Faculty of Science

Department of Physics

Study Plan for the Bachelor Degree in Physics

2019 / 2020

Vision:

Excellence in learning and teaching physics, scientific research and community service.

Mission:

Graduating students who are skilled and scientifically qualified in the field of physics by providing a stimulating educational and research environment to meet the labor market requirements.

Program Objectives:

1. Preparing graduates who are able to employ their practical and scientific capabilities to meet the needs of the labor market.
2. Developing students' skills in scientific thinking and problem solving in the field of physics and its applications.
3. Developing students' criticism and scientific research skills.
4. Encourage scientific research for faculty members in the field of physics.
5. Activating community service through volunteer programs conducted by students and faculty members.
6. Establishing the concept of professional ethics for students and working with them.

Intended Learning Outcomes (ILOs):

Student will be able to:
1. Knowledge of physical principles and concepts
2. Use the analytical ideas and views to understand classical mechanics, electricity and magnetism, quantum mechanics, and thermal physics. So, he/she can explain the natural phenomena that is relate to these sciences.
3. Possess the skills of connection and communication and work as one team.
4. Use the information and the communication technology in data collections as well as data analysis in physics.
5. Employ the modern knowledge on measurements, analysis of readings and conclusions in the correct scientific ways.

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Framework for Physics Bachelor Degree (135 Cr. Hrs.)

Classification	Hrs			Percentage
	Compulsory	Elective	Total	
University Requirements	**12**	**12**	**24**	**17.78 %**
Faculty Requirements	**21**	**0**	**21**	**15.56 %**
Program Requirements	**75**	**12**	**87**	**64.44 %**
Support Courses	**0**	**0**	**0**	**00.00 %**
Free Electives	**0**	**3**	**3**	**2.22 %**
Total	**120**	**90**	**135**	**100 %**

Course Numbering: Example (General Physics 1)

1 1	0 2	1 1	0	1
Faculty Code	**Dept. Code**	**Course Level**	**Knowledge Field**	**Sequence**

Knowledge Areas

Number	Knowledge Field	Cr. Hr.
0	General Physics	
1	Experimental Physics	
2	Light and Waves	
3	Electronics and Electromagnetic	
4	Thermodynamics and Statistical Mechanics	
5	Mechanics	
6	Modern Physics	
7	Solid State Physics	
8	Mathematical Physics and Computational Physics	
9	Training/graduation project/ Research paper and seminar	

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1. University Requirements: (24Credit Hours)
1.2. Compulsory University Requirements: (12Credit Hours)

Course No.	Course Title	Cr. Hr.	Prerequisite	Co-requisite
01101101	Military Sciences*	3	Jordanian student	
01101112	National Education*	3	Jordanian student	
01101102	Arabic Language**	3	01100011	
01101111	English Language**	3	01100012	
	Total	**12**		

*Non-Jordanian student has the right to register it or choose one of the courses offered by the university.
** If the student does not pass the level exams should be take the following courses:
Preparative Arabic language (01100011)   Preparative English language (01100012)   Preparative computer skills (0110005)

1.2. Elective: 15 Credit Hours from the following courses.

Course No.	Course Title	Cr. Hr.	Prerequisite	Co-requisite
01101103	Traffic Education	3	-	
01101104	Innovation and Entrepreneurship	3	-	
01101121	Life Skills	3	-	
01101131	Islamic Education	3	-	
01101132	Jerusalem and the Hashemite custodianship	3	-	
01101141	Sports and Health	3	-	
01101142	Environment and Society	3	-	
01101151	Computer Skills	3	01100051	
01101152	Internet and communication	3		
01101161	Economics System and Concepts	3	-	
01101171	Psychology and Society	3		
01101172	Modern language			
01101213	Communication Skills in Arabic	3	01101111	
01101214	Communication Skills in English	3	01101112	
01101243	Safety and First Aid	3		
01101281	Scientific Research Methods	3	-	
01101282	Introduction to Astronomy	3		
03011101	Law in Our Life	3	-	
03021201	Human Rights	3	-	

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2. Faculty Requirements: (21Credit Hours)
2.1 Compulsory Faculty Requirements: (21Credit Hours)

Course	Course Name	Hrs	Theory	Practical	Prerequisite	Co-requisite
06051211	Programming Fundamentals	3	3		01100051	
11011101	General Chemistry (1)	3	3		-	
11011281	General Biology	3	3		-	
11021101	General Physics (1)	3	3		-	
11031101	Calculus (1)	3	3		-	
11031141	Statistics and Probabilities	3	3		11031101	
11031202	Calculus (2)	3	3		11031101	
	Total	**21**	21			

2.2 Faculty Requirements Electives: (0 Credit Hours)

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3. Department Requirements (87 Credit Hours)
3.1. Compulsory Department Requirements: (75 Credit Hours)

Course	Course Name	Hrs	Prerequisite
11032164	Ordinary differential equations	3	11032103 Sim
11021111	General physics laboratory (1)	1	11021101 Sim
11021202	General physics (2)	3	11021101 Pre
11021212	General physics laboratory (2)	1	11021202 Sim
11022121	Optics	3	11021202 Pre
11022161	Modern Physics	3	11021202 Pre
11022181	Mathematical Physics (1)	3	11021202 Pre
11022213	Intermediate physics laboratory	1	11022121 Sim
11022222	Vibrations and waves	3	11022181 Pre
11022231	Electronics	3	11021202 Pre
11022282	Mathematical Physics (2)	3	11022181 Pre
11022283	Computer Applications in Physics	3	11022161 Pre
11023114	Electronics laboratory	1	11022231 Sim
11023123	Laser physics	3	11023162 Sim
11023132	Electromagnetic (1)	3	11022181 Pre
11023151	Classical Mechanics (1)	3	11022181 Pre
11023162	Quantum Mechanics (1)	3	11022181 Pre 11022161 Pre
11023215	Advance Physics laboratory	2	11022213 Pre
11023233	Electromagnetic (2)	3	11023132 Pre
11023241	Thermodynamics	3	11022161 Pre
11023252	Classical Mechanics (2)	3	11023151 Pre
11023263	Quantum Mechanics (2)	3	11023162 Pre
11024124	Environmental Physics	3	11023241 Pre
11024142	Statistical mechanics	3	11023162 Pre 11023241 Pre
11024143	Energy Physics	3	11023241 Pre 11022181 Pre
11024271	Solid State Physics	3	11023162 Pre 11023263 Pre
11032103	Calculus (3)	3	11031202 Pre
08012152	Curricula of Sciences and teaching methods	3	4th level
	Total	**75**	

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3.2. Compulsory Department Requirements: (75 Credit Hours)

Course	Course Name	Hrs	Prerequisite
11023164	Atomic and molecular Physics	3	11023162 Pre
11023172	Material Science	3	11022161 Pre
11023225	Medical Physics	3	11022161 Pre
11023234	Digital Electronics	3	11022131 Pre
11023253	Astro Physics	3	11023151 Pre 11023233 Pre
11024165	Nuclear Physics	3	11023162 Pre
11024226	Radiation Physics	3	11023162 Pre
11024266	Theory of Special Relativity	3	11022161 Pre
11024291	Selected Topics in physics	3	Department Approval
	Total	**12**	

4. Support Courses (0 Credit Hours)
5. Free Electives: 3 Credit Hours

Course No.	Course Title	Cr. hr.	Prerequisite	Corequisite
	Total	**3**		

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	First Year			
	First Term			
Course No.	**Course Title**	**Hrs.**	**Prerequisite**	**Corequisite**
11031101	Calculus (1)	3		
11021101	General Physics (1)	3		
11021111	General Physics Laboratory (1)	1		11021101
11011101	General Chemistry (1)	3		
11011281	General Biology (1)	3		
	University Requirement	3		
	Total	**16**		

	Second Term			
Course No.	**Course Title**	**Hrs.**	**Prerequisite**	**Co-requisite**
11021202	General Physics (2)	3	11021101	
11021212	General Physics Laboratory (2)	1		11021202
11031102	Calculus (2)	3	11031101	
06051211	Programming Fundamentals	3	01100051 or pass Computer Skills Entry Test	
11031141	Statistics and Probability	3	11031101	
	University Requirement	3		
	Total	**16**		

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	Second Year			

	First Term			
Course No.	**Course Title**	**Hrs.**	**Prerequisite**	**Co-requisite**
11032164	Ordinary Differential Equations	3		11032103
11022181	Mathematical Physics (1)	3	11021202	
11022161	Modern Physics	3	11021202	
11032103	Calculus (3)	3	11031202	
11022121	Optics	3	11021202	
	University Requirement	3		
	Total	**18**		

	Second Term			
Course No.	**Course Title**	**Hrs.**	**Prerequisite**	**Co-requisite**
11022181	Mathematical Physics (1)	3	11021202	
11022231	Electronics	3	11021202	
11022282	Applications of computer in Physics	3	11022161	
11022213	Intermediate Physics Laboratory	1		11022121
11022222	Vibration and Waves	3	11022181	
	Department Electives	3		
	Total	**16**		

Third Year				
First Term				
Course No.	**Course Title**	**Hrs.**	**Prerequisite**	**Co-requisite**
11023162	Quantum Mechanics (1)	3	11022181 11022161	
11023132	Electromagnetic (1)	3	11022181	
11023114	Electronics Laboratory	1		11022231
11023151	Classical Mechanics (1)	3	11022181	
11023123	Laser Physics	3		11023162
	University Requirement	3		
	Total	**16**		

Second Term				
Course No.	**Course Title**	**Hrs.**	**Prerequisite**	**Co-requisite**
11023263	Quantum Mechanics (2)	3	11023162	
11023233	Electromagnetic (2)	3	11023132	
11023241	Thermodynamics	3	11022161	
11023252	Classical Mechanics (2)	3	11023151	
11023215	Advance Physics Laboratory	2	11022231	
	University Requirement	3		
	Total	**17**		

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	Fourth Year			
	First Term			
Course No.	**Course Title**	**Hrs.**	**Prerequisite**	**Co-requisite**
11024142	Statistical Mechanics	3	11023241 11023162	
11024143	Energy Physics	3	11022181 11023241	
11024124	Environment Physics	3	11023241	
	Department Electives	3		
	University Requirement	3		
	University Requirement	3		
	Total	**18**		

	Second Term			
Course No.	**Course Title**	**Hrs.**	**Prerequisite**	**Co-requisite**
11024271	Solid State Physics	3	11023162 11023263	
08012152	Curricula of Sciences and teaching methods	3	4th level	
	Department Electives	3		
	Department Electives	3		
	University Requirement	3		
	Free course	3		
	Total	**18**		

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11021101	General Physics (1)	3 Credit Hours	Prerequisite: No

Motion in one Dimension, Vectors, Motion in two Dimensions, Newton's law of motions, Circular Motion and Other Applications of Newton's Laws, Work Energy Theorem, Conservation of Energy, Linier momentum and Collisions , Rotation of a Rigid Object About a Fixed Axis

11021202	General Physics (2)	3 Credit Hours	11021101 Pre

Electric charge, Electric force, Electric field, Gauss law, Electric potential, Electric potential Energy, Capacitance and dielectrics, Current and resistance, DC Circuits, Ohm's law, Kirchhoff's Laws, Magnetic field, Lorentz's Force Law. Sources of magnetic fields, Biot and Savart law, Ampere's law, electromagnetic induction, Faraday's and Lenz law. Induced electromotive force and self-inductance.

11021111	General Physics laboratory (1)	1 Credit Hour	11021101 Sim

Measurements and Uncertainties, Vectors and Forces in Equilibrium, Motion in One Dimension, Projectiles Motion, Force and Motion, Simple pendulum, Newton's Laws of Motion, Friction, Conservation of Energy Principle, Conservation of Linear Momentum. Viscosity

11021212	General Physics laboratory (2)	1 Credit Hour	11021202 Sim

Galvanometer Experiment, Ohm's law, Electric Field and Electric Potential, Capacitors, Wheatstone bridge, Electromotive Force, Kirchhoff's laws, Electric Circuits of Resistance, Capacitors and Inductance.

11022213	Intermediate physics laboratory	1 Credit Hour	11022121 Sim

Experiment in applied Optics: Prism, Diffraction of Light through a Single Slit, Polarization of Light, Millikan's Oil Drop Experiment, Kerr Effect, Faraday's Effect, Measurement of Plank Constant, Diffraction of Light through a Multiple Slits, Michelson Interferometer.

11023114	Electronic laboratory	1 Credit Hour	11022231 Sim

Experiments on Semiconductor devices, Diodes, Transistors, Rectification and Filtering, Voltage Stabilizer, Amplifiers, Electronic Timer.

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| 11023215 | **Advance Physics laboratory** | **2 Credit Hour** | **11022213 Pre** |

Experiments on Nuclear and Atomic Physics: Rutherford Experiment, Spectrum of Gamma Radiation, Electron Spin Resonance, Frank – Hertz, Black Body Radiation, Hall Effect, Diffraction of X-Ray, Diffraction of Electrons, Measurement of Charge and Mass of an Electron. Nuclear Magnetic Resonance.

| 11022121 | **Optics** | **3 Credit Hour** | **11021202 Pre** |

Vibrations, Wave Motion and Equation of Motion, Waves, Longitudinal and Transverse waves, Polarization and Malus Law Reflection and Refraction and Snell Law, Geometrical Optics, Mirrors and Lenses, Interference, Huygens' Principle, Young's double slit, interference measurement, single slit and two slit diffraction, diffraction of X-rays and Bragg's law

| 11022222 | **Vibrations and Waves** | **3 Credit Hour** | **11022181 Pre** |

Simple and damped harmonic motion, simple harmonic and damped oscillators, energy decay, forced vibrations, forced oscillator, synchronized vibrations, wave motion of oscillators, transverse wave motion, reflectance and permeability of transverse waves, longitudinal waves, longitudinal waves in gases and in solids, electromagnetic waves, Maxwell's equations, and the Poynting vector.

| 11023123 | **Laser physics** | **3 Credit Hour** | **11023162 Sim** |

Emission and Absorption of Light, Einstein Relations, Inversion Population, Gain Factor, Optical Resonance, Laser types, Solid State Lasers, Gas laser, Diode lasers, Semiconductor Lasers, Liquid Dye Lasers, Laser of Free Electron, Modern Laser Types, Laser Characteristics, Laser Wavelength Lines, Coherent Laser Beam, Focused Laser Beams, Frequency Doubling, Application of Laser: Medical Applications, Industrial, Military, Measurements, Holography, Communications.

| 11024124 | **Environment physics** | **3 Credit Hour** | **11023241 Pre** |

Properties of Gases and Liquids. Laws of thermodynamics and the human body, Energy transfers. Transport of Heat, Mass, and Momentum, Transport of Radiant Energy, Solar Radiation, Atmosphere and radiation, Noise pollution , water, wind, physics of ground, energy for living.

| 11023225 | **Medical physics** | **3 Credit Hour** | **11022161 Pre** |

Biomechanics, biomechanical fluids, sound and hearing, light and vision, heat and heat temperature, electricity and magnetism in human body, using radiation and ionic radiations, radiation therapy, diagnostic radiology (Medical Imaging), radiobiology, dosimetry, radiation protection.

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11024226   Radiation physics   3 Credit Hour   11023162 Pre

Structure Of atoms, Radiations Source, Radioactivity, interaction of radiations with matter, Radiation unit and limit, X ray Predictions radiations detection, radiations dosimeters, radiation exposure, radiation hazard, radiation shielding, and Radiation in life.

11022231   Electronics   3 Credit Hour   11021202 Pre

Direct current circuits, alternating current circuits, semiconductors, diode theory, diode circuits, special-purpose LEDs, transistors, transistor basics and bias circuits, voltage amplifiers, power amplifiers, field transistor effect and its circuits, operational amplifier theory, operational amplifier circuits and applications, generators wave and frequency generators, timer.

11023132   Electromagnetic (1)   3 Credit Hour   11022181 Pre

Electrostatic Fields, The Electric Field Vector, The Flux Density Vector, The Gauss Theorem, Boundary Conditions, The Laplace-Poisson Equation, The Electrostatic Potential, The Legendre's Expansion of Potential, The Laplace Equations in Spherical Coordinates, Series Expansion of the Coulomb Potential, Legendre's Polynomials, A Conducting Sphere in a Uniform Field, Ampere's Law. Magnetic field in matter bara and diamagnetic.

11023233   Electromagnetic (2)   3 Credit Hour   11023132 Pre

The bound currents, magnetic field in linear materials. the force between currents, Magnetic Induction, the variable current with time, Maxwell equations, the conservation of charge and energy as well as momentum in electromagnetic fields, Electromagnetic waves, boundary conditions on traveling electromagnetic waves, the reflection and refraction laws in electromagnetic waves, electromagnetic radiation, waveguide.

11023234   Digital electronics   3 Credit Hour   11022131 Pre

Number systems and Codes, Logic States, Decimal, Binary and Hexadecimal Systems, Hexadecimal to Binary Conversion, Binary to Decimal Conversion, Binary Addition and Subtraction, Basic logic Gates, Gate Invertors, Half Adder and Full Adder. Boolean Algebra and Reduction Techniques, Exclusive- OR and Exclusive- NOR Gates, Arithmetic Operations and circuits, Code Converters. Coder/Decoder, Integrated Circuits, Karnaugh Map for Three and Four Variables. Multiplexers, and De -multiplexers, Flip-Flops, Counter circuits.

11023241   Thermodynamics   3 Credit Hour   Prerequisite: 11022161

Expectation values, Probability, ensemble theory, thermal equilibrium, temperature, fluctuations, partition function, Helmholtz free energy, ideal gas, atom in a box, atoms in a box, equipartition of energy, Planck's law and Stephen-Boltzmann's law, emission and absorption, photons in solids, Gibbs coefficient and Gibbs sum, Fermi-Dirac distribution and Bose-Einstein distribution.

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11024142	Statistical mechanics	3 Credit Hour	11023162 Pre 11023241 Pre

Statistics, Binomial Distribution, Macroscopic and Microscopic States, Entropy and the number of Microstates, Gibbs Paradox, Liouville's Theorem, Partition Function, Micro-canonical Ensemble, Quantum States and Phase Space, Canonical Ensemble, Energy Fluctuation in Canonical Ensemble

11024143	Energy physics	2 Credit Hour	11022181 Pre 11023241 Pre

Energy, work and energy, power, energy conservation, electric energy and its generation and transfer, fossil fuels, oil, shale, natural gas, coal, nuclear energy, nuclear fission and fusion, solar energy, solar energy uses, electromagnetic waves, photovoltaic electricity, water energy, water wheels, dams, tides, wave energy, bioenergy, photosynthesis, biofuels, bioenergy sources and consumption, reuse, and recyclable waste.

11023151	Classical mechanics (1)	3 Credit Hour	11022181 Pre

Matrices and vectors calculus, Newton's mechanics-single particle and the Motion in to dimension, Conservation Laws, Linear and Nonlinear Oscillations, Gravitation

11023252	Classical mechanics (2)	2 Credit Hour	11023151 Pre

Calculus of Variation using Euler's equations, Lagrange equations of motion, Hamilton's equations of motion used to describe central force motion, Generalized Coordinates, dynamic of system of particle, center of mass, Elastic and inelastic collision, The energy, linier momentum and angular momentum.

11023253	Astro Physics	3 Credit Hour	11023233 Pre 11023151 Pre

Stars (its movements, distances, luminosity, absolute magnitude, temperatures and sizes, multi-stars systems, variable stars distribution, inter-stellar mediums, births and ages of stars, death of stars(white dwarf, pulsating neutron stars, black hole),the Milky way, galaxies, the cosmos).

11022161	Modern physics	3 Credit Hour	11021202 Pre

Special and general relativity, particle characteristics of waves, electromagnetic waves, black body radiation, Compton phenomenon, particle wave properties, De Broglie waves, principle of uncertainty, atomic structure, Bohr's atom, atomic excitation, quantum mechanics, wave equation, Schrödinger equation, particle in box, quantum theory of a Hydrogen atom

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| 11023162 | Quantum mechanics (1) | 3 Credit Hour | 11022181 Pre |
| | | | 11022161 Pre |

The Limitation of the Classical Physics, Heisenberg's Uncertainty Principles, Operators and Hilbert's Space, Reciprocal Relationships, Schrodinger's Equations, Wave Mechanics, Solving the Schrodinger's Equations in One Dimension, Schrodinger's Equations in One Dimension, Simple Harmonic Oscillator, Momentum, Rotational and Spin Momentum Effects, Hydrogen Atom, Solve the Schrodinger Equation for Hydrogen Atom.

| 11023263 | Quantum mechanics (2) | 3 Credit Hour | 11023162 Pre |

A Review of the Model of the Hydrogen Atom, The interaction of the Electron with the Magnetic Field, Matrix Representation of Angular Momentum and Spin, Commutation of the Angular Momentum and the Spin, Time-Independent Perturbation Theory, The Hydrogen Atom and the Helium Atom, Collision and Scattering Theory, Applications of Quantum Mechanics in Nuclear Physics, Time-dependent Perturbation Theory.

| 11023164 | Atomic and molecular physics | 3 Credit Hour | 11023162 Pre |

Classical atomic theories, quantum mechanics, hydrogen atoms, spin and angular momentum and magnetic moment of the electron, interactions with electric and magnetic fields, Zeeman effect, Stark effect, interaction with electromagnetic radiation, transition probabilities and Einstein coefficients, dipole approximation, quadrupole interactions, two electron atoms, the spin wave function and the Pauli's principle, stable and excited states, multi-electron atoms, Thomas and Fermi models, molecular structure and spectra of diatomic molecules.

| 11024165 | Nuclear physics | 3 Credit Hour | 11023162 Pre |

Nuclear Properties, Nuclear Force, nuclear models nuclear decay, beta decay, gamma decay, an overview of nuclear reactions, fissions and fusion, some applications to orbital models, nuclear distortion, and uniform model, electromagnetic interactions, weak interactions.

| 11024266 | Theory of special relativity | 3 Credit Hour | 11022161 Pre |

The foundations of classical mechanics, deviations from Newtonian dynamics, the essence and propagation of light, the description of relativistic motion, Lorentz-Einstein transformations, relativity and lengths and chronometry, accelerated motions, relative dynamics, mass of static and moving particles, equivalence of mass and energy, Lorenz transformations of energy and momentum, quadruple vectors ,Relativity Electromagnetism, Summary of relativistic Electromagnetic.

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11024271	Solid State Physics	3 Credit Hour	11023162 Pre 11023263 Pre

Definition of solid state, crystals grow, crystals, amorphous and nanoparticles, atomic bonding, crystal , miller indices, lattice constants, lattice defects, Fourier transformation in periodic systems, wave diffraction and reciprocal lattice and brillouin zone, x-ray diffraction, lattice vibrations and phonons, thermal properties of materials, heat capacity, plank distribution , density of state , Debye model, Einstein model, free electron (fermi gas) model, electric ,optical and thermal properties of electron gas.

11023172	Material Science	3 Credit Hour	11022161 Pre

Classification of Materials, atomic structures and solid crystals structure, binding forces and crystal systems, diffusion , stable and unstable ,mechanical properties of metals ,stress and strain, electrical properties materials, conductors, semiconductors and insulators, thermal properties of materials, thermal conductivity and expansion, magnetic properties of materials, types of magnetic materials, magnetic storage systems, optical properties of materials, reflection, absorption and transparent

11022181	Mathematical physics (1)	3 Credit Hour	11021202 Pre

Complex numbers, complex algebra and complex series, vector analysis, Green's and Stoke theorems, linear equations: matrices and determinants, Laplace transform, Cramer's rule, matrix operations, coordinate transformations, linear and orthogonal transformations, Fourier series, wave and periodic functions, Fourier transform, differential equations, partial differential equations, linear equations of first, second and third order (homogeneous and inhomogeneous).

11022182	Mathematical physics (2)	3 Credit Hour	11022181 Pre

Conjugate variables, Euler's equation, Lagrange's equations, Gamma function, Beta function, Beta functions in terms of Gamma functions, Stirling's equation , Bessel 's equation, plots of Bessel's function and its zeros , differential equations solved by Bessel's equation, Laplace's equation applied to a constant temperature plate, wave equation, heat flow equation, contour integrals, residue theorem.

11022283	Computer Applications in Physics	3 Credit Hour	11022161 Pre

Excel Applications: understand Worksheets, Create Spreadsheets and Enter Data, Graphical Objects, Add Graphics to worksheets, Perform calculations with Functions, Excel Applications in physics:in one dimensions, projectile motion, simple pendulum, simple harmonic motion, Kirchhoff's laws and electric circuits, Introduction to Matlab, basic mathematical operations, matrix, plotting and graphs using matlab, derivatives and integrations , scripts, numerical methods, Euler methods, applications in solving physical problems by matlab, introduction to Python program, using python to solve mathematical and physical problems.

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