SCHEME OF INSTRUCTION & SCHEME OF EXAMINATIONS

M.Tech (MARINE ENGINEERING & MECHANICAL HANDLING)

Regular Course (Day Time)

I SEMESTER

Subject Code	Course	Periods L/T/Lab	Exam Hours	Sessional Marks	Exam Marks	Total	Credits
MEMH 1.1	Advanced Engineering Mathematics	4	3	30	70	100	4
MEMH 1.2	Principles of Material handling devices	4	3	30	70	100	4
MEMH 1.3	Advanced Solid Mechanics	4	3	30	70	100	4
MEMH 1.4	Marine Engineering-I	4	3	30	70	100	4
MEMH 1.5	Elective I • Theory of vibrations • wave engineering • Powering of Ships	4	3	30	70	100	4
MEMH 1.6	Elective II • Advanced FEA • Mechanics and Design of cargo handling equipment • Experimental Hydrodyanmics	4	3	30	70	100	4
MEMH 1.7	CASD Lab	3	3	50	50	100	2
MEMH 1.8	Seminars	3	Viva-Voce	100		100	2
	Total	30		330	470	800	28

II SEMESTER

Subject Code	Course	Periods L/T/Lab	Exam Hours	Sessional Marks	Exam Marks	Total	Credits
MEMH 2.1	Structural Design of Mechanical Handling equipment	4	3	30	70	100	4
MEMH 2.2	Marine Instrumentation & Stress Analysis	4	3	30	70	100	4
MEMH 2.3	Marine Engineering II	4	3	30	70	100	4
MEMH 2.4	Naval Architecture	4	3	30	70	100	4
MEMH 2.5	Elective - III • Industrial Engineering and Management • Subsea Piping	4	3	30	70	100	4
MEMH 2.7	CFD Lab	3	3	50	50	100	2
MEMH 2.8	Seminars	3	---	100		100	2
	Total	30		330	470	800	28

III SEMESTER

Code	Course Title	Scheme of Examination	Total Marks	Credits
MEMH 3.1	Dissertation (Preliminary)	Viva-Voce	100	12

IV SEMESTER

Code	Course Title	Scheme of Examination	Total Marks	Credits
MEMH 4.1	Dissertation (Final)	Viva-Voce	100	12

Grades for Dissertation (Preliminary and final) Viva Voce are A,B,C and F (A= excellent; B= Very good; C= Good F= not accepted.)

Dissertation Preview Viva-Voce Examination will be conducted with a committee consisting of Head of the Department, Chairman BOS and Guide.

Dissertation Final Viva-Voce Examination will be conducted with a committee consisting of Chairman, Board of Studies, Head of the Department, Internal Guide, External Guide (Approved by the University Administration).

SYLLABUS

M.Tech (MARINE ENGINEERING & MECHANICAL HANDLING)

I SEMESTER

MEMH 1.1 ADVANCED ENGINEERING MATHEMATICS

Periods per week: 4 Examination: 70 Marks

Credits: 4 Sessionals : 30 Marks

1. Matrices and linear systems of equations: Basic classification, solution of linear systems by Matrix inversion method, Gaussion elimination methods, iterative methods and the eigen value problem.
2. Numerical differentiation and integration: Numerical differentiation, Maximum and minimum values of a tabulated function. Numerical integration by Trapezoidal rule and Simpson rule, Romberg integration, Numerical double integration.
3. Numerical solution of ordinary differential equations: Solution by Taylor's series. Picard method of successive approximations, Euler's method. Runge-kutta methods. Predictor corrector methods, simultaneous and Higher-order equations, Boundary value problems.
4. Numerical solution of partial differential equations: Finite difference approximations to derivatives. Laplace equation by Jacobin's method, Gauss-Seidal method, parabolic equations. Interactive methods for the solution of equations.

Text books:

Chapters 4, 5, 6 and 7 of Introductory Methods-- Numerical Analysis by S.S.Sastry, Prentice Hall of India Pvt. Limited. Publication year 1981.

MEMH 1.2 PRINCIPLES OF MATERIAL HANDLING DEVICES

Periods per week: 4 Examination: 70 Marks

Credits: 4 Sessionals : 30 Marks

1. Principles of Material Handling: Classifications of the materials handling equipment, their characteristics and application, principles, packaging and storage of materials, operation analysis and study of travel diagrams and flow process charts. Preparation of a new proposal for an integrated materials handling system. Protective devices handling of fluids and multiphase systems. Handling of refrigerated cargo.
2. Theory and construction of the various parts of Mechanical Handling devices, wire ropes and chains, hooks, shackles, grabs, ladles and lifting electromagnets, sheaves, sprockets and drums, runners and rails, buffers and limit switches.
3. Design of simple mechanical handling devices, viz., screw jacks, pulley blocks, winches, hoists and capstans, wind lasses.

Text Books:

1. Materials Handling - John R. Immer and Mc Graw Hill, 1953.
2. Materials Handling Equipment - N. Rudenco, MIR Publish.
3. Materials Handling - Apple.

MEMH 1.3 ADVANCED MECHANICS OF SOLIDS

Periods per week: 4 Examination: 70 Marks

Credits: 4 Sessionals : 30 Marks

1. Three dimensional stress and strain - Principal stresses and strains-Mohr's circle representation of triaxial state of stresses and strains, theories of failure. Elementary treatment of contact stresses for point and line contacts
2. Shear Centre: Shear Centre for sections having one axis of symmetry - open channel sections, I-sections, t- sections.
3. Unsymmetrical bending: Unsymmetrical bending in sections having double axis of symmetry - Unsymmetrical bending in sections having one axis of symmetry.
4. Torsion: Torsional resistance of bars having rectangular sections - Membrane analogy.
5. Beams on elastic foundation: Beams on continuous elastic foundation, Infinite beams and semi-infinite beams.
6. Buckling of columns, beams and shafts.
7. Elementary treatment of flat plates: Rectangular and circular plates freely supported and clamped edges.
8. A brief introduction to the Mathematical theory of Elasticity: Introduction, Elementary theory of Elasticity, Essential Difference between method of ordinary Mechanics and theory of Elasticity.

Text books:

1. Advanced Mechanics of Materials by Seely and Smith.
2. Mechanics of Materials by R.C. Hibbeler
3. Advanced Strength of Materials by Den Hartog.
4. Strength of Materials Vols I and II by S. Timoshenko.

MEMH 1.4 MARINE ENGINEERING –I

Periods per week: 4 Examination: 70 Marks

Credits: 4 Sessionals : 30 Marks

1. Marine Diesel Engines – Low speed and medium speed engines – Auxiliary engines – Scavenging and supercharging systems – Starting and reversing gear – Maintenance – Automation – Hazards in engine room.
2. Marine Nuclear power installation - Principles of operation of Atomic Reactors – Different types of Reactors – Use of Nuclear reactors in sea going vessels - Radiation hazards and safety – Radioactive waste disposal.
3. Marine Turbines – Steam turbine Classification based on impulse and reaction principles – Flow thro' blade passages and design – Losses and performance – Compounding, velocity triangles – Starting and Maintenance procedures.
4. Marine gas turbines – Practical cycles and shaft arrangements - Power turbine – Applications.
5. Marine Refrigeration – Cycles – Compressors, Condensers, Evaporators and thermostatic valves – Space coolers – Maintenance and Auxiliary equipment.
6. Marine Air-conditioning – cooling, Heating, Humidication process – Types of Air conditioning systems – Ducting controls.
7. Ventilation – Requirements and provision – Insulation protection of materials and maintenance.
8. Marine Boilers – Composite and water tube boilers – Waste heat boilers Arrangement of boiler room – Feed water treatment for Marine boilers – feed supply systems and control.

Text Books:

1. Marine Power plant Engineering - Akimov.P
2. Marine I.C Engines-A.B Kane
3. Principles and practice of Marine Diesel Engines – D.K Sanyal
4. Refrigeration and air-conditioning- P.L. Ballaney
5. Marine Steam Boilers- Milton J.H.

MEMH 1.5 Elective - I

Theory of Vibrations

Periods per week: 4 Examination: 70 Marks

Credits: 4 Sessionals : 30 Marks

1. Single degree of freedom systems: Free and forced vibrations, damping, classification and damped systems. Energy methods. Vibration isolation and transmissibility. Vibration measuring instruments such as displacement, velocity, acceleration and frequency measurements, Dunkerley's equation.
2. Two degrees of freedom system. Free, forced, damped and undamped motions matrix formulation, matrix method, using of Lagrange's equations to determine equations of motion, Dynamic vibration absorbers, principle of Orthogonality. Semi-definite systems. Combined rectilinear and angular modes. Torsional systems.
3. Multi degrees of freedom systems: Free and forced vibrations of Longitudinal, torsional, and lateral modes. Critical speeds of rotors Matrix formulation, stiffness and flexibility influence coefficients. Eigen value problem Matrix method, Matrix iteraction technique for eigen values and eigen vectors. Stodola's method, Hozler's Method.
4. Continuous Systems: Axial vibrations of bars, torisonal vibrations of shafts, transverse vibrations of strings and bending vibrations of beams. Free and forced vibration of strings classical and energy methods.
5. Ship vibration : Introduction to ship hull vibration-- Mathematical basis of ship vibration - calculation of ship hull vibration.

Text books:

1. Ship Hull Vibrations: Todd
2. Mechanical vibrations, Schaum's outline series- William W. Seto
3. Mechanical Vibrations by S.S. Rao Mc-Graw Hill Publications

MEMH 1.5 Elective - I

Wave Engineering

1. Conservation of mass, moment and Energy. Euler Equation – Bernoullis Equation. Potential and Stream function.
2. Classification of Ocean Waves. Linear wave theory: Governing Equation, Boundary Conditions and solutions, Dispersion relation, Constancy of wave period.
3. Wave Kinematics : Wave celerity, water particle velocities, accelerations, displacements and pressures. Approximations for deep and shallow water conditions. Integral properties of waves: Mass flux, Energy and energy flux, Group speed, Momentum and momentum flux.
4. Wave Transformations: Shoaling, bottom friction and damping, refraction, reflection and diffraction. Wave Breaking: Type of breaking, Surf similarity parameter. Keulegan-Carpenter number, Ursell Parameter, Scattering parameter, Reynolds Number. Wave Loads: Non breaking wave forces on slender structures – Morison equation; Diffraction theory, source distribution method-Introduction to non-linear wave theories-Strokes, Cycloidal and Solitary wave theory.
5. Mass transport velocity.
6. Introduction to Random and directional waves.

Text Books:

Ippen, A.T., Estuary and Coastline Hydrodynamics, McGraw-Hill Book Company, inc., New York, 1978

Dean, R.G. and Dalrymple, R.A., Water wave mechanics for Engineers and Scientists, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1994

Sarpkaya, T. and Isaacson, M., Mechanics of Wave Forces on Offshore Structures, Van Nostrand Reinhold Co., New York, 1981

References:

Shore Protection Manual Volume I and II, Coastal Engineering Research Centre, Dept, of the Army, US Army Corps of Engineers, Washington DC, 1984

Weigel, R.L.Oceanographical Engineering, Prenticxe Hall Inc, 1982.

Sorenson, R.M., Basic Coastal Engineering, A Wiley-Interscience Publication, New York, 1978.

MEMH 1.6 Elective - II

Advanced Finite Element Analysis

1. Overview of finite element method, Discretization of the domain, Interpolation models, Higher order and isoparametric elements, Derivation of element matrices and vectors, Assembly of element matrices and vectors and derivation of system equations, Numerical solution of finite element equations, Analysis of trusses, beams, and frames
2. Analysis of plates and Shells
3. Three-dimensional problems
4. Vibration Analysis - Modal and Harmonic analysis
5. Fluid flow problems - Basic equations of fluid mechanics, Inviscid and incompressible flows

Textbooks

1. The Finite Element Method in Engineering - S S Rao, 4th Edition, Elsevier Publications
2. Finite Element Modeling for Stress Analysis - R D Cook - John Wiley

MEMH 1.6 Elective - II

MECHANICS AND DESIGN OF CARGO HANDLING EQUIPMENT

Periods per week: 4 Examination: 70 Marks

Credits: 4 Sessionals : 30 Marks

1. Kinematic, dynamic analysis and design procedures of various components, Mechanisms of (a) scraper, apron and flight conveyors, (b) roller and belt conveyors, (c) belt and chain bucket elevators (d) screw and ribbon conveyors (e) overhead chain trolley conveyors and (f) vibrating trough and shaker conveyors, rope ways.

2. Kinematic and dynamic analysis of the various components, mechanisms and design procedures of (a) floor and wall mounted jib cranes (b) hand chain and electric operated overhead travelling cranes (c) Stationery and travelling rotary jib cranes with fixed adjustable level luffing arrangements (d) Goliath and semi goliath cranes, (e) Derrick Cranes (f) tower cranes (g) mobile cranes (h) Telphers.

Text books:

1. Materials handling equipment - N. Rudenko, Mir publications.
2. Materials handling equipment- M.P. Alexandrov, Mir Publications.
3. Conveyors and related equipment - A Spirakovsky and V.Dyachkov, Mir Publications

MEMH 1.7 Computer Aided Ship Design Lab

Periods/week: 3 Ses : 50 Exam: 50

Examination Theory: 3hrs. Credits: 2

1. **Ship Structural Analysis using FEA Packages:** Modelling, Meshing and solving using FEM packages. Automatic mesh generation- presentation of results - 3-dimensional shape description and mesh generation- Application of FEA packages in the analysis of ship components.
2. **CASD (Computer Aided Ship Design)**
3. Exposure to CASD packages like Rhino, NAPA, TRIBON, Shipflow etc:
4. **Generation of ship hull parametric model using Modelling Softwares**

MEMH 1.8

Seminars

Each student has to present at least 4 seminars on a topic that is approved by the concerned teacher. The final seminar should be presented before a committee constituted by the Head of the Department

M.Tech.(MARINE ENGINEERING & MECHANICAL HANDLING)

II SEMESTER

MEMH 2.1 STRUCTURAL DESIGN OF MECHANICAL HANDLING EQUIPMENT

Periods per week: 4 Examination: 70 Marks

Credits: 4 Sessionals : 30 Marks

1. Analysis of forces of determinate, indeterminate and redundant framed structure
2. Detailed force analysis and design of overhead travelling crane structures.
3. Analysis of force and detailed design of the Jib of fixed and luffing types of rotary jib cranes.
4. Design of structures pertaining to derricks, gantries, columns, portals and supporting trusses for belt conveyers.

Text books:

1. Theory of structures - Morley, Lonmans.
2. Materials Handling Equipment - N. Rudenko

MEMH 2.2 MARINE INSTRUMENTATION & STRESS ANALYSIS

Periods per week: 4 Examination: 70 Marks

Credits: 4 Sessionals : 30 Marks

1. Generalized measuring systems – calibration – damping - Dynamic signals – Basic detectors Transducer elements – Intermediate modifying systems – terminating devices.
2. Measurement of force and torque, Measurement of pressure – High pressure and low pressure, Measurement of fuel flow – Positive displacement methods – Obstruction meters – Hotwire anemometer.
3. Measure of temperature – Thermocouples – Pyrometry, Vibration and shock measurement – Accelerometers – Vibrometers – Seismic devices. Acoustic measurements – Sound measuring techniques.
4. Stain gauges – Photo elastic, Electrical, resistance gauges, cements and cementing of Gauges – Bridge circuits – balanced and unbalanced, Calibration gauge rosettes – Evaluation of Principal stresses – Static and dynamic gauges for various applications.
5. Stress analysis – Whole field techniques by photo elasticity, brittle coatings, Grid methods & Moire – Applications to the solution of engineering problems.

Text Books:

1. Mechanical Measurements - T.G Beckwith & N.Lewis Buck.
2. Mechanical and industrial Measurements - R.K Jain.
3. Experimental methods for engineers. - J.P Holman
4. Applied Stress Analysis- A.J. Durelli.

MEMH 2.3 MARINE ENGINEERING II

Periods per week: 4 Examination: 70 Marks

Credits: 4 Sessionals : 30 Marks

1. Engine room arrangements for different power plants – Functions of Auxiliary equipment – Bilge and ballast systems – Other Auxiliaries.
2. Piping – Piping fittings and valves – Control valves, materials and corrosion in pipes – Colorcodes – Steam traps, Drains and glands.
3. Pumping systems. General principles - Simple and duplex pumps – Rotary positive displacement pumps –– Centrifugal pumps – Axial flow pumps - Bilge , ballast & sanitary pumps – Boiler feed pumps – air pumps and Ejectors.
4. Centrifugal compressors – Working principles – Impeller and diffuser design.- Performance characteristics – Blade profiles.
5. Airflow compressors –Working principles – Types – Performance characters – Aerofoil theory – Blade design.
6. Condensers, Evaporators, Deaerators and purifiers - Auxiliary condensers – Evaporating plant – Distillation plant – Feed heaters deaerators oil purifiers – Self-changing purifiers.
7. Steering gear- Types Steam steering gear, Telemotor gear, Hand steering gear, Hydraulic systems, Electro hydraulic steering gear – Electrical steering gear.

Text Books:

1. The running and maintenance of marine Machinery - J Cowley.
2. Marine Auxiliary machinery - W.J Fox.
3. Marine Auxiliary machinery and systems - M Khetaguroo
4. Theory and design of steam and gas turbines - Lee.

MEMH 2.4 NAVAL ARCHITECTURE

Periods per week: 4 Examination: 70 Marks

Credits: 4 Sessionals : 30 Marks

1. Introduction: Types of ships, Geometry 0f ship, Displacement, TPC, Coefficient of form, Wetted surface area.
2. Area Volume, First and second moments using Simpson's rule, Center of gravity, Effect of addition of mass, Effect of movement of mass, Effect of suspended mass.
3. Transverse Stability of ships: Statistical stability at small angles of heel, Calculation of B.M, metacentric diagram, Inclining experiment, free surface effect.
4. Trim: Change on draughts due to added masses, Change of mean draught and end draughts due to density, Change in mean draught and end draughts due to bilging.
5. Resistance: Frictional, residuary and total resistance, admiralty Coefficient, fuel Coefficient and Consumption.
6. Propellers: Apparent and real slip, Wake, Thrust, relation between mean pressure and speed, measurement of pitch, Cavitation, Solid propellers and other systems of propellers.
7. Rudder theory: Force on rudder, Torque on stock, angle of heel due to force on rudder, angle of heel on turning.
8. Launching: Launching curves, Ground ways and sliding ways, Dynamics of launching Docking stability – Launching lubricants and their properties.

Text Books:

1. Reed's Naval Architecture for Marine Engineering.
2. Naval Architecture for Marine Engineers by W.Muckle.
3. Basic ship theory by K.J Rawson & E.C Tupper.

MEMH 2.5 ELECTIVE - III

INDUSTRIAL ENGINEERING AND MANAGEMENT

Periods per week: 4 Examination: 70 Marks

Credits: 4 Sessionals : 30 Marks

1. Management and Organization: Functions of Management, Principles of Management, Principles of Organization: Line, Staff and functional organizations, Forms of business ownership, Entrepreneurship.
2. Facilities location and Layout: Factors for selection of a location, Urban, Suburban and rural locations, Types of layouts, process and product layouts, Line balancing, Shipyards and port layouts.
3. Material Handling: Principles of material handling, Types of material handling equipment, Selection of material handling equipment.
4. Inventory control: Costs of inventory, ABC Analysis, Economic order quantity, Economic lot-size quantity, Basic inventory models.
5. Quality Control: Quality and product design, Control charts.
6. Network analysis: Network techniques of program management, CPM and its advantages, Difference in PERT & CPM, steps in CPM technique, Steps in the technique of PERT planning, Estimation of activity duration. Float or slack, Latest finish time, resource leveling program, crash of the project.
7. Management information Systems (MIS): Impact of MIS on management, accounting information system, Objective of information systems, Computer based information management system, Management by direction, by result, management in objectives, Influence of computer based on management by direction.
8. Industrial Psychology and personnel management: Functions of functional management, Industrial legislation of India, Factories act and the industrial disputes act, Elements of industrial psychology, Hawthrone studies, Theories of motivation- Maslow, Mc Gregor.

Text Books:

1. Industrial engineering and management -O.P Khanna
2. Industrial Management - K.K.Ahuja, Khanna Publishers.

References:

1. Principles of Management - Koontz & O Donnel.
2. Production and Operations Management - Everette Adam &Ronald Ebert.
3. Operations Management - John Mc Clain & Joseph Thames.

MEMH 2.5 ELECTIVE - III

Subsea Piping

1. **Introduction:** Material properties ,pipe production, pipe fabrication, specifications, Mothods of increasing corrosion resistance, CR alloys and their manufacturing, Evaluating corrosion resistance and external protection, Welding of pipelines,welding sequence, Manual, semiautomatic and automatic welding
2. **Flexible and Composite Pipelines:** Introduction, Fabrication techniques, Internal and external corrosion, sour service, Failure modes of flexible pipes, Composite pipelines
3. **Internal Corrosion and its prevention:** Corrosion mechanisms, Sweet corrosion, Corrosion in oil pipeline and effect of flow, Solids in Oil Pipelines, Corrosion in Gas pipelines and effect of flow, Sour corrosion, Corrosion Inhibition.
4. **External Corrosion and pipeline hydraulics:** External corrosion and coatings, Cathodic protection, concrete weight coatings, thermal insulation, Single-phase flow Newtonion fluids, heat transfer and flow temperature, hydrates, multiphase flow
5. **Strength and stability:** Introduction, Design to resist Internal and external pressures, Longitudinal stress, Bending , Indentation, and Impact, Design currentsand waves, Hydrodynamic forces, laterl resistance, Stability design
6. **Marine pipeline construction and Shore approaches:** Lay-Barge construction, reel construction, pull and tow, trenching, costal Environment, site Investigation, horizontal drilling, Tunnels and tidal flat

Reference: Plamer, Andrew C.(Andrew Clennel),1938-Subsea Pipeline engineering, / Andrew C. Palmer and Roger A

MEMH 2.6 Elective IV

Introduction to Computational Fluid Dynamics

Periods per week: 4 Examination: 70 Marks

Credits: 4 Sessionals : 30 Marks

1. Introduction and Basic Numerical Methods:
2. Introduction to CFD, Approximation and interpolation, Numerical integration, Finite difference approximations of derivatives
3. The Finite Volume Method for Model Problems: 1-D diffusion, Thomas algorithm for tri-diagonal systems, 1-D convection-diffusion, 2-D model problems
4. Modelling Navier Stokes Equations: Governing equations for fluid mechanics, Staggered grids, Pressure-velocity coupling – the SIMPLE algorithm, Steady flows, Unsteady flows, Implementation of boundary conditions
5. Commercial CFD codes, Reynolds averaged Navier-Stokes (RANS) equations and turbulence modeling

Text Books:

1. Introduction to CFD the finite volume method by Malalasekera & Versfeeg

2. Computational FM and heat transfer by Anderson, Tennehill and Pletchen.

MEMH 2.6 ELECTIVE - IV

CONTROL ENGINEERING

Periods per week: 4 Examination: 70 Marks

Credits: 4 Sessionals : 30 Marks

1. Introduction, automatic control systems, on/off controllers, step controllers, continuous controllers, basic equation of a servo mechanism, transient analysis, transfer - function analysis, the laplace transformation.
2. Equations of physical systems: Introduction, mechanical system - translational, rotational, mechanical systems, thermal, hydraulic, pneumatic and electrical systems .
3. Transient analysis of servo mechanisms, block diagram concept of a control system, analysis of proportional error, servo mechanism time and frequency responses.
4. Transfer functions: Definition, deviation of transfer functions - algebra of block diagrams and transfer functions.
5. Graphical representation of transfer functions: The frequency response concept and transfer function, basic relationship between amplitudes and phase, logarithm of the transfer functions, bode diagrams, diagrams of the basic terms.
6. Analysis of servo mechanism performance, absolute stability, general discussion, instability from inspection of the differential equation, routh's criterion. Ny quists, criterion steady state and transient performance from transfer function plots.
7. Control system components: Error detectors, controllers, servo motors for DC, AC, Mechanical, hydraulic, pneumatic and thermal systems (one example each).

Text Books:

Thalore and Bronz, Analysis and design of feed back control systems - International students edition (chapters 1, 2, 4, 5, 6, 7) and appendix B.C.D)

MEMH 2.7 CFD Lab

Periods/week: 3 Ses : 50 Exam: 50

Examination Theory: 3hrs. Credits: 2

1. Exposure to CFD packages like Star-CCM+, Ansys
2. Geometry creation of simple 2-D and 3-D Objects
3. Mesh Generation
4. Boundary conditions
5. Solution for varying parameters like Reynolds Numbers, Froude Number etc
6. Application to Ship Drag calculation (pressure and Friction)
7. Presentation of results of ship drag compared with IITC values

MEMH 1.8

Seminars

Each student has to present at least 4 seminars on a topic that is approved by the concerned teacher. The final seminar should be presented before a committee constituted by the Head of the Department.