NED UNIVERSITY OF ENGINEERING & TECHNOLOGY
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No.Acad/27(185)/39130 **Dated: 03-10-2023**

NOTIFICATION

In pursuance to powers delegated to the Academic Council by Syndicate vide its Resolution No.Syn-186.4(b) dated 26-10-2018, it is hereby notified that the Academic Council vide its Resolution No. AC-161.5(vi) dated 05-09-2023 has approved revised list of elective courses of BS (Physics) for Batch 2023 and onwards at the Department of Physics, as under:

Revised list of Elective Courses

S. No	Course Code	Title	Cr Hr. Theory	Cr Hr. Practical	Cr Hr. Total
1.	MY-402	Advanced Materials	3	0	3
2.	PH-313	Cosmology and Theory of Relativity	3	0	3
3.	PH-419	Fundamentals of Medical Physics	3	0	3
4.	PH-420	Nano Science and Nanotechnology	3	0	3
5.	PH-411	Applications of Space Physics	3	0	3
6.	PH-421	Vacuum Science	3	0	3
7.	PH-422	Plasma Physics	3	0	3
8.	PH-423	Surface Science and Applications	3	0	3
9.	PH-424	Essentials of Health Physics	3	0	3
10.	PH-425	Microwave Systems	3	0	3
11.	PH-426	Essentials of Quantum Field Theory	3	0	3
12.	PH-427	Dielectric Materials	3	0	3
13.	PH-428	Renewable Energy Sources	3	0	3
14.	PH-429	Environmental Physics	3	0	3
15.	PH-430	Optoelectronic Devices	3	0	3

PH-423 Surface Science and Applications			
	Cr. Hrs.	Contact Hrs.	Exam Marks
Th.	3	3	100
Pr	0	0	0

Basics of Surface Sciences: Surface reactions, Adsorption phenomena, Heterogeneous catalysis, Semiconductor technology, Corrosion, Nanotechnology, Surface structure and classification of solids, Crystal structure, Unit cell, Bravais lattices, Band structure of metals, Insulators, and semiconductors, Fermi level, Screening, Work Function, Surface States, Electron affinity, Ionization potential, Surface chirality, Thermodynamics of surfaces, Equilibrium crystal shape.

Quantum Confinement of Electrons at Surfaces: Nucleation and growth of nanostructures and films, Magnetism in thin films.

Microscopic and Spectroscopic Techniques: Magneto Optic Kerr Effect and Kerr microscopy, Spin-Polarized Photoemission, Magnetic Force Microscopy, Surface study techniques, High-Energy Electron Diffraction, Near-Edge X-ray Absorption Fine Structure, High-Resolution Electron Energy Loss Spectroscopy, Desorption techniques, Electron spectroscopy, Mean free path, Koopman's theorem, Spin-orbit coupling effects, Chemical shifts, Binding energy, Electron analyzer, Electron optics, Scanning Tunneling Microscopy.

Applications: Silicon surfaces, Molecular adsorption on semiconductor surfaces, Adsorption properties of CO on metal, Single-crystal surfaces, Molecular or dissociative adsorption, Chemical bonding, and orientation, Adsorption site as a function of coverage, Overlayer long-range order, Ammonia synthesis, Oxide surfaces, Photovoltaic and organic electronics.

Recommended book(s) for the approved course
(Author's name, "*Title",* edition, publisher, publication year).

Textbook(s)

1. Kurt W. Kolasinski, "*Surface Science: Foundations of Catalysis and Nanoscience*", 4th edition, Wiley, 2019.
2. Mario Rocca, Talat Rahman ," ,Luca Vattuone*Springer Handbook of Surface Science*", Springer, 2021.

Reference Book(s)

1. Yury Gogotsi, " ,V. Domnich*High Pressure Surface Science and Engineering*", 1st edition, CRC Press, 2019

PH-424 Essentials of Health Physics

	Cr. Hrs.	Contact Hrs.	Exam Marks
Th.	3	3	100
Pr	0	0	0

Ionizing Radiation Detectors: Basic principles of radiation detection, Ionization chambers, Proportional and Geiger-Muller counters, and Scintillation detectors.

Radiation Spectroscopy: Radiation spectroscopy using scintillation detectors; Semiconductor detectors, CdZnTe detectors, and Neutron detection techniques.

Safety Standards for Ionizing Radiation Exposure: Radiation quantities & units, Safety standards for medical exposure, Estimation and control of external & internal exposure hazards, Absorbed dose estimation from external exposure, and Shielding.

Radiation Dose Estimation Models and Calibration: Design of neutron and gamma sources, Dose estimation from internally deposited radionuclides, International Atomic Energy Agency safety regulations for the transport of radioactive materials, Radiation accident management & early medical treatment of radiation injury, Calibration of survey meters.

Shielding Design of Radiation Facility and Radioactive Waste Management: Shielding and other design considerations for medical facilities, Regulatory and licensing requirements for medical facilities, and Radioactive waste disposal methods.

Recommended book(s) for the approved course
(Author's name, "*Title",* edition, publisher, publication year).

Textbook(s)

1. Kirsten Franklin, Paul Muir, Terry Scott, Paul Yates, "*Introduction to Biological Physics for the Health and Life Sciences"*, 2nd edition, Wiley, 2019
2. John P. Gibbons*,"Khan's The Physics of Radiation Therapy", 6th edition*, Lippincott Williams & Wilkins (LWW), 2019

Reference Book(s)

1. Thomas Johnson, *"Introduction to Health Physics"*, 5th edition, McGraw Hill / Medical, 2017

PH-425 Microwave Systems

	Cr. Hrs.	Contact Hrs.	Exam Marks
Th.	3	3	100
Pr	0	0	0

Plane Waves: Wave equation, Poynting theorem, Plane wave propagation in different media. Reflection, Refraction, Scattering, Absorption, and diffraction.

Smith Chart and Scattering Parameters: Smith chart theory and applications, Smith chart Impedance, Admittance manipulation on the chart, Reflection coefficient, Impedance of distributed circuits, Impedance matching, and S-Parameters.

Microwave Passive Devices: Coupled Quasi-TEM Lines, The Directional Coupler, Interference Couplers, Power Combiners and Dividers.

Microwave Active Devices: Bipolar and field effect transistors, Varactors, Step recovery diodes, Multipliers, Parametric amplifiers, Tunnel diodes, Negative resistance amplifier, Gunn effect, Avalanche effect diode, Klystron, Magnetron, and traveling wave tube.

Recommended book(s) for the approved course

(Author's name, "*Title",* edition, publisher, publication year).

Textbook(s)

1. Subhash Chandra Bera, *"Microwave Active Devices and Circuits for Communication"*, 1st edition, Springer, 2019
2. Cameron, Richard J, Chandra M Kudsia, and Raafat R Mansour "*Microwave filters for communication systems: fundamentals, design, and applications"*, 2nd edition, John Wiley & Sons, 2018

Reference Book(s)

1. Giovanni Ghione, Marco Pirola, "*Microwave Electronics*", Cambridge University Press, 2018

PH-426 Essentials of Quantum Field Theory

	Cr. Hrs.	Contact Hrs.	Exam Marks
Th.	3	3	100
Pr	0	0	0

Preliminary Concepts: Nonrelativistic quantum mechanics, Lorentz covariance, Klein-Gordon equation, Feynman-Stuckelberg solutions, Nonrelativistic perturbation theory, Scattering amplitude.
Lagrangian Field Theory: Classical field theory, Canonical quantization, Noether's theorem.
Klein-Gordon Field: Real Klein-Gordon field, Complex Klein-Gordon field, Covariant commutation relations, Meson propagator.
Dirac Field: Number representation for fermions, Quantization of Dirac field, Spin-statistics theorem, Fermion propagator.
Electromagnetic Field: Classical electromagnetic field, Covariant quantization, Photon propagator.
Interacting Fields: Interaction Lagrangian and gauge invariance, Interaction picture, S-matrix expansion, Wick's theorem, Feynman diagrams, Feynman rules for Quantum electrodynamics (QED), Cross sections and decay rates.

Recommended book(s) for the approved course

(Author's name, "*Title",* edition, publisher, publication year).

Textbook(s)

1. Jakob Schwichtenberg, "*No-Nonsense Quantum Field Theory: A Student-Friendly Introduction*", No-Nonsense Books, 2020
2. Tom Lancaster, Stephen J. Blundell, "*Quantum Field Theory for the Gifted Amateur*", Oxford University Press; Illustrated edition, 2014

Reference Book(s)

1. Anthony Zee, "Quantum Field Theory, as Simply as Possible", Princeton University Press, 2023

PH-427 Dielectric Materials

	Cr. Hrs.	Contact Hrs.	Exam Marks
Th.	3	3	100
Pr	0	0	0

Dielectrics in Electrostatics: Electric dipole moment and the electric polarization mechanisms, Perfect and a real dielectric, bound charge densities, Polarization current density, Local field, Electric susceptibility, Electric displacement D, Electric permittivity, Molecular polarizability and Clausius-Mossotti equation, Langevin equation, Dielectrics in time-varying electric fields, Response of a dielectric in time and frequency domain, Kramers-Kronig relations, Dispersion.
Theories for Interpretation of Data: Debye model, DRT, Power law, Universal response, Low-frequency dispersion, Maxwell-Wagner response, Diffusive model, Many body phenomena, Local field theory.
Measuring Techniques: Frequency and time domain techniques, DC measurements, DC potential probing, Resonance method, Phase method, Schering bridge, Optical methods.
Analysis of Dielectric Measurements: Impedance spectroscopy, Admittance spectroscopy, Cole-Cole plot, Cole Davidson plot, Normalization of dielectric data, Arrhenius plot, Experimental results on different materials.

Recommended book(s) for the approved course

(Author's name, "*Title",* edition, publisher, publication year).

Textbook(s)

1. Evgenij Barsoukov, J. Ross Macdonald, "*Impedance Spectroscopy: Theory, Experiment, and Applications*", Wiley, 2018.
2. ByGorur Govinda Raju, "*Dielectrics in Electric Fields*", 2nd edition, Taylor & Francis, CRC, 2016

Reference Book(s)

1. Kwn Chi Kao, "*Dielectric Phenomena in Solids*", 1st edition, Academic Press, 2002
2. Yuriy Poplavko, Yuriy Yakymenko, "*Functional Dielectrics for Electronics: Fundamentals of Conversion Properties*", 1st edition, Woodhead Publishing, 2020

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PH-428 Renewable Energy Sources			
	Cr. Hrs.	**Contact Hrs.**	**Exam Marks**
Th.	**3**	**3**	**100**
Pr	**0**	**0**	**0**

Significance of Alternative Sources of Energy: Limitation of fossil fuels, Need for renewable energy, Renewable energy resources, and their sustainable development, Potentials, and possibilities.

Solar Energy: Solar energy its importance, Solar cell, Photovoltaic (PV) systems and characteristics, Sun tracking systems.

Wind Energy: Fundamentals of wind energy, Wind turbines, and different electrical machines in wind turbines.

Tidal Energy: Ocean energy potential against wind and solar, Wave energy devices, Tide energy technologies, Ocean thermal energy, Osmotic power, and Ocean bio-mass.

Geothermal Energy: Geothermal resources, Geothermal technologies, Liquid-dominated plants, Enhanced geothermal systems.

Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydropower sources.

Other Sources of Alternate energy: Biomass, Biochemical conversion, Biogas generation.

Recommended book(s) for the approved course

(Author's name, "*Title",* edition, publisher, publication year).

Textbook(s)

1. John Twidell, "*Renewable Energy Resources*", 4th edition, Routledge, 2021.
2. Martin Stutzmann, Christoph Csoklich, "*The Physics of Renewable Energy*", 1st edition, Springer, 2023

Reference Book(s)

1. Kumar, N., H. Singh, and A. Kumar, "*Renewable Energy and Green Technology: Principles and Practices*", 1st edition, CRC Press 2021.

PH-429 Environmental Physics			
	Cr. Hrs.	**Contact Hrs.**	**Exam Marks**
Th.	**3**	**3**	**100**
Pr	**0**	**0**	**0**

Essentials of Environmental Physics: Economic system, Living in the greenhouse, Enjoying the sun, Transport of Matter, Energy, and momentum.

Basic Environmental Spectroscopy: emission spectrum of the sun, Transition electric dipole moment, Einstein coefficients, Lambert – Beer's law, Spectroscopy of bi-molecules, Solar UV and life, Ozone filter.

The Global Climate: Energy balance, Zero-dimensional greenhouse model, Elements of weather and climate, Climate variations and modeling.

Noise: Basic acoustics, Human perceptions, and noise criteria, Reducing the transmission of sound, Active control of sound.

Radiation: General laws of radiation, natural radiation, Interaction of electromagnetic radiation and plants, Utilization of photosynthetically active radiation.

Atmosphere and Climate: Structure of the atmosphere, Vertical profiles in the lower layers of the atmosphere, Lateral movement in the atmosphere, Atmospheric circulation, Cloud and precipitation, Atmospheric greenhouse effect, Climatology, and measurements of climate factors.

Recommended book(s) for the approved course

(Author's name, "*Title",* edition, publisher, publication year).

Textbook(s)

1. Robert Zakinyan, Arthur Zakinyan, "*Physics of the Atmosphere, Climatology and Environmental Monitoring: Modern Problems of Atmospheric Physics, Climatology and Environmental Monitoring*", 1st edition, Springer, 2023

Reference Book(s)

1. John Monteith, Mike Unsworth, "*Principles of Environmental Physics: Plants, Animals, and the Atmosphere*", 4th edition, Academic press, 2013
2. Abel Rodrigues, Raul Albuquerque Sardinha, Gabriel Pita, "*Fundamental Principles of Environmental Physics*", 1st edition, Springer, 2021

PH-430 Optoelectronic Devices			
	Cr. Hrs.	**Contact Hrs.**	**Exam Marks**
Th.	**3**	**3**	**100**
Pr	**0**	**0**	**0**

Excitation and Emission processes: Radiative and non-radiative process, energy-momentum diagram, direct and indirect band transitions.

Photovoltaics: Solar radiation and air mass, Photovoltaic effect and solar cells, I-V characteristics, Solar cell classifications and materials, Arrays, and modules.

Lasers: Necessary requirements for laser production, Classes of lasers, Doped insulator lasers, Gas lasers, Liquid lasers, Semiconductor lasers, Semiconductor laser structures, Homojunction lasers, Hetero junction lasers, Quantum well lasers.

Photodiodes: Principle of optical detection, Quantum efficiency and responsitivity, Photodetectors, P-N junction, Positive-Intrinsic-Negative diode (PIN) and materials, Schottky and avalanche photodiodes, Phototransistor.

Light Emitting Diodes: Optical processes in semiconductors, Electroluminescence, Internal quantum efficiency, Critical angle, Optical efficiency.

Optoelectronic Integration: Hybrid and monolithic integration, Applications of optoelectronic integrated circuits.

Recommended book(s) for the approved course

(Author's name, "*Title*", edition, publisher, publication year).

Textbook(s)

1. Naci Balkan, Ayşe Erol, "*Semiconductors for Optoelectronics: Basics and Applications*", 1st edition, Springer, 2021
2. Safa Kasap, "*Optoelectronics & Photonics: Principles & Practices*", 2nd edition, Pearson, 2012

Reference Book(s)

1. Bahaa E. A. Saleh, Malvin Carl Teich, "*Fundamentals of Photonics*", 3rd edition, Wiley, 2019
2. Michael A. Parker, "*Physics of Optoelectronics*", 1st edition, CRC Press, 2005

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REGISTRAR

To,

Chairperson, Department of Physics

Copy to:-

1- Dean (ASC)
2- Controller of Examinations
3- Director, I.T. Department
4- Mr. Muhammad Riaz, AR (Acad)

Copy for information to:-

1- PS to the Vice Chancellor
2- PA to Pro-Vice Chancellor
3- Director QEC