Syrian Arab Republic
Damascus University
Faculty of Mechanical and Electrical Engineering

COURSE DESCRIPTION
Department of Automobiles and Heavy Machines Engineering

First Academic Year

- **First Semester**

Number of weeks per semester = 15 **Total duration of one hour = 60 minutes**

	Course Name	Weekly Hours			
		Lecture	Tutorial	Lab.	**Total**
1	**Mathematics (1)**	**4**	**2**	**-**	**6**

- **Linear Algebra:**
  Algebraic polynomials; vector space; matrices; determinates; systems of linear equations; eigenvalues and eigenvector; quadratic forms.
- **Mathematical Analysis:**

1. **Introduction to Mathematical Analysis:** number sets and real numbers; Cartesian and polar coordinates in the plane; numerical sequences; real functions of one variable; limits and continuity of functions; elementary functions; infinite sequences: sequences converge to zero (Infinitesimal) and sequences diverge to positive infinity.
2. **Complex Numbers Field - Differential Calculus of Real Functions of one variable:** derivation and differentiation; basic theorems in differentiation; indeterminate forms and their removal techniques; L'Hopital's rule; functions behavior analysis and plotting; plotting of Cartesian, polar, and parametric functions.
3. **Transcendental Curves and Numerical Series:**convergence test of series with positive terms; arbitrary series; alternating series and Leibniz'stest;absolute convergence and conditional convergence.
   Functional sequences and functional series:pointwise convergence and uniform convergence; power series; Taylorseries and Maclaurinseries.

2	**Physics (1)**	**4**	**-**	**2**	**6**

- **Optics:**

1. **Basic Principles:** the nature of light, Fermat's principle; Huygens's principle; principles of measurement of light and measurement units.
2. **Geometric Optics:** mirrors; spherical refractor; twin-surface parallel planes; prism; thin lenses.
3. **Physical Optics:** polarization; semi wave plates and quarter wave plates; interference of light waves; Young's double slits; interference in equally separated multi-point source.
   Diffraction: diffraction from rectangular slit, circular aperture, or wire; diffraction grating.
4. **Optical Fibers:** working mechanism, types, characteristics, applications.

	▪ **Thermodynamics:** Introduction to temperature; equation of state – the kinetic theory of gases; object's states and status quantities; zero law of thermodynamics; first law of thermodynamics; heat transfer; thermal characteristics; the effect of changing temperature on electronic elements utilization. ▪ **Practical Lab. Experiments.**

	Course Name	**Weekly Hours**			
		Lecture	Tutorial	Lab.	**Total**
3	**Descriptive Geometry**	**2**	**2**	**-**	**4**
	Introduction to projection methods; point and line representation in projection planar; plane representation on projection planar; different positions of one & two planes, line & plane & point, plane & line on projection planar; special methods; changing projection planner and rotation around axis, main line, and hinge/traceline; polyhedron representation with line and plane on projection planar; axonometric projection (isometric, diametric, and trimetric projection).				
4	**Chemistry:**	**4**	**-**	**2**	**6**
	▪ **Theoretical Section:** Introduction; essential definitions and terms in chemistry; ideal gas and real gas; rates of chemical reaction and affecting factors, kinetic reaction and its orders; oxidation-reduction reaction in base/acid solutions; metal corrosion and protection methods; Water: water hardness and treatment methods; Thermochemistry:first, second, and third law in thermochemistry;electrolytic and non-electrolytic solutions; Electrochemistry: principles of electrochemistry and thermodynamics of electrochemical cells. ▪ **Practical Section:** 1. **Volumetric Analysis:** Laboratory: acid/base titration;oxidation/reduction titration;titration using EDTA solution; water analysis, water hardness and water alkalinity tests. 2. **Gases:** measurement of gas molecular weight; determining the Avogadro constant. 3. **Solutions:** extraction; determining the coefficient of solution distribution; chemical equilibrium; determining the constant of chemical equilibrium; kinetic of chemical reaction; reaction rate; thermal influence. 4. **Chemical Thermodynamic:** determining the energy of neutralization of base/acid titration; determining the formation energy of hydrogen peroxide. 5. **Metal Corrosion:** acid and base effects on metals (iron, copper, and aluminum)**;** metal protection methods; experiment of electroplating.				
5	**Engineering Mechanics (1) (Static Equilibrium)**	**2**	**2**	**-**	**4**
	Introduction to Engineering Mechanics Science; basics of Engineering				

	Mechanics Science; rigid body balance in the plane; friction; graphic equilibriumand truss structures analysing; summation of spatial forces; center of parallel forces and center of mass; common problems and examples.				
6	**Foreign Language (1)**	**4**	**-**	**-**	**4**
	English Language, Book: Life Lines.				
7	**Specialist Workshops**	**-**	**-**	**4**	**4**
	Lathing and adjustment workshop; casting and molds workshop; electrics workshop; electrical lining workshop; automobile electrics workshop; welding and metal sheets workshop.				
Grand Total		**20**	**6**	**8**	**34**

- **Second Semester**

Number of weeks per semester = 15 **Total duration of one hour = 60 minutes**

	Course Name	**Weekly Hours**			
		Lecture	Tutorial	Lab.	**Total**
1	**Mathematics (2)**	**4**	**2**	**-**	**6**

▪ **Integration:**

1. **Indefinite Integral:**primitive function; basic rules of integration; integration techniques.
2. **Definite Integral and its Applications:** definite integral as a function of its upper bound; derivative of definite integral; relation between definite integral and indefinite integral; improper integrals type I and II; engineering and physical applications of definite integral; numerical integration.
3. **Multi-variables Real Functions:**limits and continuity; partial derivatives; exact differentiation; Taylor expansion; extreme values (finding minima and maxima), and Lagrange method.

▪ **Differential Equations:**

1. **Ordinary Differential Equations of1st Order and 1st Degree:** separable-variables equations; homogenousdifferential equations; linear differential equation; exact differential equationsand integral factors; differential equations manipulated to linear form; initial value problem and the theorem of existence and uniqueness; Cauchy'sproblem solution by power series.
2. **OrdinaryLinear Differential Equations of Higher Orders and Constant Coefficients:** derivative operators; Lagrange method; inverse differentialoperator and finding particular solution; linear differential equation systems of constant coefficients.
3. **Approximation Methods of Solving Ordinary Differential Equations**:

	Euler's method; Runge-Kuttamethod; sequential derivation method; sequential approximation method for solving differential systems and n^{th}order differential equations solved with respect to derivative.

2	**Physics (2)**	**2**	**-**	**2**	**4**
	▪ **Modern Physics:** 1. **Introduction to Quantum Physics**; Black-body Radiation; photoelectric effect; Compton scattering; Bohr model of hydrogen atom; uncertainty principle; wave–particle duality. 2. **Nuclear Physics:** nucleus characteristics; radioactivity; laws and mechanisms of radioactive decay; nuclear reactions; fusion and fission; reaction between nucleosome and the matter. ▪ **Vibrations and Waves:** 1. **Periodic Vibratory Motions:** simple harmonic motion; superposition of two harmonic motions; transverse wave: wave equation; wave energy; wave superposition; standing wave and resonance. 2. **Sound:** sound intensity; sound number; sound speed; Doppler effect. 3. **Rigid Body Waves.** 4. **Surface Waves.** ▪ **Laser:** 1. **Light & Object Interaction**: placement distribution of atoms; Einstein's relations; laser operation principle; laser types. 2. **Laser Applications**. ▪ **Practical Lab. Experiments.**				

	Course Name	**Weekly Hours**			
		Lecture	Tutorial	Lab.	**Total**
3	**EngineeringDrawing (1)**	**2**	**2**	**-**	**4**
	Basics and technical drawing tools; geometric bodies projections according to international method; geometric body section and section projection drawing; common exercises.				
4	**Engineering Mechanics (2) (Kinematics)**	**4**	**2**	**-**	**6**
	▪ **Motion of a Mass point on Trajectory:** motion trajectory; equations of a masspoint motion on a trajectory; velocity; Frenet's curvilinear coordinates (Frenet's Frame); acceleration; motion in translational-moving coordinates system; two dimensions motion in polar coordinates. ▪ **Simple Motions Analysis:** mass point motion on a straight trajectory; constant acceleration motion; circular motion; helical motion. ▪ **Translational Motion and Rotational Motion of a Rigid Body:** introduction; translational motion; rotational motion. ▪ **Motion of a Rigid Body in the Plane:** definition; analysis of sectional points speed; instantaneous rotational center in two dimensions motion; velocity diagram; analysis of sectional points acceleration; instantaneous center of zero acceleration.				

	▪ **Motion of a Material Point in Non-Inertial Frames:** definition; motion representation; velocity composition; acceleration composition; zero-Coriolis effect. ▪ **Motion of a Rigid Body in Non-Inertial Frames:** definition; two translational motions composition; two rotational motions composition; translational and rotational motions composition.

5	**Introduction to Computer and Programming**	**2**	**-**	**2**	**4**
	Computer from the user's perspective; components of a computer system; computer data; numeral systems; character representation; integer data and floating point data; overview about computer architecture; computer peripheral units; computer Interconnection; data transfer protocols; local area network (LAN); metropolitan Area Network (MAN); wide area networks (WAN); clusters; overview about operating system; programming tools; practice on windows system; office applications programs: Word, Excel, Power Point, Explorer, Front Page.				
6	**National Culture**	**2**	**-**	**-**	**2**
	Modern topics about humanity; sociality; economic; and politics are discussed.				
7	**Arabic Language**	**2**	**-**	**-**	**2**
	Grammars and diacritics; dictation grammars;syntax; declension; Arabic dictionaries; calligraphy; various literary topics.				
8	**Foreign Language (2)**	**4**	**-**	**-**	**4**
	English Language, Book: Life Lines.				
Grand Total		**22**	**6**	**4**	**32**

Head of Automobiles and heavy Machines engineering department

Dr .

Syrian Arab Republic
Damascus University
Faculty of Mechanical and Electrical Engineering

COURSE DESCRIPTION
Department of Automobiles and Heavy Machines Engineering

Second Academic Year

- **First Semester**
  Number of weeks per semester = 15 **Total duration of one Hour = 60 minutes**

	Course Name	Weekly Hours			
		Lecture	Tutorial	Lab.	**Total**
1	**Mathematics (3)**	**4**	**2**	**-**	**6**
	▪ **Analytical Geometry in Space:** vector algebra; vector functions for one or more variables; coordinate systems in space; curvilinear coordinates. ▪ **Surfaces and Curves in Space**: surface in space; curve in space; plane; line; surfaces of second degree; geometric properties of space curve; geometric properties of space surface. ▪ **Dual Integrals**: double integration and its applications; triple integration and its applications; surface integral and its applications; line integral and its applications; improper double integrals ▪ **Vector Differentiation**: a scalar field and a vector field; 1st and 2nd order vector derivatives; vector derivative; gradient; divergence; curl; vector potential field ▪ **Vector Integrals**: ordinary vector integrals; linear vector integrals; work and the circulation; vector integrals on a closed space surface; vector function flux; volume integrals of vector functions; Gauss's theorem; Stokes theorem; Green's theorem ▪ **Probability and Statistics**: the definition of probability; conditional probability; independent events; mathematical prediction; standard dispersion and statistical deviation; probability distributions and calculation methods to estimate the potential results of measurements; methods of finding a linking factor among different incidents.				
2	**Engineering Mechanics (3) (Dynamics)**	**4**	**2**	**-**	**6**
	• **Free Motion of Point Particle:** fundamental law of dynamics of an independent point particle;differential equation of kinetic of an independent pointparticle. • **General Laws of Point Particle Dynamics:**impulse of a force; linear momentum of a point particle; work of a force; power; kinetic energy of a point particle; angular momentum of a point particle; central force motion. • **Dependent Motion of Point Particle:** fundamental law of dynamics of a dependent point particle; differential equation of kinetic of a dependent pointparticle; simple pendulum; dynamic equilibrium; D'Alembert's principle; relative motion of dependent point particle.				

	• **Linear Momentum and Angular Momentum of a System of Particles:**the angular momentum of a system of particles; dynamic system; external forces; internal forces; differential equations for motion of a system; motionof center of mass of a system; principle of linear momentum change for a system of particles; motion conservation of a center of mass and momentum conservation; angular momentum of a system of particles. • **Applying General Laws on Rigid Body Motion:** translational motion; central rotational motion; two-dimension motion; rigid body system motion; D'Alembert's principle of a system of particles.

	Course Name	**Weekly Hours**			
			Lecture	Tutorial	Lab.	**Total**
3	**Technical Engineering Drawing (2)**	**2**	**2**	**-**	**4**
	Machines elements used geometrically; attachment elements (screws, nuts, washers); other attachment elements such as rivets and welding;removable attachment elements; drawing exercises for machines assembling.				
4	**Programming (1)**	**2**	**-**	**2**	**4**
	general overview of Programming In C++; Program Style; Variables and constants; Conditional and Boolean Statements; Assignments and Comments Statements; Statements in C++ Language; (if/if-else/switch-if/else-if) controlling Statements; Iteration Statements (for loop/while loop/do-while loop) ; Functions; Function Definition; Function Declaration; Passing Types; Boolean Functions; Overloading to the functions; Function Templates; Arrays; Arrays Declaration and Definition; Passing an Array to a Function; Multidimensional Arrays; Strings; Strings Declaration; String As a Character Array; Arrays of Strings; Strings Functions.				
5	**Materials Science and their Properties**	**4**	**-**	**2**	**6**
	Classification of minerals and their solid structure; The real structure of mineral crystals and defects retinal structures; ways of testing the internal structure of metals and quality control; The formation and growth of mineral crystals; the structure of metal alloys; physical and mechanical properties of metals and metal alloys; Dynamic tests; Types of metal alloys (Aluminum, Copper magnesium, Nickel, Titanium, Zinc, Lead, Tin, Tough metal fusion). Questions and exercises **Laboratory**: Laboratory exercises and lessons.				
6	**Foreign Language (3)**	**4**	**-**	**-**	**4**
	English Language, Book: **Oxford English for Mechanical and Electrical Engineering:** Iron and Steel, Heat Treatment of Steal, Lubrication of Bearings, Welding, Steam Boilers, Steam Locomotives, Condensation and Condensers, Centrifugal Governors, Impulse Turbines, The Petrol Engine, The Carburetion				

	System, The Jet Engine, the Turbo-prop Engine, Aero foils.				
Grand Total	**20**	**6**	**4**	**30**	

- **Second Semester**
  Number of weeks per semester = 15 **Total duration of one Hour = 60 minutes**

	Course Name	**Weekly Hours**			
		Lecture	Tutorial	Lab.	**Total**
1	**Mathematics (4)**	**4**	**2**	**-**	**6**
	▪ **Complex Analysis:** - **Complex Variable and Complex Functions:** complex variable and sets; complex function; limit, derivative, and continuity of complex function; analytical functions; singular points; elementary complex functions; complex integral; Cauchy's integral theorem and formulas. - **Complex Series:** Taylor expansion; Laurent expansion; singular points classification. - **Residues Theorem:** complex integral calculation using residues method; real integral calculation using residues theorem. - **Mappings and its Representation:** complex function and complex mapping; analytical function and conformity and their representation; conformal mapping and its properties; some general exercises. ▪ **Fourier Series and Fourier Integral:** trigonometric series; complex form of Fourier series; harmonic analysis; Fourier integral; general forms of Fourier series. ▪ **Special functions:** Gamma function, Beta function, error function; Fresnel integral; sine and cosine integral; Bessel functions type I and type II; Legendre’s polynomial. ▪ **Laplace Transforms and Applications:** Laplace transform; inversion of Laplace transforms; Laplace transforms for some of special functions; Laplace transformsapplications; the relation between Fourier integral and Laplace transform, Z transform. ▪ **Partial Differential Equations: :** direct Integrated partial differential equations, partial differential equations of 1st order, partial differential equations of high orders for a function with two independent variables and constant coefficients, string equation, two dimensions heat transfer equation, the circular membrane and Bessel equation.				
2	**Strength of Materials (1)**	**4**	**-**	**2**	**6**
	• **TheoreticalSection**: Introduction of strength of materials; tension and stress; static				

	characteristics of the engineering sections; twisting; bending; transitions in the general condition of the load; Castigliano's theorem; Mohr's integral; Vereschagin's rule. • **Laboratory:** Tension testing; twisting bars; vertical and horizontal movement (Castellano); arced bars curvature machine; beams bending machine.

3	**Manufacturing Methods (1)**	**2**	**-**	**2**	**4**
	MeasurementTools; machines tools; the materials of cutting tool; principles of material operation by removing the swarf; process operating technology by turning; process operating technology by milling; process operating technology by drilling; process operating technology by grinding; automation process operation; private operation process; the general principles used in the preventive and routine maintenance performed on the operating machines;principles ofindustrial safety.				

	Course Name	**Weekly Hours**			
		Lecture	Tutorial	Lab.	**Total**
4	**Thermodynamics (1)**	**4**	**-**	**2**	**6**
	▪ **Definition and Principal Concepts:** International system of units SI; Basic thermodynamics parameter; Thermodynamic system; thermodynamic process; Heat and Work; state laws for ideal gas: Boyle–Mariotte law (when T=const), Gay-Lussac's Law (when V=const, P= const); gas equation of general state; specific heat. ▪ **First Law in Thermodynamics:** Internal energy; Heat and Work in thermodynamic processes;reversible cycle and irreversible cycle; first law in thermodynamics for closed system; mathematical formula of the first law in thermodynamics; enthalpy; entropy of an ideal Gas. ▪ **Thermodynamic Processes of Ideal Gases:** isochoric process; isobaric process; isothermal process; adiabatic process; polytrophic process. ▪ **Second Law in Thermodynamics:**Basics of the second law of thermodynamics; cycles of thermodynamic process; thermal efficiency and refrigeration factor of a cycle; mathematical formula of the second law in thermodynamics; direct and reflective Carnot cycle and its (T-S) graph; Entropy. ▪ **ThermalMachinesCycles:** classifying diesel-engine stations; thermal cycle of gas-turbine station; real and ideal thermal cycle of steam-turbine station (Clausius- Rankine cycle);Multi-stagecompressors. ▪ **Questions and Exercises.**				

5	**Programming (2)**	**2**	**-**	**2**	**4**
	• **C++ Language:** Pointers, Pointers Declaration and Definition, Arrays and Pointers, Arrays Pointers, Pointers to Function, Classes, Construction and				

	Class Definition, Constructors, Constructor Initialization Lists, Destructor, Static Data, Static Function-members, Access Functions, Static Data Members, Overloading Operator, Composition and Inheritance, Inheritance Types, Multi-inheritance, Virtual Functions, Stream I/O, Class Templates, File Processing, File Streaming, Files Operations. • **Programming laboratory**: laboratory exercises by using the computer.				
6	**Foreign Language (4)**	**4**	**-**	**-**	**4**
	English Language, Book: Oxford English for Mechanical and Electrical Engineering: Engineering Materials, Vectors, Force, Friction, Levers, Stress and Strain, Ideal and Practical Machines, the Four Stroke Petrol Engine.				
Grand Total		**20**	**2**	**8**	**30**

Head of Automobiles and heavy Machines engineering department

Dr .

Syrian Arab Republic
Damascus University
Faculty of Mechanical and Electrical Engineering

COURSE DESCTRIPTION
Department of Automobiles and Heavy Machines Engineering

Third Academic Year

First Semester

	Course Name	Weekly Hours			
		Lecture	Tutorial	Lab	**Total**
1	**Strength of Materials (2)**	**4**	**-**	**2**	**6**
	▪ **Theoretical Section:** Statically indeterminate problems; theorem of three moments (continuous beams); the theory of stress state of solids; strain state on solids; theory of stiffness; Thick and thin-walled cylinders; stability; longitudinal horizontal curvature; fatigue; impact strength. ▪ **Laboratory:** Testing the continuous beams; testing the Thick and thin-walled cylinders; testing stability; testing the bending of continuous beams; comparison between the practical application and the theoretical side of the stiffness theories.				
2	**Manufacturing Methods (2)**	**2**	**-**	**2**	**4**
	5. **Features and Defects of Casting:** definition of casting; manufacturing casting; advantages of casting; disadvantages of casting; types of casting; basic steps for sand casting. 6. **Casting Sands:** the form and size of sand grains used in casting; materials composing casting sands; general properties of casting sands; materials added to mold and core sand; materials for parting and coating the core; putties for reforming cores; selecting sand; core sands; Sodium silicate sand ($Na\ SiO_3$) (the method of Carbon dioxide CO_2). 7. **Manufacturing Patterns:** the pattern and core box; types of pattern; differentiating different parts of pattern; allowances in the pattern's dimensions; the function of pattern. 8. **The core and core box:** the importance of the core function; materials for manufacturing the cores; core boxes. 9. **Manual Mold Forming:** basic parameters that should be consider when melting and filtering and casting the melt; types of manual sand molds; forming a mold for one piece pattern; forming mold for middle parting pattern; forming a mold for three-par pattern; forming a mold on the foundry floor using the pattern; forming a mold on the foundry floor using single pattern; methods of set-up-core inside the mold cavity.				

10. **Forming Molds and Sand Molds Automatically:** the goals and features of automatically forming sand molds; classification of the tools of automatically classifying sand molds and its work mechanism; making cores automatically; drying molds and cores; drying ovens for molds and cores.
11. **Casting Systems:** the function and types of casting systems; parts of casting system; designing a casting system; balancing of forces when casting the melt**.**
12. **Casting in Thermal Permanent Molds:** materials used for manufacturing thermal permanent molds; the use of thermal permanent molds.
13. **Casting in Metallic Permanent Molds:** steps and features of casing in metallic permanent molds; types of metallic permanent molds.
14. **Centrifugal:** casting with centrifugal in a mold with vertical rotation axis.
15. **Continuous Casting:** molding pipes and pillars in the continuous method; casting boards in the continuous method.
16. **Precision Casting Using Investment Casting Pattern and the Steps of Their Production.**
17. **Precision Casting Using Shell Molds:** the elements of shell molds mixture; steps for making shell molds; advantages and disadvantage of casting using shell molds.
18. **Casting Inspection:** visual and sound testing with a hammer shock; hydrostatic pressure test; magnetic particles inspection; radiographic inspection; supersonic test.

- **Laboratory:** laboratorial exercises and lessons.

	Course Name	Weekly Hours			
		Lecture	Tutorial	Lab	**Total**
3	**Fluid Mechanics (1)**	**4**	**-**	**2**	**6**

- **Physical and mechanical properties of fluids:**classification of fluids: density; specific volume; specific weight; compressibility and flexibility; thermal expansion of fluids; surface tension and capillary action; viscosity; evaporation pressure; problems and exercises.
- **Equilibrium of non-compressible fluids:** the concept of pressure (hydrostatic stress state); distribution of pressure in homogeneous fluid (basic hydrostatic equation); distribution of pressure in heterogeneous fluid (stable equilibrium); the principle of communicating vessels; the principle of pressure measurement; manometers and parameters; calculating pressure forces on the walls of plane vessels; hydrostatic lift force (Archimedes 'principle); Pascal law (hydraulic compressor); problems and exercises.
- **Fluid hydraulics:** basic concepts of fluid hydraulics (flow field and speed field); Lagrange's Method; Euler's Method (space method);

	classification of fluids hydraulics (flow): stable-unstable flow; one dimension, two dimensions, three dimensions flow; laminar and turbulent flow - under-sonic, sonic and ultrasonic flow; general continuation equation and physical conclusions. ▪ **Fluid dynamics:** Euler's one dimensional dynamic equation; different forms of Bernoulli equation; applications on Bernoulli equation; problems and exercises.

4	**Thermodynamics (2)**	**2**	**-**	**2**	**4**
	- **Water steam:** key concepts; charts of water steam; real gases; the process of generating steam and representing it by the coordinates of (P-V); basic parameters; the temperature for fluid evaporation and dryness fraction; saturated wet steam; superheated steam; calculating parameters of water steam using tables; (T-S, I-S) chart for water steam; steam tables; basic thermodynamic processes of water steam; exercises. - **Moist air:** key definitions; the content of humidity; density of moist air; ID charts of moist air; Psychrometric chart; exercises. - **Gas turbine:** information and key concepts; the cycle of gas turbine with giving temperature at V=const, P=const, exercises. - **Cycles of steam turbines:** the work mechanism of steam machines; Carnot cycle of water steam; Rankine cycle; exercises. - **Cycles of chillers:** general information about chillers; air and vapor compression chillers; the actual cycle of steam chillers (in the area of saturated wet vapor); the actual cycle of steam chillers with pulling saturated dry vapor; problems and exercises. • **Laboratory:** laboratorial exercises and lessons.				

	Course Name	**Weekly Hours**			
		Lecture	Tutorial	Lab	**Total**
5	**Mechanical Measurements**	**2**	**-**	**2**	**4**
	Metrology; basics of measurement; tolerances and fits; engineering surface texture; machining accuracy; errors of measuring instruments; measuring instruments; optical instruments and measurement process; problems and exercises. • **Laboratory:** laboratorial exercises and lessons using fine measuring instruments.				
6	**Fuels and Mineral Oils**	**2**	**2**	**-**	**4**
	•**Liquid fuel:** overview about oil, its extraction, properties and refinement; gasoline; its production, properties and types. •**Diesel:** its production and properties - gaseous fuel; the structure of natural				

	gas: compressed and liquefied; processing and filtering gaseous fuel; types of gaseous fuel; solid fuel; coal and its origin; classification and manufacturing of coal; properties, description, and storage of coal. •**Mineral oils and their types:** methods of extracting oils and improving their quality; functions of oils; properties of oils and their characteristics. •**Grease:** classification of grease; the physical and chemical properties of grease.

Grand Total	**16**	**2**	**10**	**28**

Second Semester

	Course Name	Weekly Hours			
		Lecture	Tutorial	Lab	**Total**
	Design of Machine's Elements (1)	**4**	**2**	**-**	**6**
1	• General consideration in designing machines; basic definitions; simple and compound stresses; pillars; metals and their types; rivet joints; solder joints; dowels and their different types; bolts and screws; power transfer spirals; movement pillars; couplings and their types; clutches and their types; brakes and their types; springs and their types. • **Comprehensive problems and exercises**				
	Theory of Machines	**4**	**2**	**-**	**6**
2	▪Basic definitions; description of the structure of a famous crank machine; studying the motion of mechanical structures in the method of schematic representation of equations of relative motion; relative motion between two points of a single link; the relative motion between identical point of two moving links; the relative motion in contact point of pure rolling; applying the concept of instantaneous center in determining velocities; studying moving the mechanical structures; application on the structure of the governor, scheme of torque; application on the flywheel (amended cupboard); studying the structure of cam by establishing a chart of the cam profile; studying the structure of cam with a specified profile; gears; establishing mechanical mechanisms . ▪ **Problems and exercises.**				
3	**Fluid Mechanics (2)**	**2**	**-**	**2**	**4**
	▪**Centrifugal pump machines:** Euler's kinetic equation; the actual pressure and theoretical pressure generated by the centrifugal pump machine; volute diffuser; efficiency (total – volumetric – hydraulic – mechanic); distinctive actual curves of vane pumps; distinctive actual curve of pump; distinctive curve of actual capacity; types of distinctive curves of vane				

	pumps; complete and incomplete distinctive curves; parallel and sequence connection of pumps; distinctive curve of the network and its graphic representation; factors affecting the distinctive curve of the network and the operation point; parallel and sequence connection of pipes; cavitation height for suction; types of pressure measurement devices. ▪**Flow of compressible fluids (gases):** thermodynamic basic equations of complete gases; first thermodynamic law; second thermodynamic law; single dimension and stable basic equations of flow; waves and their propagation in fluids; Mach number; Mach cone; the effect of flow section on the properties of the current. ▪**Isentropic flow in nozzles:** converging nozzles; Converging; Diverging nozzles; shock waves. ▪**Problems and exercises. Laboratory:** laboratorial exercises and lessons.

4	**Heat and Mass Transfer**	**2**	**2**	**-**	**4**
	Heat transfer in stable case, conduction heat transfer, radiation heat transfer, heat transfer in unstable case, heat transfer with inner source of heat, convection heat transfer, boiling and condensation**,** radiation, heat exchangers, mass transfer.				

	Course Name	**Weekly Hours**			
		Lecture	Tutorial	Lab	**Total**
5	**Internal Combustion Engines (1)**	**4**	**-**	**2**	**6**
	▪Principles of work factors and engines' conditions of exploitation; field of exploitationand classification of engines; thermal processes in engine. ▪Fuel and working body in piston engines; fuel and its properties; Non-petroleum-based fuels and their sources; oxidation reactions and combustion products; processes of the actual thermal cycles; gas interaction processes; compression processes; key concepts and combustion laws; the process of forming gaseous mixture in spark engines; the process of fuel ignition and combustion; the processes of forming gaseous mixture and combustion in diesel engines. ▪Graphical and actual factors and parameters; mechanical losses; heat loads affecting the parts of the engine and heat balance in the engine. ▪Fuel feeding systems in the engines; feeding system in electric spark engines; feeding system in diesel engines. ▪Air charging systems in engines; turbocharging systems; joint work of the engine with the charging equipment.				
6	**Electrical Machinery**	**4**	**-**	**2**	**6**
	1.**Properties of Electrical Drive System:** properties of electrical engines; mechanical properties of industrial machines; mechanical properties of				

electrical engines; calculating the mechanic section of the drive system.

2. **Direct current machines:** functions, parts and work mechanism of a direct current machine; the momentum of a direct current machine; classification of direct current machines; electromechanical and mechanical features of direct current engines;regulating the velocity of direct current engines; launching of direct current engines; braking systems; control.
3. **Electrical transformers:** definition of transformer; the importance, structure and classification of transformers; work theory of a transformer; efficiency of a transformer; tests of single phase transformer; three phase transformation set; auto transformer.
4. **Alternating current machines and their mechanical and electromechanical features:** machines, engines and induction generators.
5. **Regulating the rotation speed of induction motors:** electronic circuits and methods used in regulating the speed of induction motors.
6. **Special engines used in electrical drive system.**
7. **Static controllers:** logic circuits; programmed logic circuits.
8. **Selecting the capacity of electrical engines in accordance with the types of loads**.

- **Problems and exercises.**
- **Laboratory:** laboratorial exercises and lessons.

Grand Total	**20**	**6**	**6**	**32**

Head of Automobiles and heavy Machines engineering department

Dr .

Syrian Arab Republic
Damascus University
Faculty of Mechanical and Electrical Engineering

COURSE DESCTRIPTION
Department of Automobiles and Heavy Machines Engineering

Fourth Academic Year

First Semester

	Course Name	Weekly Hours			
		Lecture	Tutorial	Lab	**Total**
1	**Computer Aided Design and Manufacturing**	**2**	**-**	**2**	**4**
	Types of Computer Numerical Control machines and their properties; components of programmable controller systems used in Computer Numerical Control machines; terminologies used in Computer Numerical Control machines (CNC); manual programming and introduction to computer aided manufacturing; practical lessons in the programs of mechanical desktop. **Practical lesions on CNC automated milling machine and automated lathe machine. Problems and exercises.**				
2	**Internal Combustion Engines (2)**	**4**	**-**	**2**	**6**
	▪ **Engine performance:** standard curves; load curves; speed curves; detonation curves; governor transient curves; momentums affecting piston engines: single and multiple cylinders engines; bio-fuels in engines; Alcohol; Ethanol and methanol; gaseous fuel; natural gas and hydrogen. ▪ Ecological properties of internal combustion engines; properties and characteristics of noise and noise pollution; toxicity of combustion products. ▪ Driving and controlling engines. ▪ **Practical Lab. Experiments.**				
3	**Automotive Engineering (1)**	**2**	**2**	**2**	**6**
	▪ Vehicle types; general dimensions and maximum weights of trucks and loads and their distribution on the axes; tractive system; vehicle wheels system; vehicle productivity. ▪ The basic components of the vehicle and specifying the basic computational characteristics. ▪ General vehicle dynamics: vehicle tractive dynamics and calculating tractive force and acceleration according to specific road resistance; vehicle braking dynamics and the effect of grip between road surface and tires. ▪ Exploitable properties: vehicle stability; vehicle economy; vehicle steerability. ▪ **Semester homework:** to execute vehicle tractive; dynamic and economic				

	calculation for a specific given example. ▪ **Practical Lab. Experiments.**

	Course Name	Weekly Hours			
		Lecture	Tutorial	Lab	**Total**
4	**Fundamentals of Electronic Engineering**	**2**	**-**	**2**	**4**

▪ **Theoretical Section:**

•**Elements of semiconductors:** introduction to semiconductors; diode (p-n); Zener diode; bipolar junction transistor (BJT); field-effect transistor (FET); multi layered elements (Thyristor, Dynistor, TRIAC, DIAC, silicon controlled switch SCS, bioperationthyristor).

•**Amplifiers:** the concept of amplifiers; amplifier linking; the concept of decibel dB; classification of amplifiers; common base voltage; procedures in designing the circuit of amplifying transistor; operational amplifier.

•**Electro-optical devices and their applications:** various types of photoelectric devices in circuits; photomultipliers; applications using the photoelectric elements in various circuits.

•**Elements of sensing, transducers and their applications:** electrical resistive transducers and measuring the resistance by using Wheatstone bridge; sensors with electrical capacity; inductive transducers; digital shift transducer; photoelectric transducer; Hall effect.

•**Boolean algebra and logic gates:** binary system; engineering logic basics: AND gate, NOT gate, INVERTER gate, NOR gate, NAND gate.

•**Programmable logic controller:**relays usage; basics of the PLC, PLC control.

•**DC power suppliers:**rectification circuits; voltage multipliers and thrysitor switches.

•**Measurement and electrical measurement devices:**measuring steps; measuring importance; digital measurement system, convenience between measuring circuit- international measurement units; measurement accuracy; types of measurement errors and their sources and measurement devices.

▪ **Practical Section:**
Practical Lab. Experiments.

5	**Design of Machine's Elements (2)**	**4**	**2**	**-**	**6**

	Studying the design of spur gears;studying the design of helical gears;studying the design of bevel gears;studying the design of worm gears;studying the design of flat belts;studying the design of V-belts; studying the design of serrated belts;studying the design of chains;studying the design of slide bearings;studying the design of rolling-contact bearings. Comprehensive problems and exercises.

6	**Machines Dynamics and Vibrations**	**4**	**2**	**-**	**6**
	▪ **Machines dynamic:** Equation of motion in mechanisms; Lagrange's equation; analytical and schematic for studying stable motion; machines' non-uniformity motion; calculating driving link acceleration; Mechanisms; balancing rotary masses; balancing rotary masses acting in one plane; static and dynamic balance of rotary masses; balancing moments of inertia; approximate balancing of first degree moments of inertia; balancing mechanisms in multi-cylinders engines. Problems and exercises. ▪ **Mechanical vibrations:**System dynamic model; Equivalent stiffness; Vibrations of one degree of freedom systems; Free vibration of un-damped linear System of one freedom degree; Free vibrations with collisions in the System; The effect of a fixed force over a period of time; The effect of a periodic inharmonic force; Damped forced vibrations of one degree of freedom systems; Effect of variable frequency force; Shafts critical speed; Vibration isolation. Problems and exercises. ▪ **Laboratory:**Laboratorial exercises and experiments: sliding chain experiment; Cams experiment; Cylindrical gears experiment; Testing belts; Flywheel moment of inertia experiment; Hartnell governor experiment; Balancing a rotary system experiment; Rapid return movement mechanism experiment.				

Grand Total	**18**	**6**	**8**	**32**

Second Semester

	Course Name	Weekly Hours			
		Lecture	Tutorial	Lab	**Total**
1	**Road and Construction Machinery**	**4**	**2**	**-**	**6**

- General information about the construction and roads machines, their tasks, loading system, design parameters, classification, basic requirements and development areas. Types of soil and its properties, the effects of employing equipment on soil, excavation forces, productivity.
- **Power system and transmission:** power system, types of used transmission, clutch, hydraulic coupling, hydraulic torque converter, gearbox, reduction units and final drives.
- **Moving mechanism:** tires and their properties,suspension of wheel type vehicles, track systems and their properties,suspension of tracktype vehicles.
- **Hydraulic circuits:** hydraulic machines, graphic characteristics, components of hydraulic circuits,types of hydraulic circuitsand its drive and control systems.
- **Basic tractive force calculation for earthmoving machines:** moving mechanism tractive force, rolling resistance, tires and track grip and slip on ground, moving mechanism tractive characteristic, tractive equilibrium, determining normal reactions, traction vs. speed characteristic, evaluating tractive characteristics.
- **Tractors:** the shape and function, classification and the work conditions, required conditions in tractors, stability and cornering of tractors.
- **Bulldozers (dozing and ripping machines):** the shape and function, classification, employing equipment, basic characteristic and computational

	situations. ▪ **Traxcavators (Scooping and loading machines):** the shape and function, classification, employing equipment, basic characteristic and computational situations. ▪ **Scrapers:** the shape and function, classification, employing equipment, basic characteristic and computational situations. ▪ **Graders:** the shape and function of this machine, classification, employing equipment, basic characteristic and computational situations ▪ **Excavators and Shovels:** the shape and function, classification, employing equipment, basic characteristic and computational situations.

2	**Design of Internal Combustion Engines**	**4**	**2**	**-**	**6**

▪ **Principles of designing internal combustion engines:** They include basic principles in designing the engine and calculating its parts on strength;the basic characteristics required in the new design;selecting the type of engine and its basic design characteristics;stages for designing the engines;using automation in the process of designing the engine.

▪ **The nature of forces and moments in engines and their role in calculating its parts and choice of its basic design characteristics:** It includes the operating systems used in the design calculations of the engine;variable periodic loads and their role in calculating the parts of the engine;elements affecting engine parts resistance for fatigue stresses; determining safety factor;methods of computational modeling for of stress, deformation and thermal fields in the parts of the engine.

▪ **Design of engine structure:** It includes studying the design characteristics of the structure in the engine, which must be available in the new design and identifying methods of calculation on strength for each of these parts (cylinders, cylinder liner, cylinder block head bolts…);solved problems;manufacturing methods and the used metals.

▪ **The Design of piston assembly:** It includes piston assembly components design characteristics and strength calculation for (piston, piston ring, piston pin); Solved problems; Manufacturing methods and the used metals.

▪ **The Design of connecting rod assembly:**It includes connecting rod components design characteristics and strength calculation; Solved problems;Manufacturing methods and the used metals.

▪ **The Design of crankshaft:** It includes design characteristics, stress concentration factor estimation and strength calculation for crankshaft components, in addition to studying the flywheel, torsional vibrations and its effect on crankshaft strength and methods of treating;ways of increasing used metal strength.

▪ **The Design of valve gear:** It includes this assembly components and its design characteristics, valve timing control system, rules of determining

valve stroke and diameter, then cam profile estimation standards and methods of specific cam profile and calculating the integral cross-sectional area for intake passage as a function of time, design calculation for valve gear components; solved problems.

- **The Design of the lubrication system:** It includes an overview about the engines lubrications;Estimating bearings operation condition and its workability;sliding journal bearings calculation;Thermal calculation of the bearing;Stages for calculating the bearings; Lubrication circuit forms and functions; calculating the components of lubrication circuit (pump and oil cooler); solved problems; filters test.
- **The Design of the cooling system:** it includes selecting the type of the cooling system; definition of liquid cooling system; liquid cooling system effectiveness control methods; engine cooling system components and design characteristics –determining liquid cooling system components design characteristics; pump, fan and radiator calculating; solved problems; calculating the cooling surface in air cooling engines; analytical comparison between the liquid cooling area in air cooled engines; a comparison between liquid and air cooling systems.
- **The air feeding system:** It includes intake system design characteristics; the design characteristics of the air filtering; operation and design of air filtering system; air feeding systems in super charged engines (compressors, turbine compressors and charged air coolers).
- **The Exhaust system:** It includes exhaust system design characteristics; exhaust silencers design and calculation; types and design characteristics of catalytic converters.
- **Starting system:** It includes the starting methods; determining starting torque; methods for facilitating engine starting.
- **Principles of selecting the internal combustion engines for transportation:** It includes engine type selection, maximum power, cooling system and utilization characteristics, in addition to evaluating the reliability of the engine and selecting the type of fuel.

3	**Locomotive Engineering**	**2**	**2**	**-**	**4**

- **Diesel tractor:** locomotive evolution.
- **Principle of locomotive drivetrain system:** The mechanical system; the hydraulic system; the electrical system.
- **Locomotive engine:** operation principle of reciprocating engines; operation schemata for diesel engine; thermal cycle; developing and increasing the engine power; diesel engines design specifications; fuel and oil feeding systems.
- **Locomotive auxiliary equipment:** diesel engine cooling system; diesel engine air filtering; Traction motors cooling; operating auxiliary equipment's in the locomotive.
- **Locomotive drivetrain electrical systems:** electrical equipment

	specialties; basic electrical machines; auxiliary electrical machines; electrical batteries; electronic equipment and measurement and supervising devices; locomotive diagnostic systems; general locomotive electrical schemata. ▪ **Locomotive's base, chassis and driving room:** the main base; locomotive chassis; driving room. ▪ **Locomotive's bed:** the design characteristics of the bed; the bed of the bases; flexible suspension system; sustaining, retracting and traction and braking forces transmitting equipment; wheel, bearings and hubs assembly; air brakes and it's equipment; traction force, the dynamics of the locomotive and cornering calculations.

4	**Automotive Engineering (2)**	**2**	**6**	**2**	**6**
	▪ Basic concepts: the design and exploitable requirements; vehicle loading system; transmission (drive train) and its function, classification, design characteristics and field of utilization. ▪ Studying the clutch, hydraulic coupling and hydraulic torque converter: configuration, work principle, classification, operation characteristics and usage features. ▪ Studying the gearbox, Cardan shaft, final drive unite, differential, driven shafts transmitting torque to driven wheels, configuration, operation principle, classification, basic components design. ▪ Studying the steering, breaking, and suspension systems, function, requirements and basic components. ▪ **Semester homework:** to execute design calculations for some of drivetrain components for a specific vehicle.				
5	**Modeling and Simulation of Mechanical Systems**	**2**	**2**	**-**	**4**
	Introducing the necessity of modeling and simulation in the engineering and technical domains, methods of modeling, stages of modeling including the computerized modeling, introduction to the major mechanical systems, substantial similarity systems, control systems and its forms, modeling control systems and applied examples, simulation of control systems and applied examples.				
6	**Practical (Applied) Project**	**-**	**-**	**4**	**4**
	A designing project to be studied by the student and supervised by one or more professors in the department, the final discussion of the project is made in the presence of a committee consisting of a number of professors to make jurisdiction and to provide the appropriate degree for the project.				
	Grand Total	**14**	**10**	**6**	**30**

Head of Automobiles and heavy Machines engineering department

Dr .

Syrian Arab Republic
Damascus University
Faculty of Mechanical and Electrical Engineering

COURSE DESCTRIPTION
Department of Automobiles and Heavy Machines Engineering

Fifth Academic Year

- **First Semester**

Number of weeks per semester = 15 **Total duration of one Hour = 60 minutes**

	Course Name	Weekly Hours			
		Lecture	Tutorial	Lab.	**Total**
1	**Automotive Electrical and Electronic Systems**	**2**	**2**	**-**	**4**
	Sensors used in advanced vehicle systems: manifold absolute air pressure sensor; barometric pressure sensor; engine coolant temperature sensor; engine intake air temperature sensor; throttle position sensor; camshaft position sensor; crankshaft position sensor; oxygen sensor; rear oxygen sensor; knock sensor; alternator signal; starter signal; electrical load sensor; air conditioner signal; air pressure sensor; service check signal; atmospheric sensor; accelerator pedal position sensor; vehicle speed sensor; exhaust gas recirculation valve's left sensor; variable signals comes to engine control unit ; engine control unit (ECU); actuators; emission control system; electronic ignition system; programmed injection system. Hi-scan pro instrument. Starting system; charging system; ignition system. Instrumentation; lighting; windscreen washers and wipers.				
2	**Maintenance and Repair and their Service Stations**	**4**	**4**	**-**	**8**
	•Automotive Maintenance: - Vehicle condition and its change during the usage time. - Fundamentals of automotive maintenance. - Technology of automotive maintenance. •Automotive Repair: - Fundamentals of automotive repair. - Productive processes used in automotive repair. - Technological methods used in automotive repair. - Repair of vehicle bodies. •Auto Service Stations: - General technical specifications of auto service stations. - Service organisation in auto service stations. - Fundamentals of the design of service stations. - Automotive parking. - Tools and equipment used in auto service stations.				

	- Layouts and economic evaluation of service stations. - General specifications of buildings in service stations.

	Course Name	Weekly Hours			
		Lecture	Tutorial	Lab.	**Total**
3	**Finite Elements and its Applications**	**2**	**2**	**-**	**4**
	▪ **Chapter one:** classification of mechanical problems; concept of finite elementsmethod; characteristics of finite elements method; mechanics of solid bodies and constructions; equations of three dimensions solid body; equations of two dimensions solid body; equations of bars; the equations of beams; equations of sheets; Lesnar Madeline theory of sheets. ▪ **Chapter tow:** Hamilton's principle; function shape characteristics; finite elementsmethod in bars; formulating function of shape; matrix of elements in position coordinates system; matrix of elements in total coordinates system; characteristics of finite elements method (property of cloning, feature and rate of convergence); higher rank one dimensional elements. ▪ **Chapter three:** modeling techniques using the finite elements method; processing unit time CPU; modeling the geometric figure; using symmetry; modeling of cloning spaces; modeling of supports; modeling of joints. ▪ **Problems and exercises.** ▪ **Laboratory:** laboratorial exercises using the computer/ (ABAQUS) Program.				
4	**Automatic Control**	**4**	**2**	**-**	**6**
	Concept of block diagram; distinct functions of typical elements; mathematical analysis of the response by selective functions ofinput signal;functions of converting linear control systems and methods of analysing transient and stable systems; polar scheme and logarithmic representation (Bode scheme) of the frequent response; the stability indicators of linear control systems.				
5	**Graduation Project**	**2**	**-**	**2**	**4**
Grand Total		**14**	**10**	**2**	**26**

- **Second Semester**

Number of weeks per semester = 15 **Total duration of one Hour = 60 minutes**

	Course Name	Weekly Hours			
		Lecture	Tutorial	Lab.	**Total**
1	**ModernAutomotive Systems**	**2**	**-**	**2**	**4**
	Basic components and characteristics; hydraulic and electronic circuits for the following modern vehicle systems: ABS, ESP, TCS, EBD, VVT, ACC, HUDs, SRP (seat belts), Air bags, Blind spot system, anti-theft system.				
2	**TransportationPlanning and Economics**	**4**	**-**	**-**	**4**
	Introduction into transportation planning; logistics in transport; transportation technology (transportation engineering); transportation strategies; transportation programming and optimal utilization for transportation. Operations research: linear programming, simplex method, classical transport problem and the traveling salesmanproblem. Calculating transportation costs; the effect of transport on environment.				
3	**Cranes and Conveyors**	**2**	**2**	**-**	**4**
	•**Cranes:**an overview of the cranes; cranes mechanisms operating system; cranes operating system; calculating the basic components of cranes; shafts; bearings; gears; cranes power sources: manual; electrical; internal combustion engine; pneumatical. •**Hanging devices:** hooks; loops; catches; clamshells; buckets. •**Stopping and braking devices:**stopping devices – braking devices (brakes). •**Lifting mechanisms:** types of lifting mechanisms – starting and braking –				

	selecting the electrical engine. •**Moving mechanism:** types of moving mechanisms – normal moving mechanisms starting and breaking - starting and braking of the trailed moving mechanisms - selecting the electrical motor. •**Rotation mechanisms:** types of rotation mechanisms; starting and braking; calculating crane foundation; counterweights; stability of cranes.				
4	**Automotive Hydraulic and Pneumatic Systems**	**2**	**-**	**2**	**4**
	Basic principles and components of hydraulic and pneumatic systems; volumetric hydraulic machines; hydraulic equipment; basic functions of hydraulic system in vehicles; hydraulic transmission; vehicle pneumatic systems; practical applications.				
5	**Graduation Project**	**2**	**-**	**2**	**4**
Grand Total		**12**	**2**	**6**	**20**

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