curve, Metacentre, Pro-Metacentre and Metacentric Radius, Metacentric Height, Metacentric Curve, Surface of Floatation, Curve	4	

	of Floatation, Righting Moment and Righting Lever.		
	Heeling Moments due to Wind, Shift of Cargo, Passengers, Turning and Non-Symmetrical Accumulation of Ice.	3	
	Effect of Superstructure on Stability.	1	
II	**Transverse Stability**- Introduction.	1	15%
	Initial Stability– GM_0, GZ at Small Angles of Inclinations, Angle of Loll, Wall Sided Ships; Stability due to Addition, Removal and Transfer (Horizontal, Lateral and Vertical) of Weight, Suspended Weight and Free Surface of Liquids; Stability while Docking and Grounding; Inclining Experiment.	5	
	Large Angle Stability- Diagram of Statistical Stability (GZ-Curve), Characteristics of GZ-Curve; Methods for Calculating the GZ-Curve (Krylov, Prohaska, Etc.); Cross Curves of Stability.	4	
	Dynamical Stability– Definition, Dynamical Stability Criteria.	2	
FIRST INTERNAL EXAM			
III	**Longitudinal Stability**– Trim, Longitudinal Metacentre, Longitudinal Centre of Flotation, Moment to Change Trim, Trimming Moment; Trim Calculations– Addition, Removal and Transfer of Weight.	9	15%
IV	**Damage Stability** – Calculations by Lost Buoyancy and Added Weight Methods; Deterministic and Probabilistic Approach, Stability in Waves.	8	15%
SECOND INTERNAL EXAM			
V	**Recommendations of Classification Societies and Governmental Authorities**– Intact and Damage Stability Criteria.	8	20%
VI	**Stability of Submarine**s- Items of Weight & its Relations, Equilibrium Conditions, Equilibrium Polygon, Stability in Depth.	8	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum marks : 100 Time : 3 hours

PART A

- Answer all 8 questions of 3 marks each.
- 1 question each from modules I to IV and 2 questions each from modules V & VI.

PART B

- Answer any 2 full questions out of 3 for each module.
- Each question from module I to IV carries 6 marks.
- Each question from module V & VI carries 7 marks.
- Each full question can have maximum of 4 sub questions, if needed.

Course No:	Course Name:	L-T-P-Credits	Year of Introduction
SB205	INTRODUCTION TO NAVAL ARCHITECTURE AND SHIP BUILDING	3-1-0-4	2016

Prerequisites: -Nil

Course Objectives:

- To impart the basic concepts of Naval Architecture and Shipbuilding.
- To develop understanding on basic terms and fundamental definitions and laws used in Naval Architecture.

Syllabus:

Historical Review, Ship Geometry, Terms and Definitions, Role of Naval Architect in Maritime Industry; Classification of Ships; Physical Fundamentals, Ships Form, Forces Acting on a Ship; Introduction to Ship Structural Members, Shipbuilding Materials, Ship Structural Components; Propulsion Machinery, General Arrangement of Propulsion Plants, Main Engines, Auxiliary Machinery; Outfitting, Bridge.

Expected Outcome:

On successful completion of the course, students will be able to:

i. Understand fundamentals of Naval Architecture.
ii. Acquire knowledge on various types of ships.
iii. Identify various types of materials used for construction of maritime structures and to identify various major and minor structural components of a ship.
iv. Understand general arrangement of propulsion plant, and various auxiliary machinery required for efficient operation of a ship.
v. Understand various machineries / equipments required for anchoring, mooring and towing operations.

Text Books:

- Tupper, E.C.; Introduction to Naval Architecture; Butterworth-Heinemann, UK.
- D.A Taylor; Introduction to Marine Engineering.

Reference Books:

- Rawson & Tupper; Basic Ship Theory, Vol. I & II
- Lewis, E.U.; Principles of Naval Architecture; SNAME, New Jersey, U.S.A.
- Taylor, D.A.; Merchant Ship Construction; Butterworths, London.
- Taggart; Ship Design and Construction; SNAME.
- D.J Eyres; Ship Construction.
- Klaas van Dokkum; Ship Knowledge - A modern encyclopedia; DOKMAR.

Course Plan:

Module	Content	Hours	Sem. Exam Marks
I	**Historical Review** - Ancient Types of Vessels (rafts, boats, and ships), The role of Ships in the Ages of the Great Discoveries.	5	15%
	Ship Geometry - Terms and Definitions.	2	
	Role of a Naval Architect in the Maritime Industry.	2	

II	**Types of Ships** – Classification.	2	15%
	Cargo Ships- General Cargo Ships, Bulk Carriers, Container Ships, Ro-Ro Ships, Barge Carriers, Tankers.	2	
	Other Ships- Fishing Vessels, Factory Ships, Supply Ships, Cable Ships, Ice Breakers, Research Vessels, and Warships.	3	
	High Speed Crafts- Hydrofoils, Air Cushion Vehicles etc; Small Pleasure Crafts- Yachts, Ketches, etc.	3	
FIRST INTERNAL EXAM			
III	**Physical Fundamentals**- Archimedes Principle, Laws of Floatation, Stability, Six Degrees of Freedom.	3	15%
	Forces Acting on a Ship- Static Condition in Waves and During Docking & Launching.	2	
	The Ship's Form - Main Dimensions, Lines Plan, Coefficients and their Meanings.	2	
IV	**Introduction to Ship Structural Members.**	4	15%
	Shipbuilding Materials- Properties, Compositions.	4	
	Structural Components - Bottom Structure, Shell Plating and Framing, Decks, Hatches and Hatch Covers, Superstructures, Bulkheads, Tanks, Holds, Fore and Aft Structure, Stern and Rudder.	4	
SECOND INTERNAL EXAM			
V	**Propulsion Machinery** - Development of Ship Propulsion, General Arrangement of Propulsion Plants.	3	20%
	Main Engines- Diesel Engines, Steam Engines & Turbines, Gas Turbines, Diesel-Electric Drive, Nuclear Power Plants.	3	
	Auxiliary Machinery- Power Supply, Auxiliary Engines for Ship Systems Operation, Auxiliary Engines for Engine Plant Operation, Steering Gear.	3	
VI	**Outfitting** - Anchor, Mooring and Towing Equipment, Cargo Handling Equipment, Rigging, Life-Saving Appliances and Fire Fighting Equipment, Heating, Ventilation and Air-Conditioning, Refrigeration Plants, Painting, Accommodation.	5	20%
	Bridge - The Control Centre of the Ship- Bridge Arrangement and Layout, Wheel House, Navigation and Communication Equipments, Methods of Navigation, Navigational Lights.	4	
END SEMESTER EXAM			

QUESTION PAPER PATTERN: Maximum marks :100 Time : 3 hours

PART A

- Answer all 8 questions of 3 marks each.
- 1 question each from modules I to IV and 2 questions each from modules V & VI.

PART B

- Answer any 2 full questions out of 3 for each module.
- Each question from module I to IV carries 6 marks.
- Each question from module V & VI carries 7 marks.
- Each full question can have maximum of 4 sub questions, if needed.

Course No:	Course Name:	L-T-P-Credits	Year of Introduction
SB206	ANALYSIS OF STRUCTURES	2-1-0-3	2016

Prerequisites: -Nil

Course Objectives:

1. To familiarize and review the basic concepts of structural analysis with emphasis on analysis of elementary structures.
2. To equip the students with the force and displacement methods of structural analysis of beams and frames
3. To learn, understand and develop concepts regarding the comprehensive strain energy methods of structural analysis.
4. To impart a scientific approach and to familiarize the applications of plate structures in the field of ship technology.
5. To enable the students to have a comprehensive idea of matrix structural analysis with emphasis on the relative advantages of the flexibility method and the stiffness method.
6. To enable the students to visualize structural dynamics problems with a proper blend of structural analysis and vibration theory.

Syllabus:

Introduction to Structural Analysis -Determinate & Indeterminate Structures-Force Displacement Methods-Three Moment Equation-Moment Distribution Method- Strain Energy Method-Principle of Virtual Work- Castigliano's Theorem- Vibrations of Continuous Systems, Introduction to Plastic Theory, Matrix Methods of Analysis-Stiffness Method, Flexiblity Method, Transformation Matrices-Introduction to theory of plates- Pure Bending, Small Deflection.

Expected Outcome:

Upon successful completion of the course, the student will be able to:

1. Demonstrate understanding of the basic concepts in structural analysis.
2. Solve simple structural analysis problems using the force/displacement method, moment distribution method & strain energy method.
3. Demonstrate an understanding of the theory of plates and be able to solve simple problems pertaining to analysis of laterally loaded plates and stiffened plates.
4. Solve simple structural analysis problems using the matrix methods.
5. Demonstrate basic understanding of the theory or vibration.

Text Books:

- Alan Williams; Structural Analysis –in theory and practice; International Code Council Inc.
- C. S. Reddy; Basic Structural Analysis; Tata McGraw-Hill.

Reference Books:

- Timoshenko, Theory of plates and shells, Tata Mcgraw Hill.
- V. P. Singh, Theory of vibrations, Dhanpat Rai and Co (P) Ltd.

Course Plan			
Module	**Content**	**Hours**	**Sem. Exam Marks**
I	**Introduction to Structural Analysis**: Concept of Determinate & Indeterminate Structures; Continuous Beams; Force/Displacement Method of Analysis; Clapeyron's Theorem of Three Moments; Support Settlement;	8	15%
II	**Moment Distribution Method:** Beams and Rigid Jointed Plane Frames (with and without sway); Effect of Support Settlement;	7	15%
FIRST INTERNAL EXAM			
III	**Strain Energy Methods:** Principle of Virtual Work; Strain Energy & Complementary Energy; Castigliano's Theorems.	6	15%
IV	**Vibrations of Continuous Systems**: Vibration of Strings and Rods; Vibration of Beams; Vibration of Shafts. **Introduction to Theory of Plasticity.**	6	15%
SECOND INTERNAL EXAM			
V	**Matrix Methods:** Stiffness Method (Continuous Beams; Rigid Jointed Frames); Flexibility Method (Continuous Beams; Rigid Jointed Frames); Transformation Matrices and its Applications.	9	20%
VI	**Introduction to Theory of Plates:** Pure Bending of Plates; Small Deflection Analysis of Laterally Loaded Plates; Boundary Conditions; Navier's Solution; Levy's Solution; Introduction to Stiffened Plates and Orthotropic Plate Model	6	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum marks : 100 Time : 3 hours

PART A

- Answer all 8 questions of 3 marks each.
- 1 question each from modules I to IV and 2 questions each from modules V & VI.

PART B

- Answer any 2 full questions out of 3 for each module.
- Each question from module I to IV carries 6 marks.
- Each question from module V & VI carries 7 marks.
- Each full question can have maximum of 4 sub questions, if needed.

Course No:	Course Name:	L-T-P-Credits	Year of Introduction
SB207	BASIC SHIP THEORY	2-1-0-3	2016

Prerequisites: -Nil-

Course Objectives:

1. To impart basic knowledge on ship's geometry and lines plan.
2. To illustrate application of approximate integration methods to hull form calculations.
3. To impart the basic concepts of hydrostatics and fundamentals of stability.

Syllabus:

Representation of Ship's Hull Geometry– Offset Table, Lines Plan, Fairing; Approximate Integration Rules– Applications to Hull Form Calculations; Bonjean Calculations– Sectional Area Curves; Hydrostatic Calculations and Curves; Buoyancy and Weight; Watertight Subdivision of Ships – Causes of Damage and their Effects, Permeability, Floodable Length Curve.

Expected Outcome:

On successful completion of the course, the student will be able to:

1. Geometrically define the hull form and draw lines plan.
2. Apply the procedures of numerical integration and calculate hydrostatic properties.
3. Understand and plot sectional area curves, bonjean curves, and hydrostatic curves.
4. Understand the concept of weight and buoyancy of a ship.
5. Understand the concept of subdivision and floodable length curves.

Text Book:

- Rawson and Tupper; Basic Ship Theory.
- Eric Tupper; Introduction to Naval Architecture.

Reference Books:

- Edward V. Lewis; Principles of Naval Architecture, Vol 1.
- Adrian B. Biran; Ship Hydrostatics and Stability.
- Capt D.C. Derret; Ship Stability for Masters and Mates.

Course Plan:

Module	Content	Hours	Sem. Exam Marks
I	**Representation of Ship's Hull Geometry**– Introduction.	2	15%
	Lines Plan- Profile, Body Plan, Half Breadth Plan and Diagonal Plan.	3	
	Table of Offsets- Fairing Process.	2	
II	**Integration Rules**– Calculation of Areas, Volumes and Moments.	2	15%
	Trapezoidal Rule.	1	
	Simpson's Rules- 1-4-1, 1-3-3-1, 5, 8,-1 and 3, 10,-1 Rule.	3	
	Tchebycheff's Rule.	1	
FIRST INTERNAL EXAM			
III	**Bonjean Area and Moments.**	3	15%
	Sectional Area Curves– Calculation and Drawing.	2	

	Bonjean Curves– Calculation and Drawing.	2	
IV	**Hydrostatics**– Definition and Relevance.	1	15%
	Definition of Properties– Volume of Displacement/ Displacement, Centre of Buoyancy, Centre of Floatation, KM_T And BM_T Metacentric Radius, TPC 1cm, MCT 1cm, Form Coefficients (C_B, C_P, C_M And C_W), LCF.	3	
	Hydrostatic Calculations.	3	
	Hydrostatic Curves.		
SECOND INTERNAL EXAM			
V	**Buoyancy and Weight of Ship**– Definitions, Components of Weight.	2	20%
	Centre of Gravity and Centre of Buoyancy.	1	
	Archimedes Principle and Laws of Floatation, Equilibrium Conditions.	2	
	Effect of Change of Water Density, Fresh Water Allowance.	2	
VI	Causes and Effects of Damage of Ships.	1	20%
	Watertight Subdivisions– Need and Types.	1	
	Concept of Bulkhead Deck, Margin Line and Permeability.	1	
	Factor of Subdivision, Compartment Standard, Criterion Numeral.	2	
	Floodable Length– Concept, Curves.	2	
END SEMESTER EXAM			

QUESTION PAPER PATTERN:
Maximum marks : 100 Time : 3 hours

PART A

- Answer all 8 questions of 3 marks each.
- 1 question each from modules I to IV and 2 questions each from modules V & VI.

PART B

- Answer any 2 full questions out of 3 for each module.
- Each question from module I to IV carries 6 marks.
- Each question from module V & VI carries 7 marks.
- Each full question can have maximum of 4 sub questions, if needed.

Course code	Course Name	L-T-P-Credits	Year of Introduction
SB231	MECHANICS OF FLUIDS LAB	0-0-3-1	2016

Prerequisite : SB203 Mechanics of fluids

Course Objectives:

1. Introduce major instruments commonly used in the domain of fluid mechanics.
2. Familiarization with setting up of experiments in a laboratory environment.
3. Provide an environment to enable correlation of theoretical knowledge gained in the class room with the physical world.

List of Exercises/ Experiments (Minimum 10 are mandatory)

1. Study of Various Pressure, Velocity and Flow Measuring Instruments.
   Equipment: Pressure/ Vacuum Gauge, U Tube Manometer, Pitot Tube, Flow Meter etc.

2. Pressure Measurements using a U-Tube Manometer.
   Equipment: U Tube Manometer.

3. Determination of Metacentric Height and Radius of Gyration of Floating Bodies.
   Equipment: Flat Bottom Pontoon, Water Tank.

4. Experimental Verification of Bernoulli's Theorem.
   Equipment: Bernoulli Apparatus.

5. Determination of Darcy's Constant and Chezy's Constant for Pipe Flow.
   Equipment: Experiment set up with pipes of various diameters fitted with flow control valves, Tank, U Tube Manometer.

6. Determination of Critical Velocity in Pipe Flow.
   Equipment: Reynold's Apparatus.

7. Determination of Minor Losses in Pipe Flow.
   Equipment: Hydraulic Bench, Pipe Bends & Fittings Apparatus.

8. Determination of Type of Flow using Reynolds Number.
   Equipment: Reynold's Apparatus.

9. Study of Laminar-Turbulent Transition for Flow in a Tube.
   Equipment: Reynold's Apparatus.

10. Determination of Coefficient of Discharge of V Notch.
    Equipment: Supply Tank, Collecting Tank, V Notch.

11. Determination of Coefficient of Discharge of Rectangular & Trapezoidal Notches.
    Equipment: Supply Tank, Collecting Tank, Rectangular Notch.

12. Determination of Coefficient of Discharge of Trapezoidal Notch.
    Equipment: Supply Tank, Collecting Tank, Trapezoidal Notch.

13. Determination of Hydraulic Coefficients of Orifices under Constant Head Method.

Equipment: Supply Tank, Collecting Tank, Orifices.

14. Determination of Hydraulic Coefficients of Mouthpieces under Constant Head Method.
    Equipment: Supply Tank, Collecting Tank, Mouthpieces.

15. Determination of Hydraulic Coefficients of Orifices under Time of Emptying Method.
    Equipment: Supply Tank, Collecting Tank, Orifices.

16. Determination of Hydraulic Coefficients of Mouthpieces under Time of Emptying Method.
    Equipment: Supply Tank, Collecting Tank, Mouthpieces.

17. Calibration of Venturimeter.
    Equipment: Venturimeter, U Tube Manometer, Supply Tank, Collecting Tank.

18. Calibration of Orificemeter.
    Equipment: Orificemeter, U Tube Manometer, Supply Tank, Collecting Tank.

19. Calibration of Watermeter.
    Equipment: Watermeter, Supply Tank, Collecting Tank.

20. Study and acquire a thorough knowledge of the various Pipe Fittings and Plumbing Tools.
    Equipment: Fittings like Reducers, Bends, Elbows, Y Connectors, Union, Coupling etc; Tools like Pipe Wrenches, Pipe Threaders, Pipe Bending Machine etc.

21. Study the use of different types of Valves.
    Equipment: Gate Valve, Butterfly Valve, Globe Valve, Relief Valve, Non-return valve etc.

22. Determination of Chezy's Constant and Manning's Number for Open Channel Flow.
    Equipment: Open channel of rectangular cross section with slope adjusting mechanism.

Note: Only major equipments are indicated.

Expected Outcome:

Upon successful completion of the course, the student will be:

i. Familiar with the arrangement and conduct of experiments in the fluid mechanics laboratory environment.
ii. Able to note down relevant readings and perform calculations while an experiment is in progress.
iii. Able to comprehend the factors responsible for variation between theoretical and experimental results pertaining to the domain of fluid mechanics.

Text Books:

- Yunus A. Cenegel, John M. Cimbala; Fluid Mechanics- Fundamentals and Applications (in SI Units); McGraw Hill.
- Bansal R.K, Fluid Mechanics and Hydraulic Machines (SI Units); Laxmi Publications.

Course code	Course Name	L-T-P-Credits	Year of Introduction
SB232	LINES PLAN & HYDROSTATICS LAB	0-0-3-1	2016

Prerequisite :

Course Objectives:

1. To provide practical experience on plotting Lines plan and fairing process using any ship design software.
2. To provide practical experience on computation of ship hydrostatic particulars.
3. To provide practical exposure on Intact and damage Stability computations.

List of Exercises/ Experiments (Minimum 10 Mandatory)

1. Study of Principal Parameters of the Hull form of a Ship.
2. Study of Various Approaches in Generating Lines Plan of Ships.
3. Modelling of Hull Surface from Offset Data.
4. Modelling of Hull Surface by Modifying General Hull Form from Software Database.
5. Modelling Hull Surface by Using Custom Definition of Boundary Curves & Sections.
6. Solid Modelling from Boundary Surfaces (e.g Ship Superstructure).
7. Solid Modelling by Revolving Closed Areas about an Axis (e.g Submarine Hull).
8. Boolean operations on Solids (e.g Bow Thruster Tunnel Modelling).
9. Modelling Tanks and Cargo Spaces.
10. Plotting Lines Plan of a Vessel from Given Offset Table.
11. Computation and Plotting of Bonjean and Sectional Area Curve.
12. Computation of Ship Hydrostatic Particulars.
13. Calculate Equilibrium Condition of a Given Ship at Given Loading Conditions.
14. Computation of Transverse Metacentric Height.
15. Computation of Stability at Small and Large Angles of Heel.
16. Computation of Static Stability and Cross Curves of Stability.
17. Dynamic Stability Computations.
18. Generate Stability Booklet Report for Given Ship Particulars and Conditions.
19. Carryout Floodable Length Calculations for a Ship at Given Loading Condition.
20. Damage Stability Computations at Given Condition.

Equipment: Any Ship Design & Analysis software eg. NAPA, PARAMARINE,GHS, FORAN, TRIBON etc.

Course Outcome:

Upon successful completion of the course, the student will be able to:

1. Generate lines plan for given offset table and perform fairing.
2. Generate report of hydrostatics particulars for given hull form data.
3. Compute and analyse initial and damage stability results for given conditions.

Text Books:

- Rawson and Tupper; Basic Ship Theory; Butterworth-Heinemann.
- D.R. Derret; Ship Stability for Masters and Mates 5E; Butterworth-Heinemann.
- Eric Tupper, Introduction to Naval Architecture.
- Lewis, E.U.; Principles of Naval Architecture, SNAME, New Jersey, U.S.A.