

# Gdynia Maritime University



FACULTY of  
MARINE ENGINEERING

ECTS Package  
2009/2010

## **FACULTY of MARINE ENGINEERING**

Branch of study: Mechanics and Mechanical Engineering

**B.Sc. Programme**

### **Specialization:**

- **Marine Power Plant Engineering and Ocean Construction (3)**
- **Marine Maintenance Engineering (11)**
- **Industrial Plant Engineering (18)**

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Branch of study: Mechanics and Mechanical Engineering

<b>PROGRAMME of STUDIES</b>		
B.Sc. Programme	Faculty of Marine Engineering	
	Specialization	<b>Marine Power Plant Engineering And Ocean Construction</b>

Unit responsible

1	Sports Department
2	Mathematics Department, Navigation Faculty
3	Physics Department, Marine Engineering Faculty
4	Marine Power Plant Department, Marine Engineering Faculty
5	Engineering Sciences Department, Marine Engineering Faculty
6	Marine Maintenance Department, Marine Engineering Faculty
7	Foreign Language Department
8	Ship Automation Department, Electrical Faculty
9	Marine Electrical Power Engineering Department, Electrical Faculty
10	Chemistry Department, Business Administration Faculty
11	Humanities Department, Business Administration Faculty

L – Lecture, T – Tutorial, Lab – Laboratory, P – Project, S - Seminar

Fall semester (I)

No.	Course title/description	No. of hrs. in semester	ECTS points	Unit resp.
1	<b>Labor Sociology</b> <i>Description:</i> The range of the sociology. Social processes. The sociology of the work.	30 L	2	11
2	<b>History of Technique</b> <i>Description:</i> Term of 'engineer'. Ancient inventions, machines, materials, energy sources. Development of military, transport and shipping engineering, Development of communication means, machine and ship propulsion. History of subjects for study course 'mechanical engineering'. Archimedes; Leonardo da Vinci; Albert Einstein and others.	30 L	1	5
3	<b>Occupational Safety and Ergonomics</b> <i>Description:</i> Aims, objectives and benefits of subject. Work stress - causes, preventative and protective measures. Physiological, psychological and mechanical	30 L	2	5

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	factors of hazards. Prevention against hazards. Definition and scope of ergonomics and systems of work. Human characteristics, capabilities and limitations.			
4	<b>Mathematics I</b> <i>Description:</i> Elements of the logic. Real numbers. Single variable function. Trigonometry. Algebra of vectors. Analytical geometry.	30 L 90 T	8	2
	<b>Physics I</b> <i>Description:</i> Kinematics and dynamics of rigid body. Gravity. Pressure. Gas propriety. Electric current. Electrical & magnetic fields. Induction.	30 L 45 T	7	3
5	<b>Material Science I</b> <i>Description:</i> Metals and alloys. Fundamentals of metal properties. Iron-carbon system. Basic of thermal treatment of metals. Characteristic properties of iron-based alloys with regard to chemical composition, manufacturing technology, structure and properties.	30 L	2	6
6	<b>Fundamentals of Manufacturing Engineering I</b> <i>Description:</i> Basic quantities. Founding. Plastic working. Uniting. Bases cutting.	30 L	2	6
7	<b>Fundamentals of Electrotechnics &amp; Electronics I</b> <i>Description:</i> Basic terms. Simple electrical circuit. Direct, alternating and three-phase current. Power. Since current circuits. Transformer. Electric machinery.	30 L 15 T	4	9
8	<b>Environmental Protection</b> <i>Description:</i> Sources and types of environment pollution. The basic concepts. International conventions (Kyoto, Basel, Rio de Janeiro, Helsinki). MARPOL Convention, HELCOM, DUMPING. Other environmental hazards.	30 L	2	6

Summer semester (II)

No.	Course title/description	No. of hrs. in semester	ECTS points	Unit resp.
1	<b>English:</b>	30 L	2	7
2	<b>Fundamentals of Informatics</b> <i>Description:</i> PC construction and operation, operating systems and languages, Bool algebra, basics in programming, computer graphics.	15 L 30 Lab	3	4
3	<b>Physical Education</b>	30 T	0,5	1
4	<b>Mathematics II</b> <i>Description:</i> 2-variable function. Single and double integral. Curvilinear integral. Indefinite integral. Definite integral. Triple integral.	30 L 30 T	4	2
	<b>Physics II</b> <i>Description:</i> Matter structure. Solid state physics. Physical phenomena research – physics laboratory.	15 L 30 T	3	3
	<b>Engineering mechanics I</b> <i>Description:</i> Fundamental force concepts and principles. Moments and couples. Equilibrium conditions. Free body diagrams. Friction. Center of gravity. Fundamental motion concepts and principles. Displacement, velocity, acceleration and their interrelationship.	30 L 15T	4	5
	<b>Engineering Graphics I</b> <i>Description:</i> Fundamentals of descriptive geometry and	30 L 30 P	4	5

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	projection drawing. Projection of geometrical solids. Cutting geometrical solids with planes. Intersections of geometrical solids. Principles for technical drawings and dimensioning. Views, sectional views and sections in machine drawings. Fundamentals of ship hull and installation drawings.			
5	<b>Material Science II</b> <i>Description:</i> Non ferrous metal alloys –copper, aluminium, titanium, nickel. Non metallic materials – plastics, wood products, glass and ceramic materials. Structure and properties. Macroscopic and microscopic studies.	15 L 30 Lab	3	6
6	<b>Fundamentals of Manufacturing Engineering II</b> <i>Description:</i> Cutting and grinding. Erosion machining.	15 L 15 Lab	2	6
7	<b>Fundamentals of Electrotechnics &amp; Electronics II</b> <i>Description:</i> Laboratory of Electrotechnics & Electronics.	30 Lab	2	9
8	<b>Marine practice I</b> <i>Description:</i> Marine practice on University training vessel: “Dar Młodzieży”	4-6 week	2,5	4

Fall semester (III)

1.	<b>English</b>	30 T	2,5	
2.	<b>Physical education</b>	15 T	0,5	1
3.	<b>Mathematics III</b> <i>Description:</i> Surface integral. Differential equation. Integral transformation.	30 L 30 T	3	
4.	<b>Physics III</b> <i>Description:</i> Physical phenomena research – physics laboratory.	15 Lab	1	3
5.	<b>Engineering mechanics II</b> <i>Description:</i> Newton's laws. D'Alembert's principle. Moment of inertia. Work, power and energy. Conservation of energy. Shocks.	30 L 30 T	4	5
6.	<b>Strength of Materials I</b> <i>Description:</i> Introduction. Hooke's law. Tension and compression. Geometrical characteristics of a section. Torsion. Bending. State of stress. Generalized Hooke's law. Combined stress – basic hypotheses.	30 L 15 T	3	5
7.	<b>Engineering Graphics II</b> <i>Description:</i> Views, sectional views and sections in machine drawings. Isometric and orthographic projections. Mechanical component drawings (fasteners, bearings and standard parts). System of dimension and geometrical tolerances. Surface quality marks. Detail and assembly drawings.	30 P	3	5
8.	<b>Fundamentals of Machine Elements Design &amp; CAD I</b> <i>Description:</i> Machine life cycle. Introduction to design. Conceptual design and innovation. Quantitative and systematic methods for design. Tolerances and fits. Friction and wear. Lubricants. Hydrodynamics of lubrication. Rolling contact bearings. Journal and thrust bearings. Screws, fasteners and connections, welding and other joints. Springs and flexible mechanical elements. Clutches, brakes and couplings. Fatigue.	30 L	2	5
9.	<b>Material Science III</b> <i>Description:</i> Practical presentation of research technology of metals and alloys by means of	15 Lab	1	6

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	macroscopic and microscopic studies and measurement of hardness.			
10.	<b>Fundamentals of Manufacturing Engineering III</b> <i>Description:</i> Basis of manufacturing engineering. Manual treatment with elements of repair. Electrical and gas welding. Automatic machines. Turning – basic information. External and internal turning. Electric Workshop. Dismantling, assembling and repair of electrical installations.	60 workshop	2	6
11.	<b>Thermodynamics I</b> <i>Description:</i> Thermodynamic properties. The laws of thermodynamics. The processes. Entropy. Ideal gas and steam equations. Thermodynamic cycles. Efficiencies of cycles. Heat transfer: heat conduction, forced and free convection, empirical relations, thermal radiation. Heat exchangers.	30 L 30 T	4	5
12.	<b>Fundamentals of Control Engineering &amp; Robotics</b> <i>Description:</i> Taxonomy of the control systems. Linearity and linearization. Laplace's transformation. Mathematical models of linear continuous control systems. Linear objects' response to typical inputs. Fundamental elements of control systems and their characteristics. Block diagrams. PID controllers. Stability and quality of control systems. Relay systems. Robotics – taxonomy, structures of manipulators, equations of movement.	30 L 30 Lab	4	5

Summer semester (IV)

1.	<b>English</b>	30 T	2,5	7
2.	<b>Physical education</b>	30 T	1	1
3.	<b>Strength of Materials II</b> <i>Description:</i> Frames. Elastic strain energy – Castigliano's and Menabrea's theorems. Rods of large curvature. Stability of the rods. Lamé's problem. Evaluation base characteristics of materials. Application of resistance strain gauges. Certification of wire ropes.	15 L 15 T 30 Lab	4	5
4.	<b>Fluid mechanics</b> <i>Description:</i> : Definition of fluid mechanic terms. Laws of fluid mechanics. Fluid statics. Kinematics of fluid. Conservation of mass. Fluid dynamics. Navier-Stokes equations. Euler's equation. Bernoulli equation. Conservation of energy. Laminar and turbulent flows. Incompressible viscous flow. Empirical relations. Compressible flow.	30 L 15 T	3	5
5.	<b>Engineering Graphics II</b> <i>Description:</i> Computer aided drafting - initiating the graphics package (setting the paper size, space; setting the limits, units; use of snap and grid commands). Drawing of primitives (line, arc, circle, ellipse, triangle etc.). Setting the layers and application of the layers. Dimensioning the drawing and adding text.	15 P	2	5
6.	<b>Fundamentals of Machine Elements Design &amp; CAD II</b> <i>Description:</i> Valves, pipes and expansion joints. Shafts and their balancing. Spur gear. Helical, bevel and worm gears. Friction, belt and chain drives. Lubrication of gears. Seals. Laboratory (threaded and welded joints, journal bearings, clutch, springs). Project (design of unit with power screw, design of clutch).	30 L 30 lab 15 P	4	5

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7.	<b>Thermodynamics II</b> <i>Description:</i> Fundamental measurements of thermodynamic, thermofluid and fluid flow variety properties (such as pressure, temperature, density, specific heat, viscosity, mass flow rate). Investigation of heat transfer and heat exchangers.	30 Lab	2	5
8.	<b>Metrology &amp; measurement systems</b> <i>Description:</i> Unit of quantity. Accuracy and errors of measurement. Hierarchy scheme of measuring instruments. Procedure of measurement. Least squares method. Ultrasonic, pneumatic measurement.	15 L 30 Lab	2	6
9.	<b>Marine Power Plants I</b> <i>Description:</i> Power plants – classification and characterization, efficiency. Construction, operating and maintenance of motor ship systems.	30 L	2	4
10.	<b>Marine Internal Combustion Engines* I</b> <i>Description:</i> Theory and general principles – theoretical heat cycle; working cycles; parameters – efficiency, mean indicated and effective pressure, power, torque, mean piston speed, speed, fuel consumption; fuels and lubes: chemistry and treatment; engine performances; scavenging and turbocharging; fuel injection and combustion; piston-connecting rod lever mechanics.	30 L	2	4
11.	<b>Marine Auxiliary Machines &amp; Equipment I</b> <i>Description:</i> Construction, operation and maintenance of marine pumps.	15 L	1	4
12.	<b>Marine Electrotechnics &amp; Electronics I</b> <i>Description:</i> Electric motors starting and restarting. Electric drives. Electric diagrams. Electric motor laboratory testing.	15 L 15 Lab	2	9
13.	<b>Marine practice II</b> <i>Description:</i> Marine practice on University training vessel: "Horyzont II".	4-6 week	2,5	4

Fall semester (V)

1.	<b>English</b>	45 T	3	7
2.	<b>Physical education</b>	30 Lab	1	1
3.	<b>Fundamentals of Machine Elements Design &amp; CAD III</b> <i>Description:</i> Computer-Aided Mechanical Design. 3D space geometry data structure. CAD system Configuration. Geometric Modeling. Modeling Techniques (surface modeling, 3D solid modeling). CAD techniques to finite element data preparation. Automatic mesh generation and presentation of results. Project (design of gear).	30 Lab 15 P	4	5
4.	<b>Fundamentals of Machine Operation &amp; Maintenance</b> <i>Description:</i> Structure of operation and maintenance system. Friction, lubrication, and wear. Reliability and durability. Machine diagnostic. Safety management and risk analysis. Computer aided management of machine operation and maintenance.	30 L	1	5
5.	<b>Naval Architecture &amp; Ship Construction</b> <i>Description:</i> Ship's hull geometry, lines plan and principal dimensions, IMO and classification societies, freeboard, floatation, stability at small angles and stability in damaged condition, free surface effects, dynamic stability. Ship types, loads acting on ship's structure, principal structural members and their construction,	15 L 15 T	2	5

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	propellers, class surveys and docking.			
6.	<b>Marine Power Plants II</b> <i>Description:</i> Power plant of steam ships – construction, operating and maintenance.	15 L 15 T	2	4
7.	<b>Marine Internal Combustion Engines II</b> <i>Description:</i> Construction – bedplate, columns, cylinder block, thrust bearing, cylinder liner, cylinder cover, piston, connecting rod, crankshaft, camshaft, crosshead, valve, turbocharger system, injection system, starting and reversing air system.	15 L 30 lab	3	4
8.	<b>Marine Boilers I</b> <i>Description:</i> Marine steam boilers – classification. Combustion. Heat transfer. Water natural and forced circulation. Construction and operating of main and auxiliary boilers.	30 L	2	4
9.	<b>Marine Turbines</b> <i>Description:</i> Basic of steam turbine theory, working principle, power, torque, efficiency, steam-condensate systems of turbine plant, characteristics, power adjustment, construction, operation and maintenance. Basic of gas turbine theory, working principle, construction and operation.	30 L 15 T 15 Lab	3	4
10.	<b>Marine Auxiliary Machines &amp; Equipment II</b> <i>Description:</i> Construction, operation and maintenance of marine compressors, blowers, fans, filters, centrifugal separators, heat exchangers and hydraulic machinery.	30 L 15 Lab	2	4
11.	<b>Marine Refrigeration &amp; Air Conditioning I</b> <i>Description:</i> Refrigerating cycles – thermodynamic basis, marine refrigerating plant and air conditioning equipment, cooling agents, calculations and maintenance – practical presentation.	15 L 15 Lab	2	4
12.	<b>Marine Control System I</b> <i>Description:</i> Binary control systems. Automation in classification rules. Dynamics of ship's movement system. Dynamics of thermal – flow systems. Rotary movement control of internal combustion engines. Automation of ship propulsion systems. Language of automation in the specification sheets. Exercise of ship control system operations - laboratory.	15 L 15 Lab	2	5
13.	<b>Marine propulsion Plant*</b> <i>Description:</i> Ship resistance. Engine characteristic curves. Fixed and controllable pitch propellers. Propulsion characteristics.	30 I	1,5	4
	<b>Machines of Offshore Drilling Units*</b> <i>Description:</i> Types of oil rigs, oil rigs and platforms power systems, machines of oil rigs and process platforms – boilers, compressors, fuel systems, diving equipment, stabilizing systems, fire fighting systems.			
14.	<b>Mar. Internal Combust. Engine-Operation &amp; Mainten.*</b> <i>Description:</i> Construction internal combustion engines, fuel, lubricating, cooling and starting systems, maintenance, timing, development trends.	30 L	1,5	4
	<b>Marine Turbines - Operation &amp; Maintenance*</b> <i>Description:</i> Operation and maintenance of marine turbine propulsion plants, inspections and overhauls, typical turbine failures, regulations of classification societies.			

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	<b>Offshore Drilling Unit Power Plants-Operat. &amp; Maintenance*</b> <i>Description:</i> Safety maintenance systems of oil rigs - fresh water, sea water, lubricating oil, fuel oil, steam and compressed air, operation and maintenance of diesel engines, fresh water generators, purifiers, filters and compressors.			
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\* - Subjects to choose by students

Summer semester (VI)

1	<b>Marine practice III</b>	Min 4 months	30	4
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Fall semester (VII)

1.	<b>English</b>	15 L	1	7
2.	<b>Repair Engineering</b> <i>Description:</i> Phase manufacturing process disassembly machine, cleaning machine, assembly machine method. Working tools, methods of procedure repair pipeline installation marine power plant, marine engine repair technology, base of metrology in workshop.	30 I 15 Lab 15 S	3	6
3.	<b>Marine Power Plants II</b> <i>Description:</i> Presentation and discussion of seminar-works executed during the marine practice.	8 S	0,5	4
4.	<b>Management of Ship Operation Safety</b> <i>Description:</i> Shipboard and safety familiarization. Safety information symbols, signs and alarm signals. Code of Safe Working Practices for Merchant Seamen. International Safety Management Code. Basic procedures concerning the safety of the ship and the prevention of pollution. International Ship and Port Facility Security Code.	7 S	0,5	5
5.	<b>Marine Internal Combustion Engines III</b> <i>Description:</i> Presentation and discussion of seminar-works executed during the marine practice.	8S	0,5	4
6.	<b>Marine Boilers II</b> <i>Description:</i> On schedule seamanship and training record book. Presentation and discussion of seminar-works executed during the marine practice.	8 S	0,5	4
7.	<b>Marine Auxiliary Machines &amp; Equipment III</b> <i>Description:</i> Construction, operation and maintenance of ship steering gears, controllable pitch propellers, stern tubes and deck machinery.	15 L 15 Lab 8 S	2,5	4
8.	<b>Marine Refrigeration &amp; Air Conditioning II</b> <i>Description:</i> Thermodynamic cycles calculation, equipment selection.	7 S	0,5	4
9.	<b>Marine Electrotechnics &amp; Electronics II</b> <i>Description:</i> Presentation and discussion of seminar-works executed during the marine practice.	7 S	0,5	9
10.	<b>Marine Control System II</b> <i>Description:</i> Presentation and discussion of the solutions and operation procedures of ship power plant control systems.	8 S	0,5	5

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11.	<b>Water, Fuel &amp; Lubricants</b> <i>Description:</i> Chemical components. Acidity. Reactions. Boiler malfunctions. Waste utilization. Liquid fuel. Grease oil – classification. Laboratory.	15 L 15 Lab	2	10
12.	<b>Engine Room Simulator</b> <i>Description:</i> Preparation for getting underway. Harbor maneuvering. Open sea steaming. Operation of auxiliary machinery. Finishing with the engine. Emergency operation.	30 Lab	1	4
13.	<b>Mar. Internal Combust. Engine-Operation &amp; Mainten.*</b> <i>Description:</i> Operation and maintenance of marine internal combustion engines.			
14.	<b>Marine Turbines - Operation &amp; Maintenance*</b> <i>Description:</i> Operation procedures of turbine propulsion plants: preparation for start, heating up, starting, running and stoppage and cooling down, repairing works, typical failures, regulations of classification societies.	15 L	1	4
15.	<b>Offshore Drilling Unit Power Plants-Operat. &amp; Maintenance*</b> <i>Description:</i> Operation and maintenance of oil rigs hydraulic systems, environment protection facilities and fire fighting facilities.			
16.	<b>Diploma Thesis Seminar</b>	30 S	1	4
17.	<b>Diploma Thesis Work</b>		15	4

\* - Subjects to choose by students

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	Specialization	<b>Marine Maintenance Engineering</b>

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L – Lecture, T – Tutorial, Lab – Laboratory, P – Project, S - Seminar

Fall semester (I)

No.	Course title/description	No. of hrs. in semester	ECTS points	Unit resp.
1	<b>Labor Sociology</b> <i>Description:</i> The range of the sociology. Social processes. The sociology of the work.	30 L	2	11
2	<b>History of Technique</b> <i>Description:</i> Term of 'engineer'. Ancient inventions, machines, materials, energy sources. Development of military, transport and shipping engineering, Development of communication means, machine and ship propulsion. History of subjects for study course 'mechanical engineering'. Archimedes; Leonardo da Vinci; Albert Einstein and others.	30 L	1	5
3	<b>Occupational Safety and Ergonomics</b> <i>Description:</i> Aims, objectives and benefits of subject. Work stress - causes, preventative and protective	30 L	2	5

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	measures. Physiological, psychological and mechanical factors of hazards. Prevention against hazards. Definition and scope of ergonomics and systems of work. Human characteristics, capabilities and limitations.			
4	<b>Mathematics I</b> <i>Description:</i> Elements of the logic. Real numbers. Single variable function. Trigonometry. Algebra of vectors. Analytical geometry.	30 L 90 T	8	2
	<b>Physics I</b> <i>Description:</i> Kinematics and dynamics of rigid body. Gravity. Pressure. Gas propriety. Electric current. Electrical & magnetic fields. Induction.	30 L 45 T	7	3
5	<b>Material Science I</b> <i>Description:</i> Metals and alloys. Fundamentals of metal properties. Iron-carbon system. Basic of thermal treatment of metals. Characteristic properties of iron-based alloys with regard to chemical composition, manufacturing technology, structure and properties.	30 L	2	6
6	<b>Fundamentals of Manufacturing Engineering I</b> <i>Description:</i> Basic quantities. Founding. Plastic working. Uniting. Bases cutting.	30 L	2	6
7	<b>Fundamentals of Electrotechnics &amp; Electronics I</b> <i>Description:</i> Basic terms. Simple electrical circuit. Direct, alternating and three-phase current. Power. Since current circuits. Transformer. Electric machinery.	30 L 15 T	4	9
8	<b>Environmental Protection</b> <i>Description:</i> Sources and types of environment pollution. The basic concepts. International conventions (Kyoto, Basel, Rio de Janeiro, Helsinki). MARPOL Convention, HELCOM, DUMPING. Other environmental hazards.	30 L	2	6

Summer semester (II)

No.	Course title/description	No. of hrs. in semester	ECTS points	Unit resp.
1	<b>English:</b>	30 L	4,5	7
2	<b>Fundamentals of Informatics</b> <i>Description:</i> PC construction and operation, operating systems and languages, Bool algebra, basics in programming, computer graphics.	15 L 30 Lab	3	4
3	<b>Physical Education</b>	30 T	0,5	1
4	<b>Mathematics II</b> <i>Description:</i> 2-variable function. Single and double integral. Curvilinear integral. Indefinite integral. Definite integral. Triple integral.	30 L 30 T	4	2
	<b>Physics II</b> <i>Description:</i> Matter structure. Solid state physics. Physical phenomena research – physics laboratory.	15 L 30 T	3	3
	<b>Engineering mechanics I</b> <i>Description:</i> Fundamental force concepts and principles. Moments and couples. Equilibrium conditions. Free body diagrams. Friction. Center of gravity. Fundamental motion concepts and principles. Displacement, velocity, acceleration and their interrelationship.	30 L 15T	4	5
	<b>Engineering Graphics I</b>	30 L	4	5

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	<i>Description:</i> Fundamentals of descriptive geometry and projection drawing. Projection of geometrical solids. Cutting geometrical solids with planes. Intersections of geometrical solids. Principles for technical drawings and dimensioning. Views, sectional views and sections in machine drawings. Fundamentals of ship hull and installation drawings.	30 P		
5	<b>Material Science II</b> <i>Description:</i> Non ferrous metal alloys –copper, aluminium, titanium, nickel. Non metallic materials – plastics, wood products, glass and ceramic materials. Structure and properties. Macroscopic and microscopic studies.	15 L 30 Lab	3	6
6	<b>Fundamentals of Manufacturing Engineering II</b> <i>Description:</i> Cutting and grinding. Erosion machining.	15 L 15 Lab	2	6
7	<b>Fundamentals of Electrotechnics &amp; Electronics II</b> <i>Description:</i> Laboratory of Electrotechnics & Electronics.	30 Lab	2	9

Fall semester (III)

13.	<b>English</b>	30 T	3	
14.	<b>Physical education</b>	15 T	0,5	1
15.	<b>Mathematics III</b> <i>Description:</i> Surface integral. Differential equation. Integral transformation.	30 L 30 T	3	
16.	<b>Physics III</b> <i>Description:</i> Physical phenomena research – physics laboratory.	15 Lab	1	3
17.	<b>Engineering mechanics II</b> <i>Description:</i> Newton's laws. D'Alembert's principle. Moment of inertia. Work, power and energy. Conservation of energy. Shocks.	30 L 30 T	4	5
18.	<b>Strength of Materials I</b> <i>Description:</i> Introduction. Hooke's law. Tension and compression. Geometrical characteristics of a section. Torsion. Bending. State of stress. Generalized Hooke's law. Combined stress – basic hypotheses.	30 L 15 T	3	5
19.	<b>Engineering Graphics II</b> <i>Description:</i> Views, sectional views and sections in machine drawings. Isometric and orthographic projections. Mechanical component drawings (fasteners, bearings and standard parts). System of dimension and geometrical tolerances. Surface quality marks. Detail and assembly drawings.	30 P	3	5
20.	<b>Fundamentals of Machine Elements Design &amp; CAD I</b> <i>Description:</i> Machine life cycle. Introduction to design. Conceptual design and innovation. Quantitative and systematic methods for design. Tolerances and fits. Friction and wear. Lubricants. Hydrodynamics of lubrication. Rolling contact bearings. Journal and thrust bearings. Screws, fasteners and connections, welding and other joints. Springs and flexible mechanical elements. Clutches, brakes and couplings. Fatigue.	30 L	2	5
21.	<b>Material Science III</b> <i>Description:</i> Practical presentation of research technology of metals and alloys by means of macroscopic and microscopic studies and measurement of hardness.	15 Lab	1	6

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22.	<b>Fundamentals of Manufacturing Engineering III</b> <i>Description:</i> Basis of manufacturing engineering Manual treatment with elements of repair. Electrical and gas welding. Automatic machines. Turning – basic information. External and internal turning. Electric Workshop. Dismantling, assembling and repair of electrical installations.	60 workshop	2	6
23.	<b>Thermodynamics I</b> <i>Description:</i> Thermodynamic properties. The laws of thermodynamics. The processes. Entropy. Ideal gas and steam equations. Thermodynamic cycles. Efficiencies of cycles. Heat transfer: heat conduction, forced and free convection, empirical relations, thermal radiation. Heat exchangers.	30 L 30 T	4	5
24.	<b>Fundamentals of Control Engineering &amp; Robotics</b> <i>Description:</i> Taxonomy of the control systems. Linearity and linearization. Laplace's transformation. Mathematical models of linear continuous control systems. Linear objects' response to typical inputs. Fundamental elements of control systems and their characteristics. Block diagrams. PID controllers. Stability and quality of control systems. Relay systems. Robotics – taxonomy, structures of manipulators, equations of movement.	30 L 30 Lab	4	5

Summer semester (IV)

14.	<b>English</b>	30 T	3	7
15.	<b>Physical education</b>	30 T	1	1
16.	<b>Strength of Materials II</b> <i>Description:</i> Frames. Elastic strain energy – Castigliano's and Menabrea's theorems. Rods of large curvature. Stability of the rods. Lamé's problem. Evaluation base characteristics of materials. Application of resistance strain gauges. Certification of wire ropes.	15 L 15 T 30 Lab	4	5
17.	<b>Fluid mechanics</b> <i>Description:</i> : Definition of fluid mechanic terms. Laws of fluid mechanics. Fluid statics. Kinematics of fluid. Conservation of mass. Fluid dynamics. Navier-Stokes equations. Euler's equation. Bernoulli equation. Conservation of energy. Laminar and turbulent flows. Incompressible viscous flow. Empirical relations. Compressible flow.	30 L 15 T	3	5
18.	<b>Engineering Graphics II</b> <i>Description:</i> Computer aided drafting - initiating the graphics package (setting the paper size, space; setting the limits, units; use of snap and grid commands). Drawing of primitives (line, arc, circle, ellipse, triangle etc.). Setting the layers and application of the layers. Dimensioning the drawing and adding text.	15 P	2	5
19.	<b>Fundamentals of Machine Elements Design &amp; CAD II</b> <i>Description:</i> Valves, pipes and expansion joints. Shafts and their balancing. Spur gear. Helical, bevel and worm gears. Friction, belt and chain drives. Lubrication of gears. Seals. Laboratory (threaded and welded joints, journal bearings, clutch, springs). Project (design of unit with power screw, design of clutch).	30 L 30 lab 15 P	4	5
20.	<b>Thermodynamics II</b> <i>Description:</i> Fundamental measurements of	30 Lab	2	5

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	thermodynamic, thermofluid and fluid flow variety properties (such as pressure, temperature, density, specific heat, viscosity, mass flow rate). Investigation of heat transfer and heat exchangers.			
21.	<b>Metrology &amp; Measurement Systems</b> <i>Description:</i> Unit of quantity. Accuracy and errors of measurement. Hierarchy scheme of measuring instruments. Procedure of measurement. Least squares method. Ultrasonic, pneumatic measurement.	15 L 30 Lab	2	6
22.	<b>Marine Power Plants I</b> <i>Description:</i> Power plants – classification and characterization, efficiency. Construction, operating and maintenance of motor ships systems.	30 L	2	4
23.	<b>Marine Internal Combustion Engines I</b> <i>Description:</i> Theory and general principles – theoretical heat cycle; practical cycle; working cycles; parameters – efficiency, mean indicated and effective pressure, power, torque, mean piston speed, speed, fuel consumption; fuels and lubes: chemistry and treatment; engine performances; scavenging and, turbocharging; fuel injection and combustion; piston-connecting rod lever mechanics.	30 L	2	4
24.	<b>Marine Auxiliary Machines &amp; Equipment I</b> <i>Description:</i> Construction, operation and maintenance of marine pumps.	15 L	1	4
25.	<b>Cargo Handling Equipment</b> <i>Description:</i> Construction, operation and maintenance of anchor and mooring winches, sliding ramps, davits, deck cranes, gantry cranes, harbour cargo handling equipment, container handling equipment.	30 L	3,5	4

Fall semester (V)

15.	<b>English</b>	30 T	3	7
16.	<b>Physical education</b>	30 Lab	1	1
17.	<b>Fundamentals of Machine Elements Design &amp; CAD III</b> <i>Description:</i> Computer-Aided Mechanical Design. 3D space geometry data structure. CAD system Configuration. Geometric Modeling. Modeling Techniques (surface modeling, 3D solid modeling). CAD techniques to finite element data preparation. Automatic mesh generation and presentation of results. Project (design of gear).	30 Lab 15 P	4	5
18.	<b>Fundamentals of Machine Operation &amp; Maintenance</b> <i>Description:</i> Structure of operation and maintenance system. Friction, lubrication, and wear. Reliability and durability. Machine diagnostic. Safety management and risk analysis. Computer aided management of machine operation and maintenance.	30 L	1	5
19.	<b>Naval Architecture &amp; Ship Construction</b> <i>Description:</i> Ship's hull geometry, lines plan and principal dimensions, IMO and classification societies, freeboard, floatation, stability at small angles and stability in damaged condition, free surface effects, dynamic stability. Ship types, loads acting on ship's structure, principal structural members and their construction, propellers, class surveys and docking.	15 L 15 T	2	5
20.	<b>Marine Power Plants II</b> <i>Description:</i> Power plant of steam ships – construction,	15 L 15 T	2	4

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	operating and maintenance.			
21.	<b>Marine Internal Combustion Engines II</b> <i>Description:</i> Construction – bedplate, columns, cylinder block, thrust bearing, cylinder liner, cylinder cover pisto, connecting rod crankshaft, camshaft, crosshead, valve, turbocharger system, injection system, starting and reversing air system.	15 L 30 lab	3	4
22.	<b>Marine Boilers I</b> <i>Description:</i> Marine steam boilers – classification. Combustion. Heat transfer. Water natural and forced circulation. Construction and operating of main and auxiliary boilers.	30 L	2	4
23.	<b>Marine Auxiliary Machines &amp; Equipment II</b> <i>Description:</i> Construction, operation and maintenance of marine compressors, blowers, fans, filters, centrifugal separators, heat exchangers and hydraulic machinery.	30 L 15 Lab	3	4
24.	<b>Marine Refrigeration &amp; Air Conditioning I</b> <i>Description:</i> Refrigerating cycles – thermodynamic basis, marine refrigerating plant and air conditioning equipment, cooling agents, calculations and maintenance – practical presentation.	15 L 15 Lab	2	4
25.	<b>Plastic Forming &amp; Machining</b> <i>Description:</i> Geometry of the active part of cutting tools. Geometric and kinematics quantities in machining. Forces, energy, power. Terminology for grinding processes using grinding wheels.	45 L 30 Lab	4	6
26.	<b>Welding</b> <i>Description:</i> Weldability. Classification of welding processes. Manuel metal arc welding, gas welding, metal inert gas welding, metal active gas welding, friction stir welding. Welding procedure. Inspection of welded joints.	30 L	3	6

Summer semester (VI)

1	<b>English</b>	15 T	1	7
	<b>Repair Engineering I</b> <i>Description:</i> Phase manufacturing process, Methods of beryfication parts of marine engine, Meteds of regeneration parts.	15 L 15 Lab	3	6
	<b>Workshop Metrology</b> <i>Description:</i> Approximation and estimation. Measurement of length and angle. Measurement of gears, screws, wedges, cones, roughness. Instruments of measurements.	15 L 15 Lab	3	6
	<b>Plastic Forming &amp; Machining</b> <i>Description:</i> Plastic working. Terminology. Principal terms. Forging. Rolling. Shearing. Deep drawing. Drawing.	30 L	3	6
	<b>Heat &amp; Surface processing of Materials</b> <i>Description:</i> Parameters of bulk and surface heat treatment technological process, thermochemical treatment, thermomechanical treatment.	15 L 15 Lab	3	6
	<b>Anticorrosive Engineering</b> <i>Description:</i> Electrochemical and high – temperature corrosion, corrosion inhibitors, temporary corrosion protection, electrochemical protection, protective paint, technologies of protective painting.	15 L 15 Lab	2	6
	<b>Industrial Practice</b> <i>Description:</i> Training at the selected industrial facilities.	4-6 weeks	15	6

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Fall semester (VII)

18.	<b>Repair Engineering</b> <i>Description:</i> Requirements of Classification Society for regeneration marine engine parts, marine engine repair technology, methods of procedure repair pipeline installation marine power plant, technology of fittings pipelines overhauled.	30 I 30 Lab	5	6
19.	<b>Marine Auxiliary Machines &amp; Equipment III</b> <i>Description:</i> Construction, operation and maintenance of ship steering gears, controllable pitch propellers, stern tubes and deck machinery.	15 L	2	4
20.	<b>Management of Maintenance Services</b> <i>Description:</i> System of maintenance marine engine, standard overhauled marine engine. Maintenance of repair overhauled plan, documentation of technical maintenance	15 L 30 P	4	6
21.	<b>Heat &amp; Surface processing of Materials</b> <i>Description:</i> Classification of coatings, technologies of coatings process, surface layer processing, propriety of coatings and surface layers.	20 L 15 Lab	3	6
22.	<b>Diploma Thesis Seminar</b>	30 S	1	4
23.	<b>Diploma Thesis Work</b>		15	4

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**FACULTY of MARINE ENGINEERING**

Branch of study: Mechanics and Mechanical Engineering

<b>PROGRAMME of STUDIES</b>		
B.Sc. Programme	Faculty of Marine Engineering	
	Specialization	<b>Industrial Plant Engineering</b>

Unit responsible

1	Sports Department
2	Mathematics Department, Navigation Faculty
3	Physics Department, Marine Engineering Faculty
4	Marine Power Plant Department, Marine Engineering Faculty
5	Engineering Sciences Department, Marine Engineering Faculty
6	Marine Maintenance Department, Marine Engineering Faculty
7	Foreign Language Department
8	Ship Automation Department, Electrical Faculty
9	Marine Electrical Power Engineering Department, Electrical Faculty
10	Chemistry Department, Business Administration Faculty
11	Humanities Department, Business Administration Faculty

L – Lecture, T – Tutorial, Lab – Laboratory, P – Project, S - Seminar

Fall semester (I)

No.	Course title/description	No. of hrs. in semester	ECTS points	Unit resp.
1	<b>Labor Sociology</b> <i>Description:</i> The range of the sociology. Social processes. The sociology of the work.	30 L	2	11
2	<b>History of Technique</b> <i>Description:</i> Term of 'engineer'. Ancient inventions, machines, materials, energy sources. Development of military, transport and shipping engineering, Development of communication means, machine and ship propulsion. History of subjects for study course 'mechanical engineering'. Archimedes; Leonardo da Vinci; Albert Einstein and others.	30 L	1	5
3	<b>Occupational Safety and Ergonomics</b> <i>Description:</i> Aims, objectives and benefits of subject. Work stress - causes, preventative and protective measures. Physiological, psychological and mechanical	30 L	2	5

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	factors of hazards. Prevention against hazards. Definition and scope of ergonomics and systems of work. Human characteristics, capabilities and limitations.			
4	<b>Mathematics I</b> <i>Description:</i> Elements of the logic. Real numbers. Single variable function. Trigonometry. Algebra of vectors. Analytical geometry.	30 L 90 T	8	2
	<b>Physics I</b> <i>Description:</i> Kinematics and dynamics of rigid body. Gravity. Pressure. Gas propriety. Electric current. Electrical & magnetic fields. Induction.	30 L 45 T	7	3
5	<b>Material Science I</b> <i>Description:</i> Metals and alloys. Fundamentals of metal properties. Iron-carbon system. Basic of thermal treatment of metals. Characteristic properties of iron-based alloys with regard to chemical composition, manufacturing technology, structure and properties.	30 L	2	6
6	<b>Fundamentals of Manufacturing Engineering I</b> <i>Description:</i> Basic quantities. Founding. Plastic working. Uniting. Bases cutting.	30 L	2	6
7	<b>Fundamentals of Electrotechnics &amp; Electronics I</b> <i>Description:</i> Basic terms. Simple electrical circuit. Direct, alternating and three-phase current. Power. Since current circuits. Transformer. Electric machinery.	30 L 15 T	4	9
8	<b>Environmental Protection</b> <i>Description:</i> Sources and types of environment pollution. The basic concepts. International conventions (Kyoto, Basel, Rio de Janeiro, Helsinki). MARPOL Convention, HELCOM, DUMPING. Other environmental hazards.	30 L	2	6

Summer semester (II)

No.	Course title/description	No. of hrs. in semester	ECTS points	Unit resp.
1	<b>German</b>	30 L	4,5	7
2	<b>Fundamentals of Informatics</b> <i>Description:</i> PC construction and operation, operating systems and languages, Bool algebra, basics in programming, computer graphics.	15 L 30 Lab	3	4
3	<b>Physical Education</b>	30 T	0,5	1
4	<b>Mathematics II</b> <i>Description:</i> 2-variable function. Single and double integral. Curvilinear integral. Indefinite integral. Definite integral. Triple integral.	30 L 30 T	4	2
	<b>Physics II</b> <i>Description:</i> Matter structure. Solid state physics. Physical phenomena research – physics laboratory.	15 L 30 T	3	3
	<b>Engineering mechanics I</b> <i>Description:</i> Fundamental force concepts and principles. Moments and couples. Equilibrium conditions. Free body diagrams. Friction. Center of gravity. Fundamental motion concepts and principles. Displacement, velocity, acceleration and their interrelationship.	30 L 15T	4	5
	<b>Engineering Graphics I</b>	30 L	4	5

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	<i>Description:</i> Fundamentals of descriptive geometry and projection drawing. Projection of geometrical solids. Cutting geometrical solids with planes. Intersections of geometrical solids. Principles for technical drawings and dimensioning. Views, sectional views and sections in machine drawings. Fundamentals of ship hull and installation drawings.	30 P		
5	<b>Material Science II</b> <i>Description:</i> Non ferrous metal alloys – copper, aluminum, titanium, nickel. Non metallic materials – plastics, wood products, glass and ceramic materials. Structure and properties. Macroscopic and microscopic studies.	15 L 30 Lab	3	6
6	<b>Fundamentals of Manufacturing Engineering II</b> <i>Description:</i> Cutting and grinding. Erosion machining.	15 L 15 Lab	2	6
7	<b>Fundamentals of Electrotechnics &amp; Electronics II</b> <i>Description:</i> Laboratory of Electrotechnics & Electronics.	30 Lab	2	9

Fall semester (III)

25.	<b>German</b>	30 T	2,5	7
26.	<b>Physical education</b>	15 T	0,5	1
27.	<b>Mathematics III</b> <i>Description:</i> Surface integral. Differential equation. Integral transformation.	30 L 30 T	3	2
28.	<b>Physics III</b> <i>Description:</i> Physical phenomena research – physics laboratory.	15 Lab	1	3
29.	<b>Engineering mechanics II</b> <i>Description:</i> Newton's laws. D'Alembert's principle. Moment of inertia. Work, power and energy. Conservation of energy. Shocks.	30 L 30 T	4	5
30.	<b>Strength of Materials I</b> <i>Description:</i> Introduction. Hooke's law. Tension and compression. Geometrical characteristics of a section. Torsion. Bending. State of stress. Generalized Hooke's law. Combined stress – basic hypotheses.	30 L 15 T	3	5
31.	<b>Engineering Graphics II</b> <i>Description:</i> Views, sectional views and sections in machine drawings. Isometric and orthographic projections. Mechanical component drawings (fasteners, bearings and standard parts). System of dimension and geometrical tolerances. Surface quality marks. Detail and assembly drawings.	30 P	3	5
32.	<b>Fundamentals of Machine Elements Design &amp; CAD I</b> <i>Description:</i> Machine life cycle. Introduction to design. Conceptual design and innovation. Quantitative and systematic methods for design. Tolerances and fits. Friction and wear. Lubricants. Hydrodynamics of lubrication. Rolling contact bearings. Journal and thrust bearings. Screws, fasteners and connections, welding and other joints. Springs and flexible mechanical elements. Clutches, brakes and couplings. Fatigue.	30 L	2	5
33.	<b>Material Science III</b> <i>Description:</i> Practical presentation of research technology of metals and alloys by means of macroscopic and microscopic studies and measurement of hardness.	15 Lab	1	6

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34.	<b>Fundamentals of Manufacturing Engineering II</b> <i>Description: <b>Basis of manufacturing engineering</b></i> Manual treatment with elements of repair. Electrical and gas welding. Automatic machines. Turning – basic information. External and internal turning. Electric Workshop. Dismantling, assembling and repair of electrical installations.	60 workshop	2	6
35.	<b>Thermodynamics I</b> <i>Description:</i> Thermodynamic properties. The laws of thermodynamics. The processes. Entropy. Ideal gas and steam equations. Thermodynamic cycles. Efficiencies of cycles. Heat transfer: heat conduction, forced and free convection, empirical relations, thermal radiation. Heat exchangers.	30 L 30 T	4	5
36.	<b>Fundamentals of Control Engineering &amp; Robotics</b> <i>Description:</i> Taxonomy of the control systems. Linearity and linearization. Laplace's transformation. Mathematical models of linear continuous control systems. Linear objects' response to typical inputs. Fundamental elements of control systems and their characteristics. Block diagrams. PID controllers. Stability and quality of control systems. Relay systems. Robotics – taxonomy, structures of manipulators, equations of movement.	30 L 30 Lab	4	5

Summer semester (IV)

26.	<b>German</b>	30 T	3	7
27.	<b>Physical education</b>	30 T	1	1
28.	<b>Strength of Materials II</b> <i>Description:</i> Frames. Elastic strain energy – Castigliano's and Menabrea's theorems. Rods of large curvature. Stability of the rods. Lamé's problem. Evaluation base characteristics of materials. Application of resistance strain gauges. Certification of wire ropes.	15 L 15 T 30 Lab	4	5
29.	<b>Fluid mechanics</b> <i>Description:</i> : Definition of fluid mechanic terms. Laws of fluid mechanics. Fluid statics. Kinematics of fluid. Conservation of mass. Fluid dynamics. Navier-Stokes equations. Euler's equation. Bernoulli equation. Conservation of energy. Laminar and turbulent flows. Incompressible viscous flow. Empirical relations. Compressible flow.	30 L 15 T	3	5
30.	<b>Engineering Graphics II</b> <i>Description:</i> Computer aided drafting - initiating the graphics package (setting the paper size, space; setting the limits, units; use of snap and grid commands). Drawing of primitives (line, arc, circle, ellipse, triangle etc.). Setting the layers and application of the layers. Dimensioning the drawing and adding text.	15 P	2	5
31.	<b>Fundamentals of Machine Elements Design &amp; CAD II</b> <i>Description:</i> Valves, pipes and expansion joints. Shafts and their balancing. Spur gear. Helical, bevel and worm gears. Friction, belt and chain drives. Lubrication of gears. Seals. Laboratory (threaded and welded joints, journal bearings, clutch, springs). Project (design of unit with power screw, design of clutch).	30 L 30 lab 15 P	4	5
32.	<b>Thermodynamics II</b> <i>Description:</i> Fundamental measurements of	30 Lab	2	5

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	thermodynamic, thermofluid and fluid flow variety properties (such as pressure, temperature, density, specific heat, viscosity, mass flow rate). Investigation of heat transfer and heat exchangers.			
33.	<b>Metrology &amp; measurement systems</b> <i>Description:</i> Unit of quantity. Accuracy and errors of measurement. Hierarchy scheme of measuring instruments. Procedure of measurement. Least squares method. Ultrasonic, pneumatic measurement.	15 L 30 Lab	2	6
34.	Chemistry <i>Description:</i> Atom structure. Particle. Chemical linkage. Periodic system. Compounds. Mixture and solution. Petroleum. Plastics.	15 J 15 Lab	2	10
35.	<b>Industrial plants</b> <i>Description:</i> Construction, operation and maintenance of pumps compressors, purifiers and heat exchangers, industrial steam, compressed air, heating and water supply systems.	30 L 15 P	3	4
36.	<b>Turbines &amp; Steam Boilers</b> <i>Description:</i> Steam and water boilers – combustion. Heat transfer. Water natural and forced circulation. Gases flow.	30 L 30T	4	4

Fall semester (V)

27.	<b>German</b>	45 T	3	7
28.	<b>Physical education</b>	30 Lab	1	1
29.	<b>Fundamentals of Machine Elements Design &amp; CAD III</b> <i>Description:</i> Computer-Aided Mechanical Design. 3D space geometry data structure. CAD system Configuration. Geometric Modeling. Modeling Techniques (surface modeling, 3D solid modeling). CAD techniques to finite element data preparation. Automatic mesh generation and presentation of results. Project (design of gear).	30 Lab 15 P	4	5
30.	<b>Fundamentals of Machine Operation &amp; Maintenance</b> <i>Description:</i> Structure of operation and maintenance system. Friction, lubrication, and wear. Reliability and durability. Machine diagnostic. Safety management and risk analysis. Computer aided management of machine operation and maintenance.	30 L	1	5
31.	<b>Simulation &amp; Data Processing</b> <i>Description:</i> Fundamentals of discreet control system. Discreet control algorithms. Structures of industrial control systems. Construction of drivers. Nets systems of steering and control. Data processing in SCADA system. Data visualization. Overview of industrial control systems.	15 L 15 Lab	2	5
32.	<b>Turbines &amp; Steam Boilers</b> <i>Description:</i> Boilers – Construction and operating. Heat surfaces. Screens. Superheaters and preheaters. Burners. Basic of steam turbine theory, working principle, power, torque, efficiency, steam-condensate systems of turbine plant, characteristics, power adjustment, construction, operation and maintenance.	15 L 15 Lab	2	4
33.	<b>Internal Combustion Engines</b> <i>Description:</i> Theory and general principles – theoretical heat cycle; practical cycles; working cycles; parameters – efficiency, mean indicated and effective pressure, power.	45 L 15 K 30 Lab	5	4

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	Torque, mean piston speed, fuel consumption; fuels and lubes: chemistry and treatment; engine performances; scavenging, turbocharging; fuel injection and combustion. Frame, thrust bearing, cylinder liner, cylinder cover, piston, connecting rod, crankshaft, camshaft, valve, turbocharger system, injection system. Operation and maintenance, diagnostics.			
34.	<b>Water, Fuel &amp; Lubricants</b> <i>Description:</i> Chemical components. Acidity. Reactions. Boiler malfunctions. Waste utilisation.	30 L 30 Lab	3,5	10
35.	<b>Industrial Control Systems</b> <i>Description:</i>	15 L 15 Lab	2	4
36.	<b>Electrical machines</b> <i>Description:</i> DC machines. Transformers. Couplers. Relays. Switches. Fuses. Power systems. UPS.	30 L 30 Lab	3,5	9
37.	<b>Economics</b> <i>Description:</i> Microeconomics, macroeconomics. Market, demand, supply. Theory production. Theory of costs. The national income. Monetary policy. International trade.	30 L 15 K	3	11

Summer semester (VI)

1	<b>Industrial practice</b> <i>Description:</i> Training at the selected industrial facilities.	1 semester	30	4
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Fall semester (VII)

24.	<b>Management of Maintenance Services</b> <i>Description:</i> Maintenance systems. Wear of technical systems. Maintenance policies. Service and repairing methods. Maintenance documentation.	15 L 30 P	2	5
25.	<b>Robotics</b> <i>Description:</i> Discrete automatic control system. PLC. Distributed control system. Positioning systems. Structure, kinematics and dynamics of robots.	15 L 15 Lab	2	8
26.	<b>Industrial law</b> <i>Description:</i> Law standards, industrial law, the law of companies, public orders, public auctions, brooking. Agreements to sell, deliveries, transport. Leasing, factoring.	15 L 15 K	2	11
27.	<b>Ventilation &amp; Air Conditioning*</b> <i>Description:</i> Air Mollier diagram – construction and basic processes, air parameters, kinds of ventilation (gravity and mechanical), equipment, air conditioners, systems calculations and practical presentation.	30 L 30 Lab	4	4
28.	<b>Refrigeration*</b> <i>Description:</i> Refrigerating cycles – thermodynamic basis, industrial refrigerating plant, heat pumps and air conditioning equipment, cooling agents, calculations and maintenance – practical presentation.			
29.	<b>Logistics*</b> <i>Description:</i> Logistic systems – supply, production, stores, transport, delivery. Logistics organization. Information in logistics.	30 L (30 K) 30 Lab	4	10 11

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30.	<b>Sewage &amp; Water Treatment*</b> <i>Description:</i> Contents and pollution of natural water. Cleanness classes. Water cleaning technology. Sewer contents characteristics. Filters. Biological cleaning.			
31.	<b>Diploma Thesis Seminar</b>	30 S	1	4
32.	<b>Diploma Thesis Work</b>		15	4