Curriculum
of
Bachelor of Science in Physics
(BS Physics)

Department of Physics

Faculty of Natural & Applied Sciences

Mirpur University of Science and Technology (MUST), Mirpur
AJK, Pakistan.

Mirpur University of Science & Technology (MUST), Mirpur

Vision of the University

To be a superior teaching and research institution, having transformative impact on society and acting as a knowledge corridor between Azad Jammu & Kashmir, Pakistan and rest of the world.

Mission of the University

MUST is committed to all-encompassing growth of its students, besides enabling them to tap the world of knowledge and assume leadership roles in the future through a process of continual innovation in education, research, creativity, technological advancement and entrepreneurship.

Faculty of Natural and Applied Sciences Mission Statement

To produce human resource of integrity, who should be able to cater the needs of the public and private sector by their capabilities for understanding and solving the National and International problems.

Department of Physics

Vision of the department

To provide broad, innovative and quality education in physics to contribute to greater good of community.

Mission of the Department

To impart quality education in physics with the aim to serve the nation by providing skilled human resource.

Mission of the BS Program

To produce well-rounded critical thinkers and lifelong graduates who are prepared to successfully perform in higher study or professional work in Physics, education, or relevant fields.

BS PHYSICS PROGRAM

Curriculum of BS Physics Program

The Curriculum of BS 4-year Program in Physics from Session 2019 is prepared in the light of guidelines of HEC, Pakistan. A total of 124-136 credit hours are required for BS in Physics. The details of the curriculum are as follows:

<table>
<tr><th colspan="2">Content</th><th colspan="4">Description</th></tr>
<tr><td>1</td><td>Title of the Degree</td><td colspan="4">Bachelor of Science in Physics (BS Physics) or as per University Policy</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Entrance Requirement</td><td colspan="4">Intermediate or equivalent with physics and mathematics with minimum 45% marks (2nd division), from an accredited institution. Three-year Engineering diploma with math and physics</td></tr>
<tr><td colspan="4">No D-grade in academic career</td></tr>
<tr><td colspan="4">Entry Test will be conducted by the University with the following breakup:
Physics: 30 %
English: 10%
Mathematics: 30%
Chemistry or Computer: 30%
Merit will be determined on 20% of SSC, 50% of Intermediate and 30% of Entry Test marks (As per University Policy).</td></tr>
<tr><td>3</td><td>Duration of the Program</td><td colspan="4">8-12 Semesters</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Credits (Credit Hours)</td><td colspan="4">Course Work: 130 Credits</td></tr>
<tr><td colspan="4">Project/ Special Papers: 06 Credits</td></tr>
<tr><td colspan="4">Total Credits: 133</td></tr>
<tr><td rowspan="6">5</td><td rowspan="6">Evaluation Criteria (Examination)</td><td rowspan="3">Sessional</td><td></td><td>Theory Courses</td><td>Lab Courses</td></tr>
<tr><td>Two Quizzes</td><td>10 %</td><td>-</td></tr>
<tr><td>Two Assignments/ Lab reports</td><td>10 %</td><td>25 %</td></tr>
<tr><td>Mid Examination</td><td>Mid Examination</td><td>30 %</td><td>25 %</td></tr>
<tr><td rowspan="2">Terminal Exam.</td><td>Practical</td><td>-</td><td></td></tr>
<tr><td>Terminal Exam</td><td>50 %</td><td>50 %</td></tr>
<tr><td>6</td><td>Requirement for the Award of Degree</td><td colspan="4">Completion of degree within the prescribed time with at least 60% cumulative percentage and CGPA 2.50 (As per university Policy)</td></tr>
</table>

Scheme of Study (Structure)

Sr. No.	Category	No. of Courses	Credits
01	Compulsory Courses	08	22
02	General Courses	07	21
03	Foundation Courses	11	27
04	Major Courses	18	55
05	Electives Courses	03	09

Layout/Framework

Category	Course Title	Credits
Compulsory	English I	03
	English II	03
	English III	03
	Pakistan Studies	02
	Islamic Studies	02
	Math-I (Calculus-I)	03
	Math-II (Calculus-II)	03
	Introduction to Computing	03
	Total	**22**
General Courses	Programming Fundamentals (GRF-I)	03
	Probability and Statistics (GRF-II)	03
	Linear Algebra (Math-III)	03
	Differential Equations (Math-IV)	03
	Three social science (GOF) courses will be taught from the following list: 1. Arabic 2. Economics 3. Entrepreneurship 4. Human Resource Management 5. International Relations 6. Introduction to management 7. Kashmir Studies 8. Mass Communications 9. Organizational Behavior 10. Psychology	 03 03 03 03 03 03 03 03 03 03

	11. Sociology	03
	Total	**21**
Foundation Courses	Mechanics	04
	Waves & Oscillations	03
	Heat & Thermodynamics	03
	Electricity and Magnetism	04
	Modern Physics	03
	Optics	03
	Computational Physics	03
	Lab-I	01
	Lab-II	01
	Lab-III	01
	Lab-IV	01
	Total	**27**
Major Courses	Mathematical Method of Physics-I	03
	Classical Mechanics	04
	Electromagnetic theory I	03
	Electronics-I	03
	Lab-V	02
	Mathematical Method of Physics-II	03
	Quantum Mechanics-I	03
	Electromagnetic Theory-II	03
	Electronics-II	03
	Thermal & Statistical Physics	03
	Lab-VI	02
	Nuclear Physics Quantum Mechanics-II	03 03
	Atomic Physics	03
	Solid State Physics-I	03
	Lab-VII	02
	Solid State Physics-II	03
	Research Project/Special Paper/Elective	06
	Total	**55**

Elective Courses	**Elective – I**	
	Elective – II	
	Elective – III	
	Note: These Courses will be Selected from the list of elective Courses. 1. Astro Physics (PHY-XX29) 2. Atomic and Molecular Spectroscopy (PHY-XX30) 3. Computer Simulations in Physics (PHY-XX31) 4. Digital Electronics (PHY-XX32) 5. Electronic Materials and Devices (PHY-XX33) 6. Environmental Physics (PHY-XX34) 7. Experimental techniques in Particle and Nuclear Physics (PHY-XX35) 8. Fluid Dynamics (PHY-XX36) 9. Introduction to Materials Science (PHY-XX37) 10. Introduction to Nanotechnology (PHY-XX38) 11. Introduction to Photonics (PHY-XX39) 12. Introduction to Quantum Computing (PHY-XX40) 13. Laser Engineering (PHY-XX41) 14. Laser Physics (PHY-XX42) 15. Methods of Experimental Physics (PHY-XX43) 16. Particle Physics (PHY-XX44) 17. Plasma Physics (PHY-XX45) 18. Quantum Electronics (PHY-XX46) 19. Quantum Field Theory (PHY-XX47) 20. Quantum Information Theory (PHY-XX48) 21. Quantum Optics (PHY-XX49) 22. Research Methodology and Skill Enhancement (PHY-XX50) 23. Semiconductor Physics (PHY-XX51) 24. Surface Science (PHY-XX52)	
	Total	**09**

Scheme of Study for BS Physics Program

Revised for the Sessions:	**Session (19-23) and Onwards**
Duration:	**8 Semesters**
Courses: Compulsory General Foundation Major Elective	**128 Credit Hours** 22 21 27 49 09
Final Year Project/Special paper:	**3+3=6**
Total:	**134 Credit Hours**

Semester-I

Code	Title	Cr. Hrs.
PHY-1101	Mechanics (F-1)	04
----------	(GOF-1)	03
PHY-1102	Lab-I (F-2)	01
COM-1105	Introduction to Computing (C-1)	03
ENG-1107	English-I (C-2)	03
MAT-1115	Calculus-I (C-3)	03
	Total	**17**

Semester-II

Code	Title	Cr. Hrs.
PHY-1203	Electricity and Magnetism (F-3)	04
PHY-1204	Heat and Thermodynamics (F-4)	03
PHY-1205	Lab-II (F-5)	01
COM-1205	Programming Fundamentals (GRF-1)	03
ENG-1207	English-II (C-4)	03
MAT-1215	Calculus II (C-5)	03
	Total	**17**

Semester-III

Code	Title	Cr. Hrs.
PHY-2306	Waves and Oscillations (F-6)	03
PHY-2307	Modern Physics (F-7)	03
ENG-2307	English-III (C-6)	03
PHY-2308	Lab-III (F-8)	01

Semester-IV

Code	Title	Cr. Hrs.
PHY-2409	Optics (F-9)	03
PHY-2410	Lab-IV (F-10)	01
*	(GOF-3)	03
MAT-2415	Differential Equations (Math-IVG)	03

*	(GOF-2)	03	STA-2420	Probability and Statistics (GRF-2)	03
MAT-2315	Linear Algebra (Math-IIIG)	03	ISL-2412	Islamic Studies (C-8)	02
PS-2317	Pakistan Studies (C-7)	2	PHY-2411	Computational Physics (F-11)	03
	Total	**18**		**Total**	**18**

Semester-V

Code	Title	Cr. Hrs.
PHY-3512	Mathematical Methods of Physics-I (M)	3
PHY-3513	Classical Mechanics (M)	4
PHY-3514	Electromagnetic Theory-I (M)	3
PHY-3515	Electronics-I (M)	3
PHY-3516	Lab-V (M)	2
	Total	**15**

Semester-VI

Code	Title	Cr. Hrs.
PHY-3617	Mathematical Methods of Physics-II (M)	3
PHY-3618	Quantum Mechanics – I (M)	3
PHY-3619	Electromagnetic Theory-II (M)	3
PHY-3620	Electronics-II (M)	3
PHY-3621	Solid State Physics-I (M)	3
PHY-3622	Lab-VI (M)	2
	Total	**17**

Semester-VII

Code	Title	Cr. Hrs.
PHY-4723	Nuclear Physics (M)	3
PHY-4724	Quantum Mechanics – II (M)	3
PHY-4725	Atomic Physics (M)	3
PHY-4726	Solid State Physics-II (M)	3
PHY-4727	Lab-VII (M)	2
PHY-4899/47XX	Research Project/Special Paper (M)	3
	Total	**17**

Semester-VIII

Code	Title	Cr. Hrs.
PHY-4828	Thermal and Statistical Physics (M)	3
PHY-48XX	Elective course I	3
PHY-48XX	Elective course-II	3
PHY-48XX	Elective course –III	3
PHY-4899 /PHY-48XX	Research project/Special Paper(M)	3
	Total	**15**

*Code and subject shall be chosen from the list of GOF courses, subject to availability of faculty and suitability to the program need.

** Special paper shall be selected from the list of elective courses subject to availability of teacher and suitability to the program need

GRF = General subjects from Faculty of Natural and Applied Sciences
GOF = General subjects other than Faculty of Natural and Applied Sciences

List of (GOF) courses

S. No.	Code	Subject	S. No.	Code	Subject
1	ARA-0001	Arabic	7	KS-0013	Kashmir Studies
2	ECO-0006	Economics	8	MC-0014	Mass Communications
3	ETRE-0008	Entrepreneurship	9	OB-0016	Organizational Behavior
4	HRM-0009	Human Resource Management	10	PSY-0019	Psychology
5	IR-0010	International Relations	11	SOC-0021	Sociology
6	ITM-0011	Introduction to management			

List of Elective Courses:

(*First and second 'X' represent the year and semester respectively***.** *Selection of a course from the list shall be made based on availability of relevant faculty and suitability to the program need*)

S. No.	Codes	Title
1.	PHY-XX29	Astro Physics
2.	PHY-XX30	Atomic and Molecular Spectroscopy
3.	PHY-XX31	Computer Simulations in Physics
4.	PHY-XX32	Electronic Materials and Devices
5.	PHY-XX33	Environmental Physics
6.	PHY-XX34	Experimental Techniques in Particle and Nuclear Physics
7.	PHY-XX35	Fluid Dynamics
8.	PHY-XX36	Introduction to Materials Science
9.	PHY-XX37	Introduction to Nanotechnology
10.	PHY-XX38	Introduction to Photonics
11.	PHY-XX39	Introduction to Quantum Computing
12.	PHY-XX40	Laser Engineering
13.	PHY-XX41	Laser Physics
14.	PHY-XX42	Methods of Experimental Physics
15.	PHY-XX43	Particle Physics
16.	PHY-XX44	Plasma Physics
17.	PHY-XX45	Quantum Electronics
18.	PHY-XX46	Quantum Field Theory
19.	PHY-XX47	Quantum Information Theory
20.	PHY-XX48	Quantum Optics
21.	PHY-XX49	Research Methodology and Skill Enhancement
22.	PHY-XX50	Semiconductor Physics
23.	PHY-XX51	Surface Science

Approved contents of syllabi for BS Physics under semester system

SEMESTER-I

Code	Title	Cr. Hrs.
PHY-1101	Mechanics (F-1)	04
----------	(GOF-1)	03
PHY-1102	Lab-I (F-2)	01
COM-1105	Introduction to Computing (C-1)	03
ENG-1107	English-I (C-2)	03
MAT-1115	Calculus-I (C-3)	03
	Total	**17**

PHY-1101 **MECHANICS** **Credit Hrs: 04**

Objectives:

The main objective of this course is to understand the different motions of objects on a macroscopic scale and to develop simple mathematical formalisms to analyze such motions. This is a calculus-based introductory course with maximum emphasis on applying the acquired knowledge to solving problems.

Motion in One, Two and Three Dimensions: Position & Displacement, Velocity and Acceleration, Motion under Constant Acceleration, Projectile Motion, Uniform Circular Motion, Relative Velocity and Acceleration in One and Two Dimensions, Inertial and Non-Inertial Reference Frames.

Newton's Laws: Newton's Laws of Motion and their Applications, Newton's Law of Gravitation, Gravitational Potential Energy, Escape Velocity, Satellite Orbits & Energy, Work done by Constant and Variable Forces: Gravitational and Spring Forces, Power, Conservative and Non-Conservative Forces, Work and Potential Energy, Isolated Systems and Conservation of Mechanical Energy.

Work and Kinetic Energy: Work done by Constant and Variable Forces, Work Done by External Forces including Friction, and Conservation of Energy.

System of Particles: Motion of a System of Particles and Extended Rigid Bodies, Center of Mass and Newton's Laws for a System of Particles, Linear Momentum, Impulse, Momentum & Kinetic Energy in One- and Two-Dimensional Elastic and Inelastic Collisions,

Rotational Motion: Rotation about a fixed Axis, Angular Position, Angular Displacement, Angular Velocity and Angular Acceleration, Rotation under Constant Angular Acceleration, relationship between Linear and Angular Variables, Rotational Inertia, Parallel-axis Theorem, Torque and Newton's Law for Rotation, Work and Rotational Kinetic Energy, Power, Rolling Motion, Angular Momentum for a single Particle and a System of Particles, Conservation of Angular Momentum, Static Equilibrium involving Forces and Torques, Determination of moment of inertia of various shapes i.e. for disc, bar and solid sphere.

Angular Momentum: Angular Velocity, Conservation of angular momentum, effects of Torque and its relationship with angular momentum.

Simple Harmonic Motion (SHM): Amplitude, Phase, Angular Frequency, Velocity and Acceleration in SHM, Linear and Angular Simple Harmonic Oscillators, Energy in SHM, Simple Pendulum, Physical Pendulum, SHM and Uniform Circular Motion, Damped Harmonic Oscillator.

Special Theory of Relativity: Introduction to Special theory of relativity, Inertial and non-inertial frame, Postulates of Relativity.

Recommended Books

1. D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics", John Wiley & Sons, 9th ed. 2010.
2. R. A. Serway and J. W. Jewett, "Physics for Scientists and Engineers", Golden Sunburst Series, 9th ed. 2015.
3. R. A. Freedman, H. D. Young, and A. L. Ford (Sears and Zeemansky), "University Physics with Modern Physics", Addison-Wesley-Longman, 14th International ed. 2015.

4. D. C. Giancoli, “Physics for Scientists and Engineers, with Modern Physics”, Addison-Wesley, 4th ed. 2014.

PHY-1102 **LAB-I** **Credit Hrs: 01**

LIST OF EXPERIMENTS:

1. (a) To determine the Modulus of rigidity of wire by a static method

1. (b) To determine the modulus of rigidity of wire by solid cylindrical rod (oscillating rod)

1. (c) To determine the modulus of rigidity of the material of a wire by Maxwell's needle

1. (d) To determine the modulus of rigidly of flat spiral spring

1. (e) To determine the Young's modulus of elasticity of the material of flat spring

1. (f) To determine the Poisson's ratio of the material of a given wire by Seale's dynamical method

2. (a) To study the damping features of an oscillating system using simple harmonic oscillator

2. (b) To study the damping features of an oscillating system using simple pendulum

3. (a) Measurement of viscosity of a liquid by Stokes method

3. (b) Measurement of viscosity of a liquid by Poisuille's method

4 To determine the surface tension of water by capillary tube method

5. (a) To determine the value of "g" by a compound pendulum

5. (b) To determine the value of "g" by Katter's pendulum

6 To determine the dependence of centripetal force on mass, radius and angular velocity of a body in circular motion

7 Investigation of phase changes with position in travelling wave and measurement of velocity of sound by using C.R.O

8 Determination of the moment of inertia of a solid sphere/ hollow cylinder and sphere

9 To study the conservation of energy (Hook's Law)

10. (a) To determine the spring constant of a spring by statistical method

10. (b) To determine the spring constant of a spiral spring by dynamical method and also to determine the mass of the spring.

COM-1105 INTRODUCTION TO COMPUTING Credit Hrs: 03

Brief history of computers and their applications, Major, components of a computer (CPU and Memory, Data storage devices, Input/Output devices), Software (Standards, Application software, System software, Standard options, Windows, Linux and Macintosh) Computers Networks, Telecommunication basics, The Internet and the World Wide Web, Web Pages, Intro to Information Systems in Business, Office automation tools, Word processing, Graphic packages, Databases and Spreadsheets, Current trends in research and future prospects, Legal and moral aspects of Computer Science, Presentation Software etc.

RECOMMENDED BOOKS

1. Meta, Toledo, Roman, Schaum's Outline of Introduction to Computer Science, McGraw Hill, Book Company, 2000
2. Kelly, Julia, Nelson, Stephan L., Office XP The Complete Reference, McGraw Hill Book Company, 2001.
3. Joseph, Rubin, Excel 2007, CPA Company, 2007
4. Michael, Halvorson, Microsoft XP 2000, Microsoft Press Washington, 2007.

ENG-1107 **ENGLISH-I** **Credit Hrs: 03**

Basics of Grammar, Parts of speech and use of articles, Sentence structure, active and passive voice, Practice in unified sentence, Analysis of phrase, clause and sentence structure, Transitive and intransitive verbs , Punctuation and spelling, Comprehension: Answers to questions on a given text, Discussion: General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students), Listening: To be improved by showing documentaries/films carefully selected by subject teachers, Translation skills: Urdu to English, Paragraph writing: Topics to be chosen at the discretion of the teacher, Presentation skills: Introduction. **Note:** Extensive reading is required for vocabulary building

RECOMMENDED BOOKS

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492
2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506
3. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-4
4. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

MAT-1115 **CALCULUS-I** **Credit Hrs: 03**

Introduction, real numbers, intervals, absolute values and its properties, coordinates planes and graphs, lines, functions, operation on functions, graph of functions, shifting of graph limits, continuity, graphical and analytical approach. The derivatives, geometrical meanings of derivatives, tangent lines and rate of changes. Derivatives of Trigonometric functions, inverse trigonometric functions, the chain rules, implicit differentiation, differential derivative of hyperbolic, inverse hyperbolic, logarithmic, exponent function, first order differential equation and application, increase and decrease, concavity relative extrema, first and second derivatives test, Maximum and minimum of a function, applied maximum and minimum problem, L' hospital rules integration, basic rules of integration, formula of integration, integration by parts, by substitutions, partial fraction definite integrals, Riemann sur theorems of definite integral, first and second fundamental theorems of calculus definite integral with property areas between curves, Disk and washer, volumes by cylindrical shell and slicim length of plane curves, Area of surface of revolution, First order differential equation and applications, Roll's theorem, mean values theorem and its application, improper integral, convergent and divergence of integrals, straight line in R3, Planes, Cylindrical and Spherical coordinate surfaces, cylinders and cones, sphere, spherical trigonometry.

RECOMMENDED BOOKS

1. Calculus and analytical Geometry, by Thomas & Finny. 10th Edition. 2. Calculus & Analytical Geometry, by Howard anton, 7th Edition
3. Calculus & Analytical Geometry, by S.M. Yosuf.
4. Calculus & Analytical Geometry, by SkowSky. 6th Edition.

SEMESTER-II

Code	Title	Cr. Hrs.
PHY-1203	Electricity and Magnetism (F-3)	04
PHY-1204	Heat and Thermodynamics (F-4)	03
PHY-1205	Lab-II (F-5)	01
COM-1205	Programming Fundamentals (GRF-1)	03
ENG-1207	English-II (C-4)	03
MAT-1215	Calculus II (C-5)	03
	Total	**17**

PHY-1203 ELECTRICITY AND MAGNETISM Credit Hrs: 04

Objectives:

The main objective of this course is to understand the Physics of Electromagnetism and to develop simple mathematical formalisms to analyze the electromagnetic fields and interactions. This is a calculus-based introductory course with maximum emphasis on applying the acquired knowledge for solving problems.

Electrostatics: Electric Charge, Conductors and Insulators, Coulomb's Law, Electric Fields due to a Point Charge and an Electric Dipole, Electric Field due to a Charge Distribution, Electric Dipole in an Electric Field, Electric Flux, Gauss' Law and its Applications in Planar, Spherical and Cylindrical Symmetry.

Electric Potential: Equipotential Surfaces, Potential due to a Point Charge and a Group of Point Charges, Potential due to an Electric Dipole, Potential due to a Charge Distribution, Relation between Electric Field and Electric Potential Energy, Dielectrics and Gauss' Law (1 week).

DC Circuits: Electric Current and Current Density, Resistance and Resistivity, Ohm's Law, Power in Electric Circuits, Semiconductors and Superconductors, Work, Energy, and EMF,

Magnetic Field and Magnetic Force: Magnetic Force on a Current Carrying Wire, Torque on a Current Loop, Magnetic Dipole Moment, Magnetic Field Due to a Current, Force between two Parallel Currents, Ampere's Law, Biot- Savart Law, Magnetic Field due to a Current, Long Straight Wire carrying Current, Solenoids and Toroids, A current-carrying Coil as a Magnetic Dipole, Inductance, Faraday's Law of Induction, Lenz's Law, Induction and Energy Transfers, Induced Electric Fields, Inductors and Inductances, Self-Inductance, RL Circuits, Energy Stored in a Magnetic Field, Energy Density, Mutual Induction.

Alternating Fields and Currents: LC Oscillations, Damped Oscillations in an RLC circuit, Alternating Currents, Forced Oscillations, Resistive, Capacitive, and Inductive Loads, RLC series Circuit, Transformers, Gauss' Law for Magnetism, Induced Magnetic Fields, Displacement Current, Spin & Orbital Magnetic Dipole Moment, Diamagnetism, Paramagnetism, Ferromagnetism, Hysteresis.

Recommended Textbooks

1. D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics", John Wiley & Sons, 9th ed. 2010.
2. R. A. Serway and J. W. Jewett, "Physics for Scientists and Engineers", Golden Sunburst Series, 8th ed. 2010.
3. R. A. Freedman, H. D. Young, and A. L. Ford (Sears and Zeemansky), "University Physics with Modern Physics", Addison-Wesley-Longman, 13th International ed. 2010.
4. F. J Keller, W. E. Gettys and M. J. Skove, "Physics: Classical and Modern, McGraw Hill. 2nd ed. 1992.
5. D. C. Giancoli, "Physics for Scientists and Engineers, with Modern Physics", Addison-Wesley, 4th ed. 2008.

PHY-1204 HEAT AND THERMODYNAMICS Credit Hrs: 03

Objectives:

To understand the fundamentals of heat and thermodynamics.

Basic Concepts and Definitions in Thermodynamics: Thermodynamic system, Surrounding and Boundaries. Types of systems. Properties and state of the substance: Equilibrium, Mechanical and Thermal Equilibrium. Processes and Cycles: Isothermal, Isobaric and Isochoric. Zeroth Law of Thermodynamics and its Consequences. The state of the system at Equilibrium.

Heat and Temperature: Temperature, Kinetic theory of ideal gas, Work done on an ideal gas, Review of previous concepts. Internal energy of an ideal gas: Equipartition of Energy, Intermolecular forces, Qualitative discussion, The Virial expansion, The Van der Waals equation of state.

Thermodynamics: First law of thermodynamics and its applications to adiabatic, isothermal, cyclic and free expansion, Reversible and irreversible processes, Second law of thermodynamics, Carnot theorem and Carnot engine, Heat engine, Refrigerators, Calculation of efficiency of heat engines, Thermodynamic temperature scale: Absolute zero, Entropy, Entropy in reversible process, Entropy in irreversible process, Entropy and Second law of thermodynamics, Entropy and Probability, Thermodynamic Functions: Internal energy, Enthalpy, Gibb's functions, Entropy, Helmholtz functions, Maxwell's relations, TdS equations, Energy equations and their applications, Low Temperature Physics, Joule-Thomson effect and its equations, Thermoelectricity: Thermocouple, Seabeck effect, Peltier effect, Thomson effect, Introduction to statistical mechanics, Maxwell distribution.

Recommended Books:

1. D. Halliday, R. Resnick and K. Krane, "Physics", John Wiley, 5th ed. 2002.
2. D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics", John Wiley, 9th ed. 2010.
3. M. W. Zemansky, "Heat and Thermodynamics", Mc Graw Hill, 7th ed. 1997.
4. M. Sprackling, "Thermal Physics" McMillan 1991.
5. B. N. Roy, "Principle of Modern Thermodynamics", Institute of Physics, London 1995.

PHY-1205 **LAB-II** **Credit Hrs: 01**

LIST OF EXPERIMENTS:

1 To determine thermal emf and plot temperature diagram

2 Determination of the temperature co-efficient of resistance of a given wire

3 To determine the mechanical equivalent of heat J by Calendar and Barnes method

4 To determine the Stefan's constant

5 Calibration of thermocouple the potentiometer

6 To determine the frequency of AC supply by cathode ray oscilloscope

7 With the help of Sextant determine

(a) – Vertical distance between two points

(b) – Height of an inaccessible object

(c) – Horizontal distance

8 Determination of wavelength of sodium D-lines by Newton rings

9 To determine the wavelength of light/laser by diffraction gratin and spectrometer

10 Determination of the wavelength of sodium light by Fresnel biprism

11 To find resolving power of diffraction grating

12 The measurement of specific rotation of sugar solution with Laurent half shade polarimeter

13 To study the combination harmonic motions (Lissajeous figures)

14 To study the parameters of waves (the phenomenon of beats)

15 (a) To determine the thermal conductivity of copper (good conductor) by Searle's apparatus

15 (b) To determine the thermal conductivity of copper (bad conductor) by Lee's apparatus

16 To study laws of vibration of stretched using Sonometer

17 To determine the stopping potential by photocell

ENG-1205 **ENGLISH-II** **Credit Hrs: 03**

(Communication Skills)

Paragraph writing, Practice in writing a good, unified and coherent paragraph, Essay writing, Introduction, CV and job application, Translation skills, Urdu to English, Study skills, Skimming and scanning, intensive and extensive, and speed reading, summary, and précis writing and comprehension, Academic skills, Letter/memo writing, minutes of meetings, use of library and internet, Presentation skills, Personality development (emphasis on content, style and pronunciation)

Note: documentaries to be shown for discussion and review.

RECOMMENDED BOOKS

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.
2. Writing. Intermediate by Marie-Chrisitine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
3. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).
4. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0. 5.

Reading and Study Skills by John Langan

6. Study Skills by Riachard Yorky.

COM-1207 PROGRAMMING FUNDAMENTALS Credit Hrs: 03

Computer programming, principles of structured and modular programming, overview of structured programming languages, algorithms and problem solving, program development, analyzing problem, designing algorithm/solution, testing designed solution, translating algorithms into programs, fundamental programming constructs, data types, basics of input and output, selection and decision (If, If-rlse, Nested If-else, Switch statement, and Condition operator), repetition (While and For Loop, Do-while Loops), break statement, continue statement, control structures, functions, arrays, pointers, records, files, (Input/Output), testing and debugging.

RECOMMENDED BOOKS

1. C how to program, Paul Deitel and Harvey Deitel, Prentice Hall; 7th Ed. (2012) 2. Programming in C, Stephen G. Kochan, Addison-Welley Professional; 4th Ed. (2013)
3. Java how to program, Paul Deitel and Harvey Deitel, Prentice Hall; 9th Ed. (2011) 4. C++ how to program, Paul Deitel and Harvey Deitel, Prentice Hall; 9th Ed. (2013).

MAT-1215 **CALCULUS-II** **Credit Hrs: 03**

Sequences, Monotone sequences, convergence of sequence, infinite series, partial sum, convergence test Alternating sequence, conditional convergence, Power series Taylor's and Maclaurin's series, differential and integration of series. Arc length in polar, Cartesian, parametric curves, surface area, area in polar and Cartesian form of curves. Area of revolution in polar and Cartesian forms. Conversion of systems, Unit tangent and normal Vectors, Curvature and radius of Curvature, Motion along a curve. Function of several variables, homogeneous function Euler theorem, Partial derivatives, Laplace equation. Differentiability and chain rules, Tangent planes, total differential, Directional Derivatives Gradient of two functions Function of n- Variables maxima and minima of two functions Lagrange Multipliers Double integral, triple integrals Centroid, center of Gravity, Total mass. Triple integrals, Jacobians, triple integrals in cylindrical and Spherical coordinates. Introduction to conic section, rotation of axes, Parabola, Ellipse, Hyperbola, Sketching of conics Volumes of Surfaces, complex numbers: DeMoivre's theorem and its applications, Complex functions, analytical functions, harmonic and conjugate, harmonic functions, Cauchy- Rehmunn equations (in Cartesian and polar coordinates). Line integrals, Green's theorem, Cauchy' theorem, Chauchy's integral formula, singularities, poles, residues and contour integration and applications.

RECOM ENDED BOOKS

1. Calculus & Analytical Geometry, by Thomas & Finny, 10th Edition
2. Calculus & Analytical Geometry, by Howard Anton, 7th Ed
3. Calculus & Analytical Geometry, by S.M. Yousaf
4. Calculus & Analytical Geometry, by Skowsky, 6th Edition.

SEMESTER III

Code	**Title**	**Cr. Hrs.**
PHY-2306	Waves and Oscillations (F-6)	03
PHY-2307	Modern Physics (F-7)	03
ENG-2307	English-III (C-6)	03
PHY-2308	Lab-III (F-8)	01
*	(GOF-2)	03
MAT-2315	Linear Algebra (Math-IIIG)	03
PS-2317	Pakistan Studies (C-7)	2
	Total	**18**

PHY-2306 **Waves and Oscillations** **Credit Hrs: 03**

Objectives:

Objective(s): To develop a unified mathematical theory of oscillations and waves in physical systems.

Simple and Damped Simple Harmonic Oscillation: Mass-Spring System, Simple Harmonic Oscillator Equation, Complex Number Notation, LC Circuit, Simple Pendulum, Quality Factor, LCR Circuit. Forced Damped Harmonic Oscillation: Steady-State Behavior, Driven LCR Circuit, Transient Oscillator Response, Resonance. Coupled Oscillations: Two Spring-Coupled Masses, Two Coupled LC Circuits, Three Spring Coupled Masses, Normal Modes, Atomic and Lattice Vibrations.

Transverse Waves: Transverse Standing Waves, Normal Modes, General Time Evolution of a Uniform String, Phase velocity, Group Velocity.

Longitudinal Waves: Spring Coupled Masses, Sound Waves in an Elastic Solid, Sound Waves in an Ideal Gas.

Traveling Waves: Standing Waves in a Finite Continuous Medium, Traveling Waves in an Infinite Continuous Medium, Energy Conservation, Transmission Lines, Reflection and Transmission at Boundaries, Electromagnetic Waves.

Wave Pulses: Fourier series and Fourier Transforms, Bandwidth, Heisenberg's Uncertainty Principle.

Multi-Dimensional Waves: Plane Waves, Three-Dimensional Wave Equation, Laws of Geometric Optics, Waveguides, Cylindrical Waves.

Interference and Diffraction of Waves: Double-Slit Interference, Single-Slit Diffraction. Recommended Books:

1. J. Pain, "The Physics of Vibrations and Waves", John Wiley, 6th ed. 2005.

2. P. French, "Vibrations and Waves", CBS Publishers (2003).

3. F. S. Crawford, Jr., "Waves and Oscillations", Berkeley Physics Course, Vol. 3, McGraw-Hill, 1968.

4. A. Hirose, and K. E. Lonngren, "Introduction to Wave Phenomena", Krieger Publications, 2003.

PHY-2307 **MODERN PHYSICS** **Credit Hrs: 03**

Objectives:

To understand the non-classical aspects of Physics, the emphasis is on the applications of Quantum Physics on microscopic-scale Physics, atomic and molecular structure and processes.

Motivation for Non-Classical Physics: Quantum interference, blackbody radiation and ultraviolet catastrophe, Planck's quantization.

Waves-Particle Duality: Photoelectric effect, Compton effect, production and properties of X-rays, diffraction of X-rays, concept of matter waves, de Broglie relationship, electrons are waves, electron diffraction, particulate nature of matter, contributions of Faraday (atoms exist), Thomson (electron exists), Rutherford (nucleus exists) and Bohr (quantization of energies inside an atom), wave packets and wave groups, dispersion, Heisenberg uncertainty principle, direct confirmation of quantization through Franck-Hertz experiment and spectroscopy, working of electron microscopes.

Quantum Mechanics in One Dimension: The concept of a wave function, time independent Schrodinger equation and interpretation of the equation, solving the Schrodinger equation for a free particle, for a particle inside an infinite box, relationship between confinement and quantization, Concept of tunneling, reflection and transmission of wave functions from barriers

Quantum Mechanical in Three Dimensions: Angular momentum and its quantization, orbital magnetism, Zeeman Effect, concept of spin, Pauli's exclusion principle, Introduction to semiconductors, LED's and Lasers.

Nuclear Structure: Size and structure of nucleus, nuclear forces, radioactivity and nuclear reactions, radiocarbon dating. Introduction to theory of relativity.

Recommended Books:

1. R.A. Serway, C.J. Moses and C.A. Moyer, "Modern Physics", Brooks Cole, 3rd ed. 2004.
2. Paul A. Tipler and Ralph A. Llewellyn, "Modern Physics", W H Freeman and Company 6th ed. 2012.
3. Arthur Beiser, "Concepts of Modern Physics", McGraw-Hill, 6th ed. 2002.
4. R. M. Eisberg and R. Resnick, "Quantum Physics of Atoms, molecules, Solids, Nuclei and Particles", John Wiley, 2nd ed. 2002.

PHY-2308 **LAB-III** **Credit Hrs: 01**

LIST OF EXPERIMENTS:

1(a) To determine an unknown resistance by using neon flash lamp and capacitor
1(b) To determine the unknown high resistance by neon flash lamp and the capacitor
2(a) Conversion of a galvanometer in to ammeter of range 0 to 0.1 A
2(b) Conversion of a galvanometer in to voltmeter of range 0 to 3 V
3 Study the characteristics of photo emission and determination of Plank's constant using a photo cell
4(a) Calibration of an ammeter by potentiometer
4(b) To calibrate a voltmeter by a potentiometer
5 To determine the current sensitivity and charge sensitivity of moving coil galvanometer
6 To compare the capacitance's of two capacitors by a ballistic galvanometer
7(a) To plot B-H curve by the deflection magnetometer method and measure the magnetic parameters
7(b) To plot B-H curve on oscilloscope and measure the magnetic parameters
8 To determine the unknown resistance by using Carey Foster's bridge
9 To study the characteristics of acceptor circuit (RLC series circuit)
10 To study the characteristics of rejector circuit (LCR series circuit)
11 Study of parameter of wave i.e. amplitude, phase and time period of a complex signal by CRO
12 Measurement of self/mutual inductance of transformer winding
13 To study the network theorems (Thevenin theorem, Norton's theorem and superposition theorem)
14 To study the application of Lorentz force by cathode ray oscilloscope (e/m by J. J. Thomson method)
15 Measurement of magnetic field using a search coil
16 To determine the intensity of earth's magnetic field by earth inductor
17 Determination of the temperature co-efficient of resistance of a given wire
18 Harmonic oscillations of helical springs-parallel and series connections of spring
19 Measuring moment of inertia of different bodies disk, hollow and solid cylinder
20(a) Measurement of speed of sound in air by oscilloscope
20(b) Measurement of speed of sound in air by resonance tube apparatus
21 Coherence and width of spectral lines
22 Diffraction intensity for a single slit and double slit
23 Stefan-Boltzmann law of radiation
24 Characteristic curves of a solar cell
25 Magnetic field of paired coils in Helmholtz arrangement

ENG-2301 **ENGLISH-III** **Credit Hrs. 03**

Objectives: To enable the students to write a research paper / technical report in a succinct manner according to a specified format.

Presentation skills, Essay writing, Descriptive, narrative, discursive, argumentative, Academic writing How to write a proposal for research paper/ term paper. How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency), Technical Report writing, Note: Extensive reading is required for vocabulary building

Recommended Books:

1. R. White, Writing. Advanced, Oxford Supplementary Skills. Third Impression 1992. (Particularly suitable for discursive, descriptive, argumentative and report writing).

2. J. Langan. College Writing Skills, McGraw-Hill Higher Education. 2004.

3. L. G. Kirszner and S. R. Mandell. Patterns of College Writing, 4th edition St. Martin's Press.

4. The Mercury Reader. A Custom Publication. Compiled by northern Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ru↵us and Maurice Scharton.

PHY-2315 **LINEAR ALGEBRA** **Credit Hrs: 03**

System of Linear Equations: Basic concepts. Standard matrix form, Inverse of matrix, Matrix operations, Elementary row and column operation Echelon & Reduce Echelon form System of homogeneous & non- homogeneous linear equations (Gauss Elimination and Gauss- Jordan). Application of linear equations, Linear Dependence & Independence sets of vectors, Linear Transformations. Vector spaces: Definitions, Properties of vector spaces, vector spaces and subspaces, Basic, Dimensions of vector space, Eigen vector & Eigen value, Characteristic Equations, Eigen vectors and Linear Transformations, Inner Product, Length and Orthogonality sets, Gram Schmidt process, Inner Product Spaces.

RECOMMENDED BOOKS

1. Linear algebra and its application (3^{rd} edition) by David C. Lay.
2. Advance Engineering Mathematics by Ervin KAREYZIG, 9^{th} Edition.
3. Elementary Linear Algebra (8^{th} edition) by ANTON.

PS-2317 **PAKISTAN STUDIES** **Credit Hrs: 02**

An overview of the British Rule in the sub-continent, two nation theory & role of Sir Sayyed for the revival of Muslims, major political organization (congress muslim league), Constitutional reforms, Constitutional & political struggle (separate electrolate, Lucknow Pact), Tehrik –e-Khilafat, Nehru Report, Jinnah's 14 point, e-Allah Abad Address 1930, Round table conferences, Election of 1937 and Congress Minstries, Pakistan Moment (194047), Crips proposal 1942, Wavell plane and shimla conference 1945, Election of 1945-46, Cabinet mission plan 1946, 3rd June plane and Red cliff award, Pakistan's Immediate Problems: Administrative problems, problems of Refuges, Problems of Accession of states(Kashmir, Hyderabad, June Garh), Distribution of Assets, Canal Water dispute, political and constitutional Development, Hurdles of Constitution Making, 1956 constitution, Islamic clauses) 1962 constitution (Islamic clauses) and Ayub Era, Yahya Regime and first General election 1970, Bhutto in power 1973 constitution (Islamic clauses), Zia government steps for Islamization, Era of Democracy (1988-1999), Pakistan's foreign policy: Relations with USA, Soviet union, Relations with neighboring countries (India, china, Iran, Afghanistan), Relations with Saudi Arabia and Turkey, Pakistan and International Organizations (UNO, OIC, ECO,SAARC), M.D. Zafar, Pakistan studies, Aziz Book Depot Urdu Bazzar Lahore.

RECOMMENDED BOOKS

1. Sheikh Muhammad Rafique, Pakistan studies, urdu Bazar Lahore 2. Sheikh Muhammad Rafique, History of Pakistan, urdu Bazar Lahore.

SEMESTER-IV

Code	Title	Cr. Hrs.
PHY-2409	Optics (F-9)	03
PHY-2410	Lab-IV (F-10)	01
*	(GOF-3)	03
MAT-2415	Differential Equations (Math-IVG)	03
STA-2420	Probability and Statistics (GRF-2)	03
ISL-2412	Islamic Studies (C-8)	02
PHY-2411	Computational Physics (F-11)	03
	Total	**18**

PHY-2409 **OPTICS** **Credit Hrs: 03**

Objectives:

To understand the optical phenomena and their uses in physical systems

Propagation of Light & Image Formation: Huygens' Principle, Fermat's Principle, Laws of Reflection and Refraction, Refraction at a Spherical Surface, Thin Lenses, Newtonian Equation for a Thin Lens.

Matrix Methods in Paraxial Optics: Ray Transfer Matrices, Thick Lens, Significance of System Matrix Elements, Cardinal Points of an Optical System with examples, Optical Instruments including Simple Magnifiers, Telescopes and Microscopes, Chromatic and Monochromatic Aberrations, Spherical Aberrations, Coma, Distortion, Stops, Pupils, Windows.

Superposition & Interference: Standing Waves, Beats, Phase and Group Velocities, Two-Beam and Multiple-Beam Interference, Thin Dielectric Films, Michelson and Fabry-Perot Interferometers, Resolving Power, Free-Spectral Range.

Polarization: Jones Matrices, Production of Polarized Light, Dichroism, Brewster's Law, Birefringence, Double Refraction.

Fraunhofer Diffraction: from a Single Slit, Rectangular and Circular Apertures, Double Slit, Many Slits, Diffraction Grating, Dispersion, Resolving Power Blazed Gratings.

Fresnel Diffraction: Zone Plates, Rectangular Apertures, Cornu's Spiral

Coherence & Holography: Temporal Coherence, Spatial Coherence, Holography of a Point object and an Extended Object.

Laser Basics: Stimulated Emission, Population Inversion, Resonators, Threshold and Gain, Multi-layered Dielectric Films.

Recommended Books:

1. F. Pedrotti, L. S. Pedrotti and L. M. Pedrotti, "Introduction to Optics", Pearson Prentice Hall, 3rd ed. 2007.

2. E. Hecht and A. Ganesan, "Optics", Dorling Kindersley, 4th ed. 2008.

3. M. V. Klein and T. E. Furtak, "Optics", John Wiley, 2nd ed. 1986.

4. K. K Sharam, "Optics: Principles and Applications", Academic Press, 2006.

5. C. A. Bennett, "Principles of Physical Optics", John Wiley, 2008.

PHY-2410 **LAB-IV** **Credit Hrs: 01**

LIST OF EXPERIMENTS:

1 The determination of Cauchy's constants using spectrometer
2 Measurement of wavelength of sodium light and difference of wavelength using Michelson interferometer
3 Determination of e/m of an electron
4 Determination of ionization potential of mercury
5 Characteristics of a semiconductor diode (compare Si with Ge diode)
6 Setting up of half and full wave rectifier and study following factors
   i. Smoothing effect of a capacitor
   ii. Ripple factor & its variation with load
   iii. Study of regulation of output voltage with load
7 To set up a single stage amplifier and measure its voltage gain and bandwidth
8 To set up transistor oscillator circuit and measure its frequency by an oscilloscope
9 To set up and study various logic gates (AND, OR, NAND etc) using diode and to develop their truth table
10 To set up an electronic switching circuit using transistor LDR and demonstrate its use as a NOT Gate
11 Characteristics of a transistor
12 To study the characteristics curves of a G.M. counter
13 Determination of range of α particles
14 Absorption coefficient of beta particles using G.M. tube
15 Mass absorption coefficient of lead for γ-rays using G.M. counter
16 Stopping power of alpha particles in air equivalent of material of given foil
17 Variation of photoelectric current with intensity of light
18 Measurement of Plank's constant using spectrometer
19 To study voltage current characteristics of electric discharge in gases at low pressure
20 Production of vacuum and its rough measurements with a manometer
21 Determining the modulus of elasticity
22 Investigating the Fourier transform by a convex lens
23 Determining resistance using a Wheatstone bridge/slide wire bridge
24 Interference of light by Fresnel Biprism
25 To study the characteristics of an acceptor circuit
26 To study the characteristics of an rejecter circuit
27 Study of parameters of wave i.e. amplitude, phase and time period of a complex signal on oscilloscope
28 Specimen readings of some selected experiments

MAT-2415 DIFFERENTIAL EQUATIONS Credit Hrs: 03

Introduction to ODEs (physical motivation), First order ODEs (separate variables, homogeneous equations, exact equations, linear equations, Bernoulli equation and other examples), applications of first order ODEs linear and non-linear, linear differential equations of higher order (initial value and boundary value problems, linear dependence and independence, solutions of linear equations, constructing a second solution from a known solution, homogeneous linear equations with constant coefficients, undetermined coefficients, variation of parameters), applications of second order ODEs (simple harmonic equation, damped and forced oscillators, electrical circuits and springs), differential equations with variable coefficients (Cauchy-Euler equation, power series solution of differential equation- solutions about ordinary and singular points-Legendre's and Bessel's equations as examples), Laplace transform (Laplace transform and its inverse properties, use in solving differential equations, Dirac function).

RECOMENDED BOOKS

1. D. G. Zill and M. R. Cullen, Differential equations with boundary value problems, 3rd Ed., National Book Foundation.
2. E. Kreyszig, Advanced engineering mathematics, Jhon Wiley, 8th
3. K. F. Riley, M. P. Hobson and S. J. Bence, Mathematical Methods for Physicists, Cambridge University Press 2006.

STAT-2420 PROBABILITY AND STATISTICS Credit Hrs: 03

Objective:
This course is to introduce the notions of probability and statistics to enable students to apply in the deferent fields of actions in physics. The concepts of data preparation and analysis is the key feature of this course.

What is Statistics? Definition of Statistics, Population, sample Descriptive and inferential Statistics, Role of statistics in physics, Observations, Data, Discrete and continuous variables, Errors of measurement, Significant digits, Rounding of a Number, Collection of primary and secondary data, Sources, Editing of Data. Exercises. Presentation of Data Introduction, basic principles of classification and Tabulation, Constructing of a frequency distribution, Relative and Cumulative frequency distribution, Diagrams, Graphs and their Construction, Bar charts, Pie chart, Histogram, Frequency polygon and Frequency curve, Cumulative Frequency Polygon or Ogive, Histogram, Ogive for Discrete Variable. Types of frequency curves.

Exercises. Measures of Central Tendency: Introduction, Deferent types of Averages, Quintiles, The Mode, Empirical Relation between Mean, Median and mode, Relative Merits and Demerits of various Averages. Properties of Good Average, Box and Whisker Plot, Stem and Leaf Display, definition of outliers and their detection. Exercises. Measures of Dispersion Introduction, Absolute and relative measures, Range, The semi-Inter-quartile Range, The Mean Deviation, The Variance and standard deviation, Change of origin and scale, Interpretation of the standard Deviation, Coefficient of variation, Properties of variance and standard Deviation, Standardized variables, Moments and Moments ratios. Exercises. Regression and Correlation: Introduction, cause and e↵ect relationships, examples, simple linear regression, estimation of parameters and their interpretation. r and R^2. Correlation. Coefficient of linear correlation, its estimation and interpretation. Multiple regression and interpretation of its parameters. Examples. Probability

and Random Variable.: Introduction to probability, sample Space, Events, Lows of probability with their applications, Conditional probability, dependent and independent events, Bays theorem and its applications. Random variable discrete and continuous random variable with their application. Mathematical Expectation, Mean, Variance etc. Statistical Packages and data analysis. SPSS software, Data analysis on excel and E Views etc.

Recommended Books:

1. R.E. Walpole, Introduction to Statistics. Macmillan Publishing Co., Inc. New York, 3rd Ed, 1982.

2. F. Muhammad, Statistical Methods and Data Analysis, Kitab Markaz, Bhawana Bazar Faisalabad, 2005.

3. B L Agarwal, Basic Statistics? New Age International, 2006. 4. Carver, Nash, Doing Data Analysis with SPSS version 14.

ISL-2412 ISLAMIC STUDIES Credit Hrs: 03

Fundamental of Islam, Tauheed: Arguments for oneness of God, impact of Tauheed on human life, place of man in the universe, purpose of creation, textual study of Surah al- Rehman and Surah al- Furqan, Prophethood, need for prophet, characteristics of a prophet, finality of prophethood, seerat; life of prophet as embodiment of Islamic ideology, faith in hereafter aakhrat, effects of belief on worldly life.Ibadah: Concepts of Ibadah, Salat, Saom, Zakat, Hajj and jehad. The Holy Quran: Its revelation and compilation, The authencity of the text, Hadith: Its need, authenticity and importance. Consensus (Ijma), analogy (Qiyas). Sources of Knowledge: Islamic approach to institution, Reason and experience. Revelation Wahi as a souce knowledge. Moral and social Philosophy of Islam: The concept of good and evil, Akhlaq -e-Hasna with special reference to surah Al- Hujrat, Professional Ethics Kasb-e- Halal. Islamic Political Principles: Salient feature of the Islamic state, Madina character, Responsibilities of the Head of the state, Rights and Duties of Citizens. Economics Oder of Islam: Right to property, System of Taxation, Distribution of Wealth Zakat and Ushar, Interest Free Economy Shirakat and Muzarabat. Islam as Living Force: Application of Islam Teaching to Socio- Economic Development in the 20th Century.

RECOMMENDED BOOKS

1. Muhanmmad, H. "Emergence of Islam", IRI, Islamabad.
2. Muhanmmad, H. "Muslim Conduct of State"
3. Muhanmmad, H. 'Introduction to Islam
5. Hussan, H. H. "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan.
6. Hasan, A. "Principles of Islamic Jurisprudence" Islamic Research Institute, International Islamic University, Islamabad (1993)
7. Mir, W. 1982. "Muslim Jurisprudence and the Quranic Law of Crimes" Islamic Book Service.
8. Bhatia, H.S. 1989. "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi.
9. Muhammad, Zia-ul-Haq.2001. "Introduction to Al Sharia Al Islamia" Allama Iqbal Open University, Islamabad.

PHY- 2411 COMPUTATIONAL PHYSICS Credit Hrs: 03

Introduction to Computer Languages: A brief introduction of computer languages; Basic, C and Pascal. Numerical Methods: Error analysis and technique for elimination of systematic and random errors, Numerical Solutions of equations, Numerical integration and differentiation. Mathematica: Introduction to Mathematica, Typing commands in Mathematica, Mathematica's Kernel, Defining a Function, Plotting a Function using Mathematica's Plot options, Functions with Manipulate, Producing a Table of Values, Working with Difference Equations, Factoring and Expanding Polynomials, Working with Rational Functions, Visualizing Derivatives, Higher Order Derivatives, Differential Equations, Integration, Numerical Integration, Sequences and Series, Vectors, RealValued Functions of Two or More Variables, Other Coordinate Systems, Vector Fields. Modeling & Simulations: Conceptual models, the mathematical models, Random numbers and random walk, doing Physics with random numbers, Computer simulation, Relationship of modeling and simulation, Some systems of interest for physicists such as
Motion of Falling objects, Kepler's problems, Oscillatory motion, Many particle systems, Dynamic systems, Wave phenomena, Field of static charges and current, Diffusion, Populations genetics etc.

RECOMMENDED BOOKS

1. The Students Introduction to Mathematica by Bruce F. Torrence and Eve A. Torrence 2. Numerical Analysis by P. A. Strak.
3. H. Gould, J. Tobochnik and W. Christian, "An Introduction to Computer Simulation Methods", Addison Wesley, 3rd ed. 2006.
4. M. L. De Jong," Introduction to Computational Physics", Addison Wesley,1991.
5. A First Course in Numerical Analysis by A. Ralston.
6. Numerical Analysis by S. A. Bhatti.

SEMESTER-V

Code	Title	Cr. Hrs.
PHY-3512	Mathematical Methods of Physics-I (M)	3
PHY-3513	Classical Mechanics (M)	4
PHY-3514	Electromagnetic Theory-I (M)	3
PHY-3515	Electronics-I (M)	3
PHY-3516	Lab-V (M)	2
	Total	**15**

PHY-3512 MATHEMATICAL METHODS OF PHYSICS-I Credit Hrs:03

Objectives:

To develop the mathematical background of student in vectors, tensors, matrices and some of their uses in the world of physics, to give basic understanding of group theory and complex variables used in physics.

Advanced vector and tensor analysis:

Transformation Properties of Vectors, Gradient, Divergence and Curl of Vectors, Vector Integration, Line, Surface and Volume Integration, Gauss's Theorem, Stokes Theorem and Green's Theorem, Dirac Delta Function, Vector Analysis in Curved Coordinates, Introduction to Tensor Analysis

Complex variables:

Analytic Functions, Types of Functions, Type of Singularities, Branch Cut, Branch Points, Theorem of Morera, Maximum Modulus Theorem, Cauchy-Rieman Condition, Taylor and Laurents Series, Complex Integration, Cauchy's Theorem, Cauchy's Integral Formula, Residue Theorem, Examples of Integration.

Matrices:

Linear Vector Spaces, Orthogonal System, Linear Transformation of Bases and Operators, Matrices (basic definitions), Orthogonal Matrices, Hermitian and Unitary Matrices, Diagonalisation of Matrices, Solution of Eigen-Value Problems.

Recommended Books:

1. Mathematical Methods for Physicists, 6th Edition, George Arfiken,
2. Mathematical Physics, Bukove, Addison-Wesley
3. Mathematical Methods of Physics, News and Walker.
4. Mathematical Physics, Gupta, Vikas Publication
5. Vector Analysis with applications to Geometry and Physics, Schwartz, Green and Rutledge, Harper and Ron.
6. Complex Variables and Applications, Churchill, Mc-Graw Hill Company.
7. Vector Analysis; Rawat.
8. Introduction to Tensor Calculus & Relativity, Lader

PHY-3513 CLASSICAL MECHANICS Credit Hrs:04

Objectives:

To demonstrate knowledge and understanding the mechanics of particles.

Review of Newtonian Mechanics: Frame of reference, orthogonal transformations, angular velocity and angular acceleration, Newton's laws of motion, Galilean transformation, conservation laws, systems of particles, motion under a constant force, motions under variable force, time-varying mass system.

The Lagrange Formulation of Mechanics and Hamilton Dynamics:

Generalized co-ordinates and constraints, D'Alembert's principle and Lagrange's Equations, Hamilton's principle, integrals of motion, non-conservative system and generalized potential, Lagrange's multiplier method, the Hamiltonian of a dynamical system, canonical equations, canonical transformations, Poisson brackets, phase space and Liouville's theorem.

Central Force Motion: The two-body problem, effective potential and classification of orbits, Kepler's laws, stability of circular orbits, hyperbolic orbits and Rutherford scattering, center of mass co-ordinate system, scattering cross-sections.

Motion in Non-Inertial Systems: Accelerated translational co-ordinate system, dynamics in rotating co-ordinate system, motion of a particle near the surface of the earth.

The Motion of Rigid Bodies: The Euler angles, rotational kinetic energy and angular momentum, the inertia tensor, Euler equations of motion, motion of a torque-free symmetrical top, stability of rotational motion.

Special Relativity: Michelson-Morley Experiment, Einstein's Postulates of Relativity, Lorentz Transformation, Geometry of Space and Time, Addition of Velocities, Kinetic Energy of Relativistic Particles, Mass Energy Relation, Momentum of Relativistic Particles, Orthogonal Transformation in three Dimensions, Lorentz Transformation as Orthogonal Transformation.

Recommended Books:

1. T. L. Chow, "Classical Mechanics", John Wiley, 1995.
2. T. Kibble and F. Berkshire, "Classical Mechanics", World Scientific, 5th edition 2004.
3. Herbert Goldstein, Charles Poole, John Safko "Classical Mechanics", Pearson, 3rd Edition.
4. Stephen T. Thornton, Jerry B.Marion "Classical dynamics of particles and systems", Thomson, Brooks/Cole, 5th Edition (2004).

PHY- 3514 ELECTROMAGNETIC THEORY-I Credit Hrs:03

Objectives:

After the reading of this course students will be able to understand concepts of Vector Calculus, Special techniques, Electrostatic and Magneto static Fields.

Review of Calculus: vector algebra and calculus, Cartesian coordinate spherical coordinates. (1 week).

The Dirac Delta Function: Review of vector calculus using example of Dirac Delta function, the divergence of r/r2, the one-dimensional and the three-dimensional Dirac delta functions. The theory of vector fields: The Helmholtz theorem, potentials.

Electrostatics: The electric field: introduction, Coulomb's law, the electric field, continuous charge distributions. Divergence and curl of electrostatic fields: field lines, flux and Gauss's law, the divergence of E, applications of Gauss's law, the curl of E. Electric potential: introduction to potential, comments on potential, Poisson's equation and Laplace's equation, the potential of a localized charge distribution, summary, electrostatics boundary conditions, Work and energy in electrostatics: the work done to move a charge, the energy of a point charge distribution, the energy of a continuous charge distribution, comments on electrostatic energy. Conductors: basic properties, induced charges, surface charge and the force on a conductor, capacitors.

Special Techniques: Laplace's equation: introduction, Laplace's equation in one, two and three dimensions, boundary conditions and uniqueness theorems, conductors and second uniqueness theorems. The Method of Images: The classic image problem induced surface charge, force and energy, other image problems. Multi-pole Expansion: Approximate potential at large, the monopole and dipole terms, origin of coordinates in multi-pole, expansions, the electric field of a dipole.

Electric Fields in Matter: Polarization: dielectrics, induced dipoles, alignment of polar molecules, polarization. The field of a polarized object: bound charges, physical interpretation of bound charges, and the field inside a dielectric. The electric displacement: Gauss's law in the presence of dielectrics, a deceptive parallel, boundary conditions. Linear Dielectrics: susceptibility, permittivity, dielectric constant, boundary value problems with linear dielectrics, energy in dielectric systems, forces on dielectrics.

Magneto statics: The Lorentz Force law: magnetic fields, magnetic forces, currents. The Biot-Savart Law: steady currents, the magnetic field of a steady current. The divergence and curl of B: straight-line currents, the divergence and curl of B, applications of Ampere's law, comparison of magnetostatics and electrostatics. Magnetic Vector Potential: the vector potential, summary, magnetic boundary conditions, multi-pole expansion of the vector potential.

Magnetic Fields in Matter: Magnetization, diamagnets, paramagnets, ferromagnets, torques and forces on magnetic dipoles, effect of a magnetic field on atomic orbits, magnetization. The Field of a Magnetized Object: bound currents, physical interpretation of bound currents, and the magnetic field inside matter. The auxiliary field H: Ampere's law in magnetized materials, a deceptive parallel, boundary conditions. Linear and nonlinear media: magnetic susceptibility and permeability, ferromagnetism.

Recommended Books:

1. D. J. Griffiths, "Introduction to Electrodynamics", Prentice Hall, 4th ed. 2012.

2. M. N. O. Sadiku," Elements of Electromagnetics", Oxford University Press, 5th ed. 2009.
3. F. Melia, "Electrodynamics", University of Chicago Press, 2001.
4. Hearld J and W. Muller-Kristen, "Electrodynamics", World Scientific Publishing, 2nd ed. 2011.

PHY- 3515 **ELECTRONICS-I** **Credit Hrs:03**

Circuit Theory and Analysis: Superposition theorem, Thevenin's Theorem, Norton's Theorem, Basic RC and RLC circuit analysis based on these theorems.

The Semiconductor Diode: Metals, insulators and semiconductors, Conduction in Silicon and Germanium, The forbidden energy gap, n and p type semiconductors, the junction diode, diode voltage-current equation, diode as rectifier, the Π filter, the Π-R filter, the voltage doubling rectifier circuit, diode wave clippers, diode clampers. Zener diodes, light emitting diodes, photodiodes, capacitance effects in the pn junction.

The Diode as Rectifier and Switch: The ideal diode model, the half wave, the full wave rectifier, the bridge rectifier, measurement of ripple factor in the rectifier circuit, the capacitor filter, rectifying AC voltmeters.

The Junction Transistor as an Amplifier: Transistor voltage and current designations, the junction transistor introduction and working, , CB, CE and CC configuration, the basic transistor amplifiers, relation between Ai and Av, comparison of amplifier performance. the current amplification factors.

DC Bias for the Transistor: the load line and Q point, Choice of Q point, variation of Q point, fixed transistor bias, the four resistor bias circuit, design of a voltage feedback bias circuit, Common emitter, common collector, common base biasing.

Field Effect Transistor: Field effect transistor, JFET: Static characteristics of JFET, Metal oxide semiconductor Field Effect Transistor (MOSFET of IGFET): enhancement and depletion mode, FET biasing techniques, Common drain, common source and common gate, fixed bias and self-bias configurations, Universal JFET bias curve, Darlington pair.

Operational Amplifiers: The integrated amplifier, the differential amplifier, common mode rejection ratio, the operational amplifier, summing operation, integration operation, comparator, milli-voltmeter.

Recommended Books:

1. Thomas L. Floyd, "Electronics Fundamentals: Circuits, Devices and

Applications", Prentice Hall, 8th ed., 2009.

2. B. Grob, "Basic Electronics", McGraw-Hill, Tch ed. 1997.

3. B. Streetman and S. Banerjee "Solid State Electronics Devices", Prentice

Hall, 6th ed. 2005.

4. A. P. Malvino, "Electronic Principles", McGraw-Hill, 7th ed. 2006.

5. R. T. Paynter, “Introductory Electric Circuits”, Prentice Hall, 1998

PHY- 3516 **LAB-V** **Credit Hrs: 02**

LIST OF EXPERIMENTS:

1. Design and Construction of Wave shaping circuits (Integrator, Differentiator, Clipper and Clamper) and study of their characteristics.
2. Study of a PN-junction diode characteristics and construction of half wave and full wave (center tapped and bridge) circuits and study of their characteristics with load resistance and filters
3. Design of a low tension regulated power supply using fixed and variable voltage regulators.
4. Draw BJT (Bipolar junction transistor) I/P and O/P characteristics in CE and CB configuration and Derivation of I/P and O/P parameters.
5. Design and construction of a single stage common emitter transistor amplifier and measurement of Input / Output Impedance and frequency response curve.
6. Design and construction of Operational amplifier with 741 IC and study its characteristics and functions
7. Design and construction of discrete AND, OR, NOT (invertor), NAND and NOR Logic Gate circuits and verify their truth tables using discrete components and 74LS00 and 74LS03 ICs for the same purposes.
8. Design and construction of a Monostable, Astable and Bistable Multivibrators and study of their characteristics using IC and discrete components.

SEMESTER-VI

Code	Title	Cr. Hrs.
PHY-3617	Mathematical Methods of Physics-II (M)	3
PHY-3618	Quantum Mechanics – I (M)	3
PHY-3619	Electromagnetic Theory-II (M)	3
PHY-3620	Electronics-II (M)	3
PHY-3621	Solid State Physics-I (M)	3
PHY-3622	Lab-VI (M)	2
	Total	**17**

PHY-3617 MATHEMATICAL METHODS OF PHYSICS-II Credit Hrs:03

Objectives:

To give the understanding of Differential equations and their uses in Physics, Introduction to special functions, Fourier Series, Fourier Transforms, Solution of Boundary value problems and their uses.

Fourier Series:

Definition of Fourier Series, Example of Fourier Series, Fourier Sine and Cosine Series, Complex Form of Fourier Series, point wise and mean convergence of Fourier series, Applications of Fourier Series.

Fourier Transform:

Integral Transforms, Fourier Transforms of Derivatives, Fourier Sine Transform, Fourier Cosine Transform, Fourier Transformation of Generalized Functions, Fourier Transform and its Properties, Connection Between Laplace and Fourier Transform, Laplace Transform, its Properties and Applications.

Special Functions:

Introduction to Homogeneous and Non-Homogenous Equations, Gamma Function (Definitions And Simple Properties), Beta Function, Bessel Function of First Kind, Bessel Function of Second Kind, Fourier Bessel Series, Generating Functions of Legendre Functions, Recurrence Relations and Special Properties, Spherical Harmonics.

Recommended Books:

1. Mathematical Methods for Physicists, 6^{th} Edition, George Arfiken,
2. Mathematical Physics, Bukove, Addison-Wesley
3. Mathematical Methods of Physics, News and Walker.
4. Mathematical Physics, Gupta, Vikas Publication
5. Mathematical Methods for Physicists, Skolonihoff
6. Fundamental of Mathematical Physics, Krout E. A.

PHY- 3618 **QUANTUM MECHANICS-I** **Credit Hrs: 03**

Operators and Eigen functions: Observables and Operators, Eigen Functions and Eigen Values, The Measurements in Quantum Mechanics, The State Function and Expectation Values, Orthogonal Systems, Completeness of Eigen Functions, Hermitian Operator, Simultaneous Eigen Functions and The Commutator, The Parity Operator, The Fundamental Commutation Rule and The Uncertainty Principle, Ehrenfest Theorem, Correspondence Principle. Formulation of quantum mechanics: Wave Particle Duality, Wave Packets, Uncertainty Principle and the Related Gedenken Experiment, Wave Function for a Free Particle, Schrödinger Equation, Interpretation of Wave Function, Probability Density and Probability Current. Application of schrödinger equation: Application of Schrödinger Equation for one Dimensional Problems, Potential Step, Potential Barrier and Tunneling, Rectangular Potential-Well, Linear Harmonic Oscillator. Spherically symmetric systems: The Schrödinger Equation for Spherically Symmetric Potentials, Degeneracy, Angular Momentum, Many Particle System, the Hydrogen Atom.

RECOMMENDED BOOKS

1. Introductory Quantum Mechanics 4th ED, Richard Liboff.
2. Introduction to Quantum Mechanics 2nd ED, David Griffith.
3. Modern Quantum Mechanics. Sakurai.
4. Quantum Mechanics, S-Gasiorowiz.
5. Quantum Mechanics, Gupta.
6. Quantum Mechanics, Powell and Grasemann.

PHY- 3619 ELECTROMAGNETIC THEORY-II Credit Hrs:03

Objectives:

To provide the understanding of the theory of EM wave generation and propagation, radiation, electrodynamics and relativity, solution of relevant theoretical problems.

Electrodynamics: Electromotive force: Ohm's law, electromotive force, motional emf, electromagnetic induction: Faraday's law, the induced electric field, inductance, energy in magnetic fields, Maxwell's equations: electrodynamics before Maxwell, how Maxwell fixed Ampere's law, Maxwell's equations, magnetic charges, Maxwell's equations in matter, boundary conditions.

Conservation Laws: Charge and energy: the continuity equation, Poynting's theorem, momentum: Newton's third law in electrodynamics, Maxwell's stress tensor, conservation of momentum, angular momentum.

Electromagnetic Waves: Waves in one dimension: the wave equation, sinusoidal waves, boundary conditions, reflection and transmission, polarization, electromagnetic waves in vacuum: the wave equation for E and B, monochromatic plane waves, energy and momentum in electromagnetic waves, electromagnetic waves in matter: propagation in linear media, reflection and transmission at normal incidence, reflection and transmission at oblique incidence, absorption and dispersion: electromagnetic waves in conductors, reflection at a conducting surface, the frequency dependence of permittivity, guided waves: wave guides, the waves in a rectangular wave guide, the coaxial transmission line.

Potentials and Fields: The potential formulation: scalar and vector potentials, gauge transformations, Coulomb gauge and Lorentz gauge, continuous distributions: retarded potentials, Jefimenko's equations, point charges: Lienard-Wiechert potentials, the field of a moving point charge.

Radiation, Dipole Radiation: What is radiation, electric dipole radiation, magnetic dipole radiation, radiation from an arbitrary source, point charges: power radiated by a point charge, radiation reaction, the physical basis of the radiation reaction.

Electrodynamics and Relativity: The special theory of relativity: Einstein's postulates, Lorentz transformations, proper time and proper velocity, relativistic energy and momentum, relativistic kinematics and dynamics, relativistic electrodynamics: magnetism as a relativistic phenomenon, how the field transform, the field tensor, electrodynamics in tensor notation, relativistic potentials.

Recommended Books:

1. D. J. Griffiths, "Introduction to Electrodynamics", ed. Prentice Hall, 4th ed. 2012.
2. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 5th ed. ed. 2009.
3. F. Melia, "Electrodynamics", University of Chicago Press, 1st ed. 2001.
4. Hearld J and W. Muller-Kristen, "Electrodynamics", World Scientific Publishing, 2nd ed. 2011.

PHY-3620 ELECTRONICS-II Credit Hrs:03

Amplifiers and their Frequency Response: Cascade amplifier, The Amplifier pass band, The frequency plot, Low frequency plot, Low frequency limit, The un-bypassed emitter resistor, high frequency equivalent circuit, The Miller Effect, high frequency limit of transistor, bandwidth of a cascade amplifier.

Feedback: Positive and Negative feedback, Principle of feedback amplifier, stabilization of gain by negative feedback, Bandwidth improvement with negative feedback, Reduction of nonlinear distortion, control of amplifier output and input resistance, current series feedback circuit, voltage shunt feedback circuit.

Oscillators: Introduction, Classification of oscillators, Damped and undamped oscillators, the oscillatory circuit, frequency stability of an oscillator, essentials of a feedback LC oscillator, tuned base oscillator, Hartley oscillator, Colpitis oscillator, crystal oscillator.

Power Amplifiers: Introduction, Power relation in class-A amplifiers, effect of thermal environment, determination of the output distortion, Class-B amplifier, efficiency of class-A and Class-B amplifiers.

Multivibrators: Multivibrators, Basic types of Multivibrators, uses of Multivibrators, A stable Multivibrators, Mono-stable Multivibrators, Bi-stable Multivibrators, Schmitt Trigger Circuit.

Modulation and Demodulation: Introduction, carrier wave modulation, Need for modulation, radio Broadcasting, Methods of modulation, amplitude modulation, Forms of amplitude modulation, Frequency modulation.

Digital Circuits: Decimal, Binary, Octal, hexadecimal number systems, conversion of decimal numbers to any other number system and vice-versa, Binary codes, OR, AND, NOT, NAND, NOR logic gates, Boolean Algebra. Boolean expressions, simplification of Boolean expression using Boolean Algebra and Karnaugh Map, Universality of NAND and NOR gates, Logic gates as basic adders, subtractors, comparators.

Integrated Circuits: Introduction, Integrated circuit terminology, Integrated circuit advantages and drawbacks, scale of integration, classification of integrated circuit by structure and function, Comparison between different integrated circuit, Introduction to Integrated circuit fabrication.

Recommended Books:

1. Thomas L. Floyd, “Electronics Fundamentals: Circuits, Devices and Applications”, Prentice Hall, 8th ed. 2009.
2. B. Grob, “Basic Electronics”, McGraw-Hill, Tch ed. 1997.
3. Digital Fundamentals 9th ED; Thomos L. Floyd
4. B. Streetman and S. Banerjee “Solid State Electronics Devices”, Prentice

Hall, 6th ed. 2005.
5. A. P. Malvino, “Electronic Principles”, McGraw-Hill, 7th ed. 2006.
6. R. T. Paynter, “Introductory Electric Circuits”, Prentice Hall, 1998.

PHY-3621 SOLID STATE PHYSICS-I Credit Hrs:03

Aims and Objectives:

The course will provide a valuable theoretical introduction and an overview of the fundamental applications of the physics of solids. This course includes theoretical description of crystal and electronic structure, lattice dynamics, and optical properties of different materials. The objectives of this course are to enhance the knowledge of Solid State Physics with the emphasis on following concepts:

1. Crystallography
2. Bonding
3. X-ray diffraction, Reciprocal lattice
4. Phonons, Dispersion relations for Phonons
5. Heat Capacities and the semiconducting properties of Solids.

Crystal Structure:

Lattices (Bravais and non-Bravais lattices), Primitive and non-primitive unit cell, Wigner-Seitz unit cell, Symmetry and symmetry operations, Miller indices and planes, Classification of lattices, 2-dimensional and 3-dimensional lattices, (NaCl, CsCl, ZnS and diamond lattices), Reciprocal lattice.

Crystal Diffraction:

Bragg's law, Von-Laue equation, Experimental techniques of X-ray diffraction (Laue method, Rotating crystal method, Powder method), Electron diffraction. Neutron diffraction.

Crystal Binding:

Covalent bonding, Metallic bonding, Hydrogen bonding, Ionic bonding, cohesive energy of ionic crystals, Van-der-Waals bonding, Van-der-Waals London interaction.

Lattice Vibrations and Thermal Properties of Solid:

Dispersion relation of phonons for one-dimensional Mono-atomic and Diatomic linear lattices, Physical difference between optical and acoustic branches, Excitation of optical branch, Quantization of Elastic Waves Phonons, -Phonon Momentum. Lattice heat capacity, Dulong and Petit Law for specific heat of solids, Einstein Model of specific heat of solids, Debye model of specific heat of solids with high and low temperature limitations

Recommended Books:

1. C. Kittel,Introduction to Solid State Physics, John Wiley & Sons8th.ed., (2005)
2. R. J Elliot and A. F. Gibson; ELBS and Macmillan, an Introduction to Solid State Physics and its Applications.
3. M. A. Omar, Elementary Solid State Physics, Pearson Education 2000.
4. N. M. W. Ashcroft N. D. Mermin, Solid State Physics, Holt, Rinehart & Winston, 1976,
5. J. S. Blackmore; W. B. Saunders, Solid State Physics,

6. Ziman , Principle of Solid State Physics, Cambridge University.
7. H. E. Hall John, Solid State Physics, ELBS and John Wiley & Son.
8. M.A. Wahab, Solid State Physics, Narosa Publishing House, 1999.

PHY- 3622 LAB-VI (SOLID STATE PHYSICS) Credit Hrs: 02

LIST OF EXPERIMENTS:

1. To investigate the Hall Effect in semiconductor or in metal and to draw the graph between Hall voltage and current.
2. To verify the Bragg's law for X-ray diffraction by using the rock salt crystal.
3. To expose the Van-Laue pattern of LiF on X-ray film
4. To determine the dielectric constant of solid by capacitor method.
5. (a) To study the characteristics of photocell.
   (b) To study the characteristics of thermistor.
6. To determine the energy gap in Silicon or Germanium.
7. To find the crystal structure of graphite by electron diffraction.
8. To study the thermoelectric effect by using the heat pump.
9. To study the crystal lattice structure of tungsten by Field Emission Microscope.
10. To measurement the resistivity & conductivity of metals & non-metals.

SEMESTER-VII

Code	Title	Cr. Hrs.
PHY-4723	Nuclear Physics (M)	3
PHY-4724	Quantum Mechanics – II (M)	3
PHY-4725	Atomic Physics (M)	3
PHY-4726	Solid State Physics-II (M)	3
PHY-4727	Lab-VII (M)	2
PHY-4899/47XX	Research Project/Special Paper (M)	3
	Total	**17**

PHY- 4723 **NUCLEAR PHYSICS** **Credit Hrs: 03**

Basic properties: Proton-Electron Theory of the Nucleus, Proton-Neutron Theory of the Nucleus, Size, Mass, Binding Energy, Dipole and Quadruple Moments (Electric) Parity and Statistics of Nuclei: particle detectors and accelerators: Passage of Charged Particles Through Matter, Energy Loss and Stopping Power, G.M Counter, Proportional Counter, Ionization Chamber, Semiconductor Detector, Scintillation Counter. Linear Accelerator, Betatron, Cyclotron. Radioactivity: Introduction to Radioactivity, Laws of Radioactive Disintegrations, Theory of Alpha Decay, Alpha-Ray Spectra, Introduction to Classical Theory of Beta Decay, Non-Conservation of Parity in Beta Decay, Neutrino Hypothesis, Introduction to Gamma- Decay. Nuclear forces (introductory): Two Body Problem, Ground State of Deuteron, Spin Dependence and Charge Independence of Nuclear Force, Yukawa Theory. Nuclear reactions: Conservation Laws of Nuclear- Reactions, Q-Value and Threshold Energy, Theory of Compound Nucleus, Nuclear Cross-Section, Reaction Induced by Photons, Protons, Deuterons and Alpha Particles, Nuclear Fission, (Symmetric & Asymmetric) & Fusion.

RECOMMENDED BOOKS

1. Nuclear physics, D.G.Tyal.
2. Nuclear physics, K.S. Krane
3. Nuclear physics 2nd ED Kaplan.
4. A text book of nuclear physics, Smith.
5. Theoretical nuclear physics, Belatt and Weisskoff.
6. Introduction to Nuclear Physics, H-Enge.

PHY- 4724 **QUANTUM MECHANICS-II** **Credit Hrs: 03**

Matrix mechanics: Restatement of Quantum Mechanical Assumptions, Matrix Operators, Bra and Ket Vectors. Schrodinger, Heisenberg and Interaction Pictures of Quantum Mechanics. the One-Dimensional Harmonic Oscillator in Matrix Mechanics. Angular momentum and spin: Matrix Representation of Angular Momentum and Its Components, Explicit Forms of Angular Momentum Matrices, Effect of Magnetic Field, Quantum Theory of Normal Zeeman Effect, Electron Spin and The Pauli Spin Matrices, Electronic States in a Central Field, Addition of Angular Momenta, The P-States of an Electron, Spin States for Two Particles of Spin One-Half. Methods of approximation: Variational Methods and its Application, Perturbation Theory for Non-Degenerate Stationary States with Simple Illustration, Time Dependent Perturbation, WKB Approximation. Transition Probability and Fermi's Golden Rule. Theory of scattering: Derivation of Scattering Cross Section by Partial Wave Technique, scattering by an Attractive Square Well Potential, Born Approximation, Scattering by Coulomb Field, Optical Theorem. Identical particles: Principle of Indistinguishability of Identical Particles, Generalized Pauli's Exclusion Principle, Statistics of Identical Particles, Helium Atom, Symmetric and AntiSymmetric Wave Functions.

RECOMMENDED BOOKS

1. Introductory Quantum Mechanics 4th ED, Richard Liboff.
2. Introduction to Quantum Mechanics 2nd ED, David Griffith.
3. Modern Quantum Mechanics. Sakurai.
4. Quantum Mechanics, S-Gasiorowiz.
5. Quantum Mechanics, Gupta.
6. Quantum Mechanics, Powell and Grasemann.

PHY- 4725 **ATOMIC PHYSICS** **Credit Hrs: 03**

Atomic models: Thompson Model, Rutherford Model, Rutherford Scattering Formula, Nuclear Dimensions and Electron Orbits. Atomic structure and atomic spectra: Bohr Theory of Atomic Structure and Atomic Spectra, Correspondence Principle Correction for Nuclear Motion, Frank Hertz Experiment, Somerfield Elliptic Orbits, Relativity Correction and Hydrogen Fine Structure, Vector Model of the Atom, Space Quantization, Stern Gerlach Experiment, Orbital Angular Momentum, Spin Angular Momentum, Total Angular Momentum, Orbital and Spin Magnetic Moments, Magnetic Quantum Numbers, Pauli's Exclusion Principle, Distribution of Electrons in an Atom, Spectral Notations, Relative Intensity Measurements. Coupling Scheme (LS and JJ Coupling), Zeeman Effect (Normal and Ananolous), Spectra of Two Electrons Atom, Inner Core Electron Spectra (X-Rays), Stark Effect. Quantum theory of radiation: The Failure of Classical Physics to Describe Atomic Phenomena, Emission and Absorption of Thermal Radiation, Classical Theory of Thermal Radiation and Its Failure, Planks's Quantum Theory of Thermal Radiation. Waves and particles: de-Brogli's Hypothesis, Diffraction of Electron and Neutron, Velocity of the De-Brogli Wave, Group Velocity and Phase Velocity, Photoelectric Effect, Compton Effect and Pair Production.

RECOMMENDED BOOKS

1. Concept of Modern Physics, Arthur Beiser, 4th Ed
2. Physics of Atoms and Molecules, B. H. Bransden and C. J. Joachain
3. Atomic Spectra, White,
4. Elements of Spectroscopy, S. L. Gupta, V Kumar and C. Sharma 9th Ed.

PHY-4726 SOLID STATE PHYSICS-II Credit Hrs:03

Aims and Objectives:

This course is about the electronic properties of materials and provides a valuable theoretical introduction and an overview of the fundamental applications of the physics of solids. The goal of the course is:

1. To present modern concepts of the electronic properties of the materials
2. To introduce the concept of density of states, and to discuss thermal and electronic properties.
3. To develop the modern concept of band theory of solids, starting with the free electron model of a metal and culminating with the properties of conductors and semiconductors. Bragg diffraction of vibrational and electron waves serves as a unifying theme of the course.

Semiconductor Crystals:

Crystal structure and bonding, band structure, Band Structure of Semiconductors, Impurity states, Donor states Accepter states, Holes, Effective Mass Intrinsic Carrier concentration (law of mass action), Hall Effect.

Free Electron Fermi Gas:

Energy levels and density of orbital in one dimension, Effect of temperature on the fermi-dirac distribution, Free electron gas in three dimensions, Heat capacity of the electron gas, Experimental heat capacity of metals, Electrical conductivity and Ohm's law, Experimental electrical resistivity of metals, Motion in magnetic fields, Hall effect, Thermal conductivity of metals, Ratio of thermal to electrical conductivity.

Energy Bands and Methods of Electronic Band Structure Calculations:

Nearly free electron model, Origin of the energy gap, Magnitude of the energy gap, Bloch functions, Kronig-Penney model, Wave equation of electron in periodic potential, Restatement of the bloch theorem, Crystal momentum of an electron, Solution of the central equation, Empty lattice approximation, The structure of Brillouin zones, Reduced zone scheme, periodic zone scheme and extended zone scheme, Construction of free electron Fermi surfaces, Formation of energy bands, The empty lattice energy bands, Plane wave method, Orthogonalized plane wave method, Pseudo potential method, The tight binding method, Cellular and Quantum defect method, Augmented plane wave method

Defects in Solids:

Lattice vacancies, Diffusion, Metals, Colour-centers, F-centers, Other centers in alkali halides, Shear strength of single crystals slip, Dislocations, Burgers Vectors, Stress field of dislocations, Low angle grain bounderies.

Recommended Books:

1. C. Kittel,Introduction to Solid State Physics, John Wiley & Sons8th.ed., (2005)

2. R. J Elliot and A. F. Gibson; ELBS and Macmillan, An Introduction to Solid State Physics and its Applications,
3. M. A. Omar, Elementary Solid State Physics, Pearson Education 2000.
4. N. M. W. Ashcroft and N. D. Mermin, Solid State Physics, Holt, Rinehart & Winston, 1976,
5. M.A. Wahab, Solid State Physics, Narosa Publishing House, 1999.

PHY- 4727 LAB-VII (NUCLEAR PHYSICS) Credit Hrs: 03

LIST OF EXPERIMENTS:

1. To draw the G M Tube's characteristics 2.
   To find the dead time of a G M Tube.
3. To study the exponential decrease in the intensity of gamma rays with thickness and determination of the linear absorption coefficient and mass absorption coefficient of lead.
4. To study the statistics fluctuation in emission of gamma rays and to compare the theoretical and experimental curve.
5. Determination of range of Alpha particles using solid state detector.
6. Determination of the maximum energy of beta - particles.
7. Determination of half-life of thoron gas
8. To verify the inverse square law of Nuclear radiations.
9. Detection of g-rays by sodium iodide (NaI) detector system

PHY-4899/47XX **Research Project/Special Paper-I** **Credit Hrs: 03**

Selected from the list and allotted by supervisor.

SEMESTER-VIII

Code	Title	Cr. Hrs.
PHY-4828	Thermal and Statistical Physics (M)	3
PHY-48XX	Elective course I	3
PHY-48XX	Elective course-II	3
PHY-48XX	Elective course –III	3
PHY-4899 /PHY-48XX	Research project/Special Paper (M)	3
	Total	**15**

PHY- 4828 THERMAL AND STATISTICAL PHYSICS Credit Hrs:03

Objectives:

The objective of this course is to learn how to apply thermodynamic principles in order to interpret thermodynamic systems and predict their behaviors and acquire fundamental knowledge of classical and quantum statistical mechanics.

Thermal physics: Review of Laws of Thermodynamics, Maxwell's Relations Thermodynamic Potentials, Criteria of Thermodynamical Equilibrium, Intrinsic and Mutual Stabilities of Single Component Systems, Conditions of Stabilities. The Lechatelier Braun Principle, First Order Phase Transition, Discontinuities of Volume and Entropy. Second Order Phase Transition, Kinetic Theory of Gases.

Statistical Physics : Fundamental Principles, Mean Values and Probability Distributions Statistical Ensemble, Probability and Entropy Relation- Ship, Liouville's Theorem, Statistical Concept of Temperature, Entropy and Free Energy, Micro Canonical, Macro-Canonical and Grand Canonical Ensembles, Macro & Micro States, Maxwell's Boltzmann Statistics and Its Application To (I) Equipartition of Energy, (Ii) Harmonic Oscillator, (Iii) Richardson's Equation for Thermionic Emission (Iv) Paramagnetism,

Quantum Statistical Mechanics: Basic Facts of Quantum Mechanics, Heisenberg Uncertainty Principle and Bose Einstein Statistics, Application To Black Body Radiation, Pauli Exclusion Principle and Fermi-Dirac Statistics, Application to Electron Gas, Specific Heat of Electron Gas, Thermionic Emission and Richardson's Equation, Kinetic Methods and Transport Theory, Boltzmann Transport Equation and Its Application.

Recommended Books:

1. Concepts in Thermal Physics, Stephen J. Blundell, Katherine Blundell, Oxford University Press (2006).
2. Thermal Physics by C. Kittle and H. Kroemer, W. H. Freeman and Company USA (1980).
3. Introductory Statistical Mechanics, Roger Bowley and Mariana Sanchez, Clarendon Press, Oxford (1999).
4. Fundamental of statistical and thermal Physics, F. Rief, McGraw-Hill, Inc. USA (1965).
5. Heat and Thermodynamics by Mark W. Zemansky, Richard H. Dittman, McGraw-Hill Compnies, Inc. (1997).

PHY-48XX	**Elective Course-I**	**Credit Hrs: 03**
PHY-48XX	**Elective Course-II**	**Credit Hrs: 03**
PHY-48XX	**Elective Course-III**	**Credit Hrs: 03**
PHY-4899/48XX	**Research Project/Special Paper-I**	**Credit Hrs: 03**

Elective Courses Syllabus

S. No.	Codes	Title
1.	PHY-XX29	Astro Physics
2.	PHY-XX30	Atomic and Molecular Spectroscopy
3.	PHY-XX31	Computer Simulations in Physics
4.	PHY-XX32	Electronic Materials and Devices
5.	PHY-XX33	Environmental Physics
6.	PHY-XX34	Experimental Techniques in Particle and Nuclear Physics
7.	PHY-XX35	Fluid Dynamics
8.	PHY-XX36	Introduction to Materials Science
9.	PHY-XX37	Introduction to Nanotechnology
10.	PHY-XX38	Introduction to Photonics
11.	PHY-XX39	Introduction to Quantum Computing
12.	PHY-XX40	Laser Engineering
13.	PHY-XX41	Laser Physics
14.	PHY-XX42	Methods of Experimental Physics
15.	PHY-XX43	Particle Physics
16.	PHY-XX44	Plasma Physics
17.	PHY-XX45	Quantum Electronics
18.	PHY-XX46	Quantum Field Theory
19.	PHY-XX47	Quantum Information Theory
20.	PHY-XX48	Quantum Optics
21.	PHY-XX49	Research Methodology and Skill Enhancement
22.	PHY-XX50	Semiconductor Physics
23.	PHY-XX51	Surface Science

DETAIL OF ELECTIVE COURSES FOR BS 4 YEAR PROGRAMME

Some new elective courses have been added along with their contents in the already existing list with revised codes. Approval may please be granted.

PHY-XX29 ASTRO PHYSICS

PHY-XX30 ATOMIC AND MOLECULAR SPECTROSCOPY

What is spectroscopy, the electromagnetic spectrum, Quantization and the Hydrogen Atom, Quantization in Poly-electronic Atoms, Electronic States of Diatomic and Polyatomic Molecules, Molecular Vibrations and Rotation, How Spectra are obtained. Vibrational Spectroscopy, Rotational and Electron Spectroscopy.

RECOMMENDED BOOKS

1. J. Michael Hollas, "Basic Atomic and Molecular spectroscopy, 1st Ed." Wiley-RSC, 2002 2. J. Michael Hollas, "Modern spectroscopy, 4th Ed." John Wiley & Sons Inc..2004.

PHY-XX31 COMPUTATIONAL PHYSICS Credit Hrs:03

Objectives:

Introduction of computer languages. To know the use of computer in numerical analysis. Computer simulation and modeling.

Computer Languages: A brief introduction of the computer languages like Basic, C. Pascal etc. and known software packages of computation

Numerical Methods: Numerical Solutions of equations, Regression and interpolation, Numerical integration and differentiation. Error analysis and technique for elimination of systematic and random errors

Modeling & Simulations: Conceptual models, the mathematical models, Random numbers and random walk, doing Physics with random numbers, Computer simulation, Relationship of modeling and simulation. Some systems of interest for physicists such as Motion of Falling objects, Kepler's problems, Oscillatory motion, Many particle systems, Dynamic systems, Wave phenomena, Field of static charges and current, Diffusion, Populations genetics etc.

Recommended Books:

1. M. L. De Jong, "Introduction to Computational Physics", Addison Wesley, 1991.

2. S. T. Koonini, “Computational Physics”, the Benjamin-Cummings, 1985.
3. H. Gould, J. Tobochnik and W. Christian, “An Introduction to Computer Simulation Methods”, Addison Wesley, 3rd ed. 2006.
4. S. C. Chapra and R. P. Chanle, ”Numerical Methods for Engineers with Personal Computer Applications”, McGraw-Hill,1990.
5. S. C. Chapra, “Applied Numerical Methods with MATLAB for Engineers and Scientists”, McGraw-Hill, 2nd ed. 2006.

PHY-XX32 COMPUTER SIMULATIONS IN PHYSICS Credit Hrs:03

Objectives:
The aim is to develop the ability to turn theoretical ideas of mathematics and physics into computer simulations of real-world systems.
Programming for Scientific Computation: unix/linux basics, the editingcoding- compiling-debugging-optimizing-visualizing-documenting production chain, Fortran 95.
Numerical Programming: Functions: approximation and fitting, Numerical calculus. Ordinary differential equations, Matrices, Spectral analysis, Partial differential equations.
Modeling and Simulation: Molecular dynamics simulations, modeling continuous media Monte Carlo simulations.
Project: A project will be chosen by the student in consultation with the instructor. Selection of the project should be done soon after the module on modelling and simulation starts and continue over the course of the rest of the semester. The final part of the course is reserved for presentation of preliminary and final results.
Recommended Books:
1. T. Pang, “An Introduction to Computational Physics”, Cambridge University Press, 2008.
2. R. Landau, M. Paez, C. Bordeianu, “A Survey of Computational Physics”, Princeton University Press, 2008.

PHY-XX33 ELECTRONIC MATERIALS AND DEVICES Credit Hrs: 3
Objectives:
To understand the relation between electrical, optical and magnetic devices.
Semiconductor Fundamentals: Composition, purity and structure of semiconductors, energy band model, band gap and materials classification, charge, effective mass and carrier numbers, density of states, the Fermi function and equilibrium distribution of carriers, doping, *n* and *p*-type
semiconductors and calculations involving carrier concentrations, *E*F etc., temperature dependence of carrier concentrations, drift current, mobility, resistivity and band bending, diffusion and total currents, diffusion coefficients, recombination-generation, minority carrier life times and continuity equations with problem solving examples.
Device Fabrication Processes: Oxidation, diffusion, ion implantation, lithography, thin-film deposition techniques like evaporation, sputtering, chemical vapour deposition (CVD), epitaxy etc.
***PN* Junction and Bipolar Junction Transistor:** Junction terminology, Poisson’s equation, qualitative solution, the depletion approximation, quantitative electrostatic relationships, ideal

diode equation, non-idealities, BJT fundamentals, Junction field effect transistor, MOS fundamentals, the essentials of MOSFETs.

Dielectric Materials: Polarization mechanisms, dielectric constant and dielectric loss, capacitor dielectric materials, piezoelectricity, ferroelectricity and pyroelectricity.

Optoelectronic Devices: Photoconductors, photovoltaics and photodetectors, photodiodes and photovoltaics, solar cell basics, LEDs, Lasers, displays, LCDs.

Magnetism and Magnetic Materials: Basics of magnetism, hysteresis loops, magnetic domains and anisotropy, hard and soft magnetic materials, transformers, DC motors and data storage.

Recommended Books:

1. R. F. Pierret, "Semiconductor Device Fundamentals", Addison Wesley, 2nd ed. 1996.
2. N. Braithwaite, and G. Weaver, "Electronic Materials", MA: Butterworth, 2nd ed. 1990.
3. S. O. Kasap, "Electronic Materials and Devices", McGraw-Hill, 3rd ed. 2005.
4. R. C. O'Handley, "Modern Magnetic Materials: Principles and Applications", Wiley Inter-Science, 1999.
5. D. Jiles, "Introduction to Magnetism and Magnetic Materials", Chapman & Hall, 2nd ed. 1998.

PHY-XX34 EXPERIMENTAL TECHNIQUES IN PARTICLE AND NUCLEAR PHYSICS Credit Hrs:03

Objectives:

To give students with the practical hand on the experimental techniques, physically understand the nuclear phenomena.

Review of Basic Concepts: Units used in particle physics, Definition used in particle physics, Types of particles to be detected, Cross section, Decay width, Lab Frame and CM frame, Pseudo rapidity, History of Accelerator, Linear accelerators, Circular accelerators, Introduction to RHIC, Tevatron, LEP, LHC.

Introduction to Accelerators: Lattice and geometry, The arcs, Periodicity, Aperture, Beam crossing angle, Luminosity, RF cavities, Power requirements, Longitudinal feedback system, Injection, Injection scheme, PS, SPS, Magnets, Cryogenics, Vacuum system.

Introduction to Detectors: Introduction to detectors, Need of detectors, Passage of radiation through matter, Cross-section, Interaction probability in a distance x, Mean free path, Energy loss of heavy charged particles by atomic collisions, Bohr's, calculation – classical case - The Bethe Bloch formula, Cherenkov radiation, Energy loss of electron and photon, Multiple coulomb scattering, Energy straggling, The interaction of photons, The interaction of neutrons.

General Characteristics of Detectors and Gas Detectors: Sensitivity, Detector response, Energy resolution The Fano-factor, The response function, Response time, Detector efficiency, Dead time- Ionization detectors, Gaseous ionization detectors, Ionization & transport phenomenon in gases,

Transport of electrons and ions in gases, Avalanche multiplication, The cylindrical proportional counter, The multi-wire proportional counter, The drift chambers, Time projection chambers, Liquid ionization detector.

Scintillators, Photomultipliers, Semi-conductor Detectors: Scintillation detectors, Organic scintillation, Inorganic crystals, Gaseous scintillators Glasses, Intrinsic detector efficiency for

various radiations, Photomultipliers, Basic construction and operation, The photocathode, The electron-optical input system, Semiconductor detetors, Silicon diode detectors, Introduction to CMS and its detectors.

Detector Software and Physics Objects: Introduction to Linux operating system, Introduction to CMS software (CMSSW), Basic infrastructure of software, Introduction to PYTHIA, Introduction to GEN, SIM, DIGI, RECO, reconstruction of final state objects.

Recommended Books:

1. The Large Hadron Collider Conceptual Design CERN/**AC/95-05 (LHC)**
2. Detector performance and software, **Physics Technical Design Report, Volume1**
3. Techniques for Nuclear and Particle Physics Experiments by **W.R. Leo**
4. R. Fernow, "Introduction to experimental particle physics", Cambridge University Press, 1989.
5. D. H. Perkins, "Introduction to High Energy Physics", Cambridge University Press, 4th ed. 2000.
6. **MIT website** http://mit.edu

PHY-XX35 FLUID DYNAMICS Credit Hrs:03

Objectives:

Physical understanding of fluid dynamics.

Phenomenological introduction to fluid dynamics Kinematics and conservation laws
Ideal fluids, the Euler equations, ir-rotational flow The Navier-Stokes equations
Viscous flow: Stokes flow, drag, lubrication theory, thin film flow
Waves: surface waves, internal gravity waves, nonlinear waves. solitons, shocks
Instabilities: linear stability analysis, Kelvin-Helmholts instability, Rayleigh-Bénard convection, other instabilities
Other topics depending on interest and as time permits possibly: airfoil theory, granular flows, biophysical flows.

Recommended Books:

1. D. J. Acheson, "Elementary Fluid Dynamics", Oxford University Press, 1990.
2. P. K. Kundu and I.M. Cohen, "Fluid Mechanics", Academic Press, 4th ed. 2010.
3. D. J. Tritton, "Physical Fluid Dynamics", Clarendon, 2nd ed. 1988.
4. L. D. Landau and E. M. Lifschitz, "Fluid Mechanics", Butterworth- Heinemann, 2nd ed. 1987.

PHY-XX36 INTRODUCTION TO MATERIALS SCIENCE Credit Hrs: 03

Objectives:

To understand the important aspects of materials. Moving towards microstructures.

Atomic Structure of Materials: The packing of atoms in 2-D and 3-D, unit cells of the hexagonal close packing (hcp) and cubic closed packing (ccp) structures, interstitial structures, density computation, lattices and symmetry elements, indexing lattice directions and lattice planes, interplanar spacing,
lattices and crystal systems in 3-D, symmetry, crystallographic point groups and space groups, Bragg's law and the intensities of Bragg reflections.

Imperfections in Solids: Vacancies, impurities, dislocations, interfacial defects, bulk or volume defects, atomic vibrations.

Microstructure: Microstructure and microscopy, pressure vs. temperature phase diagrams, temperature vs. composition phase diagrams, equilibrium, thermodynamic functions, variation of Gibbs energy with temperature and composition, general features of equilibrium phase diagrams, solidification, diffusion mechanisms, nucleation of a new phase, phase diagrams of Fe-C
system and other important alloys, materials fabrication.

Mechanical Behavior of Materials: Normal stress and normal strain, shear stress and shear strain, elastic deformation, plastic deformation, Young's modulus, shear modulus, Poisson's ratio, elastic strain energy, thermal expansion, estimate of the yield stress, dislocations and motion of dislocations, slip systems, dislocations and strengthening mechanisms, fracture mechanics, ductile fracture, brittle fracture, Griffith criterion, ductile fracture, toughness of engineering materials, the ductile-brittle transition temperature, cyclic stresses and fatigue, creep.

Polymers: Polymer basics, polymer identification, polymer molecules, additional polymerization, step growth polymerization, measurement of molecular weight, thermosetting polymers and gels, rubbers and rubber elasticity, configuration and conformation of polymers, the glassy state and
glass transition, determination of Tg, effect of temperature and time, mechanical properties of polymers, case Study in polymer selection and processing.

Biomaterials: Introduction to biomaterials, materials selection, biopolymers, structural polysaccharides, hard materials, biomedical materials.

Recommended Books:

1. W. D. Callister, "Materials Science and Engineering: An Introduction", Wiley, 7th ed. 2006.
2. W. D. Callister and D. G. Rethwisch "Fundamentals of Materials Science and Engineering: An Integrated Approach", Wiley, 4th ed. 2012.
3. J. F. Shackelford, "Introduction to Materials Science for Engineers",
Prentice Hall, 7th ed. 2008. 4. http://www.msm.cam.ac.uk/teaching/index.php,
5. http://www.doitpoms.ac.uk/

PHY-XX37 INTRODUCTION TO PHOTONICS Credit Hrs:03

Objectives:

To study the application of light, Studying the photonic devices including detectors.

Guided Wave Optics: Planar slab waveguides, Rectangular channel waveguides, Single and multi-mode optical fibers, waveguide modes and field distributions, waveguide dispersion, pulse propagation

Gaussian Beam Propagation: ABCD matrices for transformation of Gaussian beams, applications to simple resonators

Electromagnetic Propagation in Anisotropic Media: Reflection and transmission at anisotropic interfaces, Jones Calculus, retardation plates, polarizers

Electro-optics and Acousto-optics: Linear electro-optic effect, Longitudinal and transverse modulators, amplitude and phase modulation, Mach-Zehnder modulators, Coupled mode theory,

Optical coupling between waveguides, Directional couplers, Photoelastic effect, Acousto-optic interaction and Bragg diffraction, Acousto-optic modulators, deflectors and scanners
Optoelectronics: p-n junctions, semiconductor devices: laser amplifiers, injection lasers, photoconductors, photodiodes, photodetector noise.

Recommended Books:

1. B. E. A. Saleh and M. C. Teich, "Fundamentals of Photonics", John Wiley, 2nd ed. 2007.
2. J-M. Liu, "Photonic Devices", Cambridge University Press, 2009.
3. A. Yariv and P. Yeh, "Photonics: Optical Electronics in Modern Communications", Oxford University Press, 2006.
4. E. Hecht, "Optics", Addison-Wesley, 4th ed. 2001.

PHY-XX38 LASER ENGINEERING Credit Hrs:03

Objectives:

Deep understanding of Laser and its components, Designing of Laser.

Introduction: What is laser, brief history of laser development, principle components of laser, types of lasers, properties of laser beam, an overview of laser technology, energy states in atom, transition between energy states (absorption, spontaneous and stimulated emission), principles of laser, power and energy, special features of laser beam (directionality, diffraction, intensity, monochromaticity, coherency, line-width).

General Principles of Laser Operation: Thermal equilibrium, Einstein coefficients, condition for large stimulated emissions, condition for light amplification, population inversion, energy state, metastable state, three level laser, four level laser, line broadening, laser rate equations (two, three,
and four level systems), generic laser, gain medium, pumping source, resonant cavity

Generic Laser: Amplification and gain, optical resonator, laser action, gain of active medium (mathematical treatment), threshold condition, gain calculation, conditions for steady state oscillation, cavity resonance frequencies, laser modes (longitudinal and transverse), single mode operation, examples

Optical Resonators: Resonator (cavity) configuration, fabry-perot resonator or plane parallel cavity, confocal resonator, hemispherical cavity or combination of plane and spherical resonator, long radius cavity, stability criterion, examples (stable and unstable resonator)

Pumping Source and Active Medium: What is pumping, pumping methods, optical pumping, electric pumping (direct discharge), electric pumping for semiconductor laser, chemical pumping, flash lamps, optical pumping configuration, optical pumping assembly, active mediums (atoms, molecules, liquids, dielectric solids, semiconductor material)

Gas Lasers (theory, working, design and construction), Metal Vapor

Lasers: Gas lasers, atomic lasers, ionic lasers, molecular lasers, basic concepts of discharge tube, Brewster angle cut discharge tube, electrical circuits for gas lasers, high voltage power supplies for gas lasers, He-Ne laser, design problems related to He-Ne laser, Argon Ion laser, Krypton Ion
laser, CO2 (carbon dioxide) laser, N2 (nitrogen) laser, Excimer laser, He-Cd laser, Copper vapor laser, Gold vapor laser.

Chemical and Dye Lasers: Introduction to chemical laser, HF (hydrogen and fluoride) laser, Chemical Oxygen-Iodine laser (COIL), military applications of COIL, dye lasers, Rhodamine dye laser.

Solid State Lasers (concepts, working, design and construction):

Introduction to solid state laser, Ruby laser, Nd:YAG laser, Nd:Glass laser, electronics for solid state laser, cooling system for solid state laser, cavity design and pumping concepts for solid state laser, brief overview to commercial Nd:YAG lasers, Ti:Sapphire laser, tunable solid state laser (Alexandrite laser).

Semiconductor Laser, and Free-Electron Laser: Introduction to semiconductor laser, homojunction laser, heterojunction laser, semiconductor laser array, quantum well laser, vertical cavity surface emitting laser (VCSEL), brief introduction to free-electron laser.

Control of Laser Output (Q-switching and mode locking): Introduction to control of laser output beam, frequency selection, generation of high power pulses, Q-factor, Q-switching and giant pulses, methods of Q-switching, active Q-switching (mechanical Q-switching, acousto-optic Q-switching, electro-optic Q-switching), passive Q-switching (saturable absorber, cavity dumping), introduction to mode-locking, mode-locking techniques (active mode-locking, passive mode-locking), Q-switched Nd:YAG laser system.

Ultrafast Lasers: What is ultrafast laser, Ti: Sapphire laser, chirped pulse amplification (CPA) laser system, ultrafast laser systems, ultrafast diagnostics, mode-locked Ti: Sapphire laser system, basic concepts to Ti: Sapphire CPA laser system, ultrafast phenomenon, applications of ultrafast
lasers.

Laser Applications: Industrial applications, material processing (laser drilling, laser cutting, laser welding), LIDAR (laser imaging detection and ranging), photolithography, medical applications (LASIK surgery, laser seizer), isotope separation using laser, Nuclear fusion, brief overview of
major laser facility (NIF facility), laser holography, military applications.

Recommended Books:

1. K. J. Kuhn, “Laser Engineering”, Prentice Hall, 1997.
2. O. Svelto, “Principles of Lasers”, Springer, 5th ed. 2009.
3. W. T. Silfvast, “Laser Fundamentals”, Cambridge, 2nd ed. 2008.
4. K. R. Nambiar, “LASERS: Principles, Types and Applications”, New Age, 2009.
5. W. Koecher, “Solid-State Laser Engineering”, Springer, 2009.
6. R. F. Walter, “Gas Lasers (Optical Science and Engineering)”, CRC Press, 2006.
7. C. Rulliere, “Femtosecond Laser Pulses: Principles and Experiments”, Springer, 2nd ed. 1998.
8. K. Thyagarajan, “Lasers: Fundamentals and Applications”, Springer, 2nd ed. 2010.

PHY-XX39 QUANTUM FIELD THEORY Credit Hrs:03

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 QED. Cross sections and decay rates.

Recommended Books:

1. F. Mandl and G. Shaw, "Quantum Field Theory", Wiley, 2nd ed. 2010.
2. M. E. Peskin and D. V. Schroeder, "An Introduction to Quantum Field Theory", Addison Wesley, 1995.
3. S. Weinberg, "The Quantum Theory of Fields", Vol. 1, Cambridge University Press, 1999.
4. N. N. Bogoliubov and D. V. Shirkov, "Introduction to the Theory of Quantized Fields", John Wiley, 1980.

PHY-XX40 QUANTUM INFORMATION THEORY Credit Hrs:03

Objectives:

To understand the fundamental concepts of quantum information, communication, computation, and physical protocols for quantum computation.

Review of Quantum Mechanics and overview of Quantum information:

Postulates of quantum mechanics, quantum states and observables, Dirac notation, projective measurements, density operator, pure and mixed states, entanglement, tensor products, no-cloning theorem, mixed states from pure states in a larger Hilbert space, Schmidt decomposition, generalized measurements, (CP maps, POVMs), qualitative overview of Quantum Information.

Quantum Communication: Dense coding, teleportation, entanglement swapping, instantaneous transfer of information, quantum key distribution.

Entanglement and its Quantification: Inseparability of EPR pairs, Bell inequality for pure and mixed states, entanglement witnesses, Peres- Horodecki criterion, properties of entanglement measures, pure and mixed state entanglement, relative entropy as entanglement measure, entanglement and thermodynamics, measuring entanglement.

Quantum Information: Classical information theory (data compression, Shannon entropy, von Neumann entropy), fidelity, Helstrom's measurement and discrimination, quantum data compression, entropy and information, relative entropy and its statistical interpretation, conditional entropy, Holevo bound, capacity of a quantum channel, relative entropy and thermodynamics, entropy and erasure, Landauer's erasure.

Quantum Computation: Classical computation (Turing machines, circuits, complexity theory), quantum algorithms (Deutsch's algorithm, Oracles, Grover's algorithm, factorization and quantum Fourier transform), role of entanglement in algorithms (search algorithm), modeling quantum measurements, Bekenstein bound, quantum error correction (general conditions, stabilizer codes, 3-qubit codes, relationship with Maxwell's demon), fault tolerant quantum computation (overview).

Physical Protocols for Quantum Information and Computation: Ion trap, optical lattices, NMR, quantum optics, cavity QED.

Recommended Books:

1. V. Vedral, "Introduction to Quantum Information Science", Oxford University Press, 2007.
2. M. Nielsen and I. Chuang, "Quantum Computation and Quantum Information", Cambridge University Press, 10th Anv. ed. 2010.
3. W. Steeb and Y. Hardy, "Problems and Solutions in Quantum Computing and Quantum Information", World Scientific Publishing, 3rd ed. 2011.
4. Book on general quantum mechanics: A. Peres, Quantum Theory: Concepts and Methods, Kluwer Academic Publishers (2002).
5. Seth Lloyd's notes on quantum information available online at: *web.mit.edu/2.111/www/notes09/spring.pdf*

PHY-XX41 SURFACE SCIENCE Credit Hrs:03

Objectives:

To understand the basics of surface physics. Strengthen the previous knowledge of Solid State Physics and Quantum Mechanics.

Basics of Surface Science: Surface reactions, Heterogeneous catalysis, Semiconductor technology, Corrosion, Nanotechnology, Surface Structure and Reconstruction: Classification of solids, Crystal structure, Unit cell, Bravais lattices, Electronic Structure of Surfaces: 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: Interference of Electron Waves, Quantum size effects, Quantum wells, Mechanical Quantum Wells, Quantum Wires, Chemist's Approach, Bonds to Bands.

Surface Dynamics: Nucleation and growth of nanostructures and films, Surface Magnetism and magnetic imaging, Diamagnetism, Paramagnetism, Anti-Ferromagnetism, Magnetism in thin films, Kerr microscopy (MOKE), Spin Polarized Photoemission (SP-PEEM), Magnetic Force Microscopy (MFM).

Surface Study Techniques: Surface Sensitivity and specificity, Explanation and comparison of Low-Energy Electron Diffraction (LEED) and Reflection High-Energy Electron Diffraction (RHEED), Explanation of Near-Edge X-ray Absorption Fine Structure (NEXAFS), High-Resolution Electron Energy Loss Spectroscopy (HREELS), Introduction to Desorption Techniques, Thermal Desorption Spectroscopy (TDS), Electron Stimulated Desorption (ESD), Electron Stimulated Desorption Ion Angular Distribution (ESDIAD), Photon Stimulated Desorption (PSD), Electron Spectroscopy, Theory: Mean free path, Koopman's Theorem, Spin orbit coupling effects, chemical shifts, binding energy, Auger Electron Spectroscopy (AES), X-Ray Photo-electron Spectroscopy, Electron Analyzer, Electron optics, Scanning Tunneling Microscopy (STM), History, Theory, Electronics and applications.

Case Study: Silicon Surfaces: Geometric and Electronic Structure, 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, Over layer long-range order, Ammonia Synthesis, Oxide Surfaces.

Photovoltaic and Organic Electronics: Different types of semiconductors (organic, inorganic, conjugated polymers), Prototypes (OLEDs etc), intramolecular bonding, Van der Waals, electronic properties, polarization effects, Field effect Transistors, basics of excitonic solar cells.

Recommended Books:

1. A. Zangwill, "Physics at Surfaces", Cambridge University Press, 1988.
2. D. P. Woodruff and T. A. Delchar, "Modern Techniques of Surface Science", Cambridge University Press, 2nd ed. 1994.
3. D. Briggs and M. P. Seah, "Practical Surface Analysis", Vol-I, John Wiley, 2nd ed. 1990.
4. J. B. Hudson, "Surface Science, an Introduction", Wiley-Interscience, 1998.
5. H. Luth, "Surfaces and Interfaces of Solids", Springer-Verlag, 2nd ed. 1993.
6. M. Prutton, "Introduction to Surface Physics", Oxford University Press, 1994.

7. R. I. Masel, “Principles of Adsorption and Reaction on Solid Surfaces”, Wiley-Interscience, 1996.

GOF Courses Syllabus

ARA-0001 **ARABIC** **Credit Hrs. 03**

الدرس الاول

* عربی الفاظ ،معانی۔ اسمائے اشارات ان کا استعمال، مثالیں اسم، فعل ،حرف، کی تعریفات، مثالیں

* کلمات استفہام، نعم، بل، کا استعمال و امثلہ

الدرس الثانی

* الفاظ معانی، ضمائر کی اقسام ضمائر متصلہ عربی جملوں میں استعمال، مشق

الدرس الثالث

* الفاظ ،معانیتعریف۔ لالیس، لیست، حروف نفی کی تعریفات و امثلہ مرکب اضافی ، امثلہ

عربی جملے، ترجمہ، مشق

الدرس السادس

* واحد، جمع جمع کی اقسام اور مثالیں قواعد جمع مکسر اور مثالیں ، مشق

الدرس السابع

* فعل ماضی، تعریف فعل ماضی کی مثالیں قواعد فعل ماضی،و امثلہ، مشق کلمات **الدرس الثامن**

* فعل مضارع، فعل مضارع، و امثلہ قواعد فعل مضارع ، کلماتمکالمہ۔ مشق **الدرس التاسع**

* فعل مصنف و فعل مصنف و امثلہ قواعد فعل مصنف و کلماتمثالیں۔ مشق **الدرس العاشر**

* فعل صحیح، فعل معتل، فعل صحیح، فعل معتل، مثالیں۔ قواعد، مشق کلمات**الدرس الحادی عشر**

* مذکر مونث، مذکر مونث، مثالیں۔ اسماء الخمستہ، مشق کلمات **الدرس الثانی عشر**

* اعداد اعداد و امثلہ قواعد و اعداد عقود و امثلہ **الدرس الثالث عشرہ**

* کم۔ای اور ان کا ای۔کم امثلہ استعمال**الدرس الرابع عشرہ**

* اسم فاعل، مثالیں، جملے
کلمات **الدرس**
الخامس عشره
* اعضاء الجسم جملے، مثالیں
الدرس السادس عشره
* کلمات و امثلہ
الدرس السابع عشره
* جملہ اسمیہ و جملہ
فعلیہ **الدرس الشامن عشره**
* حروف الہجاء، حروف حروف حلقی، حروف شمسیہ، قمریہ، مخارج الحروف
مَدہ**الدرس التاسع عشره**
* الا ناشید المختارہ دُعا، ما اجمل الضیاء، الممر ضتہ

ٹیکسٹ بُک اللسان العربی۔ علامہ اقبال اوپن یونیورسٹی اسلام آباد پاکستان

ECO-0006 **ECONOMICS** **Credit Hrs. 03**

Course Contents

Introduction to Economics. Key Principles of Economics, Demand, Supply, and Market Equilibrium, Elasticity, Production and Costs, Perfect Competition, Monopoly , Market Failure and Externalities, Macroeconomics, Macroeconomic Indicators, Unemployment and Inflation, Economic Growth, Aggregate Demand and Aggregate Supply, Fiscal Policy, Money and the Banking , Monetary Policy and Inflation, International Trade and Finance **.**

Recommended Books:

1. O'Sullivan, A., Sheffrin, S., & Perez, S., (2019). Survey of Economics: Principles, Applications, and Tools, 8th Edition, Boston: Pearson Education (Older editions are OK; the digital version is much cheaper).

2. Krugman, P., Wells, R., & Graddy, K., (2016). Essentials of Economics, 4th Edition, New York: Worth Publishers (3rd edition is fine but 1st and 2nd are outdated).

ETRE-00068 ENTERPENURESHIP Credit Hrs. 03

Course Description

With more than half of the new jobs being created in the world economy by small businesses, the particular problems and experiences encountered in starting and developing new enterprises are clearly worth studying. This course of Entrepreneurship has been designed to provide the participants with an overall understanding of the concept of entrepreneurship and small business management. Participants will be prepared to start, survive, and succeed in their own businesses. For those who consider becoming part of a big traditional business, while working for someone else, as a viable career option, it is hoped that participation in this course will orient them towards thinking and acting more entrepreneurially and creatively in the big business ambiance. Thus, regardless of their future plans and hopes, this course can benefit them greatly in how they think and act, from an entrepreneurial viewpoint, in the future. The students must write at a top level, argue the potential of their ideas, and convince investors that their ideas are worth being born in the marketplace.

Entrepreneurship and The Entrepreneurial Mind-Set

The Nature of Entrepreneurship, The Economist and Sociologist View of Entrepreneurship, How Entrepreneurs Think, The Intention to Act Entrepreneurially

Entrepreneurship and The Entrepreneurial Mind-Set

Entrepreneur Background and Characteristics, Role Model and Support Systems, Sustainable Entrepreneurship, Case Study

Corporate Entrepreneurship

Reasons for Interest in Corporate Entrepreneurship, Managerial Versus Entrepreneurial Decision Making, Establishing Corporate Entrepreneurship in the Organization

Exploiting New Entry Opportunities

New Entry, Generation of a New Entry Opportunity, Entry Strategy for New Entry Exploitation

Risk Reduction Strategies for New Entry Exploitation

Creativity and the Business Idea

Ideas from Trend Analysis, Sources of New Ideas, Methods of Generating Ideas, Creativity and Entrepreneurship

Creativity and the Business Idea

Innovation and Entrepreneurs, Product Planning and Development Process, Product Life Cycle

Role of e-Commerce

Identifying and Analyzing Domestic and International Opportunities

The Nature and Importance of International Entrepreneurship, International Versus Domestic Entrepreneurship, Motivations to go Global, Entrepreneurial Entry Strategies

Protecting the Idea and Other Legal Issues for the Entrepreneur

Intellectual Property, Selection of Lawyer, Legal Issues in Setting up the Organization

Patents, Trademarks, Copyrights and Licensing.

The Business Plan: Creating and Starting the Venture

Business Plan, Importance of Business Plan, Who should Write the Business Plan, How do Potential Lenders and Investors Evaluate the Plan, Presenting the Plan

The Business Plan: Creating and Starting the Venture

Information Needs, Writing the Business plan, Using and Implementing the Business Plan, Why some Business Plans Fail

Components of Business Plan

Production Plan, Operation Plan, Marketing Plan, Organizational Plan, Financial Plan

The Marketing Plan

Industry Analysis, Difference between a Business and Marketing Plan, Marketing Mix, Steps in Preparing the Marketing Plan

The Organizational Plan

Developing the Management Team, Legal Forms of Business, Tax Attributes of Forms of Business

The Financial Plan, Forecasting Sales, Pro Forma Income Statement, Pro Forma Cash Flow Statement, Pro Forma Balance Sheet

Sources of Capital

Debt or Equity Financing, Personal Funds, Family and Friends, Commercial Banks, Government Agencies

Recommended Books:

1. Robert D. Hisrich, Mathew J. Manimala, Michael P. Peters & Dean A. Shepherd: Entrepreneurship, New Delhi, McGraw Hill Education, Indian Edition (9th Edition)

Supplementary Material

2. Peter F. Drucker: Innovation and Entrepreneurship
3. Paul Burns and Jim Dew Hurst: Small Business and Entrepreneurship

HRM-0009 Human Resource Management Credit Hrs. 03

COURSE DESCRIPTION

This course is basically designed to provide students the basic understanding of key HRM functions, which include HR planning, recruitment & selection, compensation, performance evaluation, and training & development. Since human resource provides a competitive advantage that ultimately has a vital role in success and effectiveness of any organization, this course emphasizes on the understanding of the basic concepts of managing human resource and their applications in today's organizations. The course is designed to help the students understand if western human resource management theories and practices have any relevance to the local settings. The course will also discuss the Islamic perspective of managing human resource. It will shed light on the basic tenets of human resource management given by Quran and Sunnah. The students will also be encouraged to compare and contrast the human resource practices suggested in their text books and the practices critical for achieving success from indigenous perspective

Contents

Meeting present human resource requirements, what is HRM? , Why HRM is important? Emerging Human resource management challenges. Trends in HRM, Global vs local HRM practices, HRM from Islamic and indigenous perspective, Basic Islamic philosophy of managing human resource, Conducting Job analysis. HR Planning, Job Description, Job Specification

Staffing, Recruiting and selecting employees, Recruitment techniques, Sources of recruitment, Selection tests and Interviewing techniques, **Employee development**, Performance appraisals, Performance management

Training and development, Training the employees, Types of training, Technique of training, Developing careers, Career growth, Project Description and discussion

Compensations, Managing compensation, Types of compensation, Rewarding performance, Pay for Performance, Designing and administering benefits, Types of benefits, Employee relations

Recommended Text Book:

By Luis R. Gomez Mejia, David B. Balkin, Robert L. Cardy Managing Human Resources. (Fourth ed.)

IR-0010 **International Relations** **Credit Hrs. 03**

Objectives:

The objective of this course is to highlight the significance and introduce the fundamentals of International Relations to the students.

Contents:

1. Meaning, Definition, Nature, and Scope of International Relations

2. Evolution and Development of International Relations

3. Significance of International Relations

4. Concept of Nation State

5. International System and Sub-Systems

6. Foreign Policy, National Interest, and Diplomacy

7. Power and Balance of Power

8. Regionalism and Globalization

9. State and Non-state Actors

10. Human Rights in International Relations

11. Religion, Ethics, Morality and Justice in International Relations

12. The Role of Economics in International Relations

13. The Concept of War and Peace in International Relations

Recommended Books:

1. Amstutz, Mark R. International Conflict and Cooperation: An Introduction to World Politics. (Chicago: Brown & Benchmark, 1995)

2. Griffiths, Martin, and Callaghan, Terry O'. International Relations: The Key Concepts. London, Routledge, 2003.

3. Henderson, Conway W. International Relations: Conflict & Cooperation at the Turn of the 21st Century Boston: McGraw-Hill, 1998.

4. Jackson, Robert and Sorensen; Georg, Introduction to International Relations Theories and Approaches, Oxford: Oxford University Press, 2003.

ITM-0011 INTRODUCTION TO MANAGEMENT Credit Hrs. 03

COURSE DESCRIPTION/OBJECTIVE:

Principles of Management is an introductory course and is required for all business majors. This course explains the relationships between organizational mission, goals and objectives and their successful achievement. It will clarify the significance and necessity of managing an organization. Management will reveal understanding of various organizational processes and behaviors and the theories associated with them.

Definitions of Management, Management Process, Characteristics of Management, Difference between Management and Administration. Organization and its types.

Functions a brief Treatment- Planning, Organizing, Staffing, Directing, Controlling, Coordination, Other Functions of Management, Roles of Management in organizations, Types of Management (Scope of Responsibility and Management Levels), Managerial Skills development, Contemporary Management Challenges.

Taylor's Principles, Fayol's Principles, General Principles, Scope of Management, Importance of Management.

Management as an art, Management as a Science, Management as a Profession. Evaluating Organization Environment and its Types and Understanding Organizational Culture. Strategic Management, Process and types of Strategies (Generic and Directional).

Definitions of Goals and Plans, Reasons for the importance of Goals, Essentials of a good Plan, Steps in Organizational Planning Process, Characteristics of Effective Goals, Levels and Types of Goals and Plans, Planning time frames, and Management By Objective.

Importance and Process of Decision Making, Problem and its Types, Decision and its Types, Conditions of Decision Making, Rational Decision Making Process, Group Decision Making Formats and Tools for Effective Group Decision Making. Foundations of Organization Structure: The Vertical and Horizontal structure and elements.

Definition of Communication, Process of Communication, Importance of Communication, Types of Communication, Barriers to Communication, Over Coming the Barriers, Characteristics of a good Communication System (7Cs).

Human Resource Management process, HR Planning, Definition of Staffing, Sources of Recruitment, Steps in Selection Process, Orientation and Socialization, Training and Development, Compensation Management, Employee Evaluation, Employee Movement and Replacement, Exit Interviews.

Definition of Directing, Function and Importance of Directing, Definition of Leader and Leadership, Traits/ Qualities of a Successful Leader, Leadership Styles, Power, Types and Sources of Power.

Meaning and Process, Financial and Non-Financial Incentives, Herzberg's Two Factor Theory, Maslow's Need Priority Model, Expectancy Theory, Goal-Setting Theory, Alderfer's ERG Theory, Adam's Equity Theory, Theory X and Theory Y. Definition of Controlling, Types and Levels of Controlling.

Recommended Books:

1. Management By Courtland L. Bovee, John V. Thill, Marian Burk Wood, George P. Dovel, International Edition, McGraw-Hill Inc. St.P Robins.

2. Terry, Prentice Hall USA "Principles and Practice of Management" (1998 Edition)

3. P.F. Duck Ker, Macmillion, London, "Practice of Management"(1997 Edition)

KS-0013 KASHMIR STUDIES Credit Hrs. 03

Objectives:

To understand how Kashmiris themselves have made sense of their political past, present and future, through work that centers Kashmiri experiences

To foreground emerging perspectives by Kashmiri scholars, activists and artists, including women and other often marginalized voices

To widen disciplinary approaches to studying Kashmir, beyond international relations (IR) scholarship, which largely presents Kashmir through the statist lenses of India and Pakistan

To suggest paths for DE colonial, transnational and anti-occupation solidarities among movements for freedom and emancipation, through a close study of the region

Course Contents:

THEORIZING OCCUPATION AND RESISTANCE

Histories of the present

The militarization of everyday life

Borders, regions and boundaries

State of emergency and the institutionalization of impunity

Martyrdom and memory capes

Women's organizing in Kashmir

Mapping sexual violence: from kunan poshpora to shopian to handwara

Kashmiri pundits and the politics of homeland

Claiming culture, contesting spaces: stone pelting, art, and ragda

Winning hearts and minds

Climate, infrastructure and ecologies

Imagining freedoms, seeking solidarities

Human rights reports

Recommended Books

MC-0014 MASS COMMUNICATIONS Credit Hrs. 03

Course Description:

This course is an examination of the effect and impact of mass media on contemporary life and society. The course covers both the historical evolution of media as well as contemporary developments and issues. Areas of coverage include, newspapers and journalism, magazine and book publishing, radio and television broadcasting, motion pictures, music recording, Internet and social media, cable and satellite communication, advertising and public relations; media law and ethics. Course work will include weekly chapter readings from the course text, quizzes, and regular participation in on-line discussion forums which will require writing and reflection.

Course Contents

Mass Communication overview & perspectives, Media History / The Internet & Social Media, Newspapers & News Gathering, Magazine & Book Publishing, Radio Broadcasting & The Music Industry, Motion Pictures & Television, Media Laws & Ethics.

Recommended Books:

The Dynamics of Mass Communication, 12th edition, by Joseph R. Dominick. McGraw Hill, 2013.

OB-0016 ORGANISATIONAL BEHAVIOR Credit Hrs. 03

COURSE DESCRIPTION/OBJECTIVE:

Objective of this course is to introduce students to psychology theories and research at individual, group and organizational levels. It helps students understand organizational Behavior and management practices by examining psychological principles. It facilitates a Critical evaluation of organizational practices and their impact on work behaviors, attitudes and performance.

WHAT IS ORGANIZATIONAL BEHAVIOUR

What mangers do?

Developing an Organization Behavior (OB) model, Complementing intuitions with systematic study

DIVERSITY IN ORGANIZATIONS

Biographical characteristics and Ability, Implementing diversity management Strategies

ATTITUDES AND JOB SATISFACTION

Attitudes related to OB, Different ways to achieve job satisfaction in organizations

EMOTIONS AND MOODS

What are emotions and moods?, Emotional labor. Effective events theory, Emotional intelligence. OB applications of emotions and moods

PERCEPTION AND INDIVIDUAL DECISION MAKING

Personal perceptions and perceptual errors, Linking perception and individual decision making

LEADERSHIP

Leadership theories and contingencies theories, Leader member exchange theory, Charismatic and transformational theories, Challenges to leadership construct

ORGANIZATIONAL CULTURE

What is cultural intelligence? How does organizational culture develop? How does organizational culture influence, Behavior in organizations and organizational performance?

MOTIVATION AND REWARDS

Why do individuals work?, What are the effects of different reward systems on individual motivation?

MOTIVATION: CONCEPTS TO APPPLICATIONS

Motivation by Job design, Employee Involvement, Self-Assessment Library

FOUNDATIONS OF GROUP BEHAVIOR

Defining and Classifying Groups, Stages of Group Development, Group Properties: Roles, Norms, Status, Size etc., Group Decision Making

UNDERSTANDING WORK TEAMS

Difference between Teams and Groups, Types of Teams. Creating Effective Teams. Turning Individuals into Team players

COMMUNICATION

Functions of Communications, The Communication Process. Direction of communication

Interpersonal and Organizational communication. Barriers to effective communication. Global implications

CONFLICT AND NEGOTIATIONS

The Conflict Process. Negotiation

HUMAN RESOURCE POLICIES AND PRACTICES

Selection Process. Training and development, Performance evaluation. Managing Work-Life conflicts

CHANGE

Forces of change. Planned change. Resistance to change, Managing organizational change. Create a culture for change

Recommended Books:

1. Organization Behavior by Stephen P. Robbins and Timothy A. Judge (16th edition).

Pearson.

PSY-0019 **PSYCHOLOGY** **Credit Hrs. 03**

Course Objectives

Describe psychology with major areas in the field, and identify the parameters of this discipline. Distinguish between the major perspectives on human thought and behavior. Appreciate the variety of ways psychological data are gathered and evaluated. Gain insight into human behavior and into one's own personality or personal relationships. Explore the ways that psychological theories are used to describe, understand, predict, and control or modify behavior.

1. Introduction to Psychology

a. Nature and Application of Psychology with special reference to Pakistan.

b. Historical Background and Schools of Psychology (A Brief Survey)

2. Methods of Psychology

a. Observation

b. Case History Method Experimental Method

c. Survey Method

d. Interviewing Techniques

3. Biological Basis of Behavior

a. Neuron: Structure and Functions

b. Central Nervous System and Peripheral Nervous System

c. Endocrine Glands

4. Sensation, Perception and Attention

a. Sensation

(I) Characteristics and Major Functions of Different Sensations

(II) Vision: Structure and functions of the Eye.

(III) Audition: Structure and functions of the Ear.

b. Perception

(I) Nature of Perception

(II) Factors of Perception: Subjective, Objective and Social

(III) Kinds of Perception:

(IV) Spatial Perception (Perception of Depth and Distance)

(V) Temporal Perception; Auditory Perception.

c. Attention

(I) Factors, Subjective and Objective

(II) Span of Attention

(III) Fluctuation of Attention

(IV) Distraction of Attention (Causes and Control)

5. Motives

a. Definition and Nature

b. Classification

Primary (Biogenic) Motives: Hunger, Thirst, Defection and Urination, Fatigue, Sleep, Pain, Temperature, Regulation, Maternal Behavior, Sex

Secondary (Sociogenic) Motives: Play and Manipulation, Exploration and Curiosity, Affiliation, Achievement and Power, Competition, Cooperation, Social Approval and Self Actualization.

6. Emotions

a. Definition and Nature

b. Physiological changes during Emotions (Neural, Cardial, Visceral, Glandular), Galvanic Skin Response; Pupilliometrics

c. Theories of Emotion

d. James Lange Theory; Cannon-Bard Theory

e. Schachter –Singer Theory

7. Learning

a. Definition of Learning

b. Types of Learning: Classical and Operant Conditioning Methods of Learning: Trial and Error; Learning by Insight; Observational Learning

8. Memory

a. Definition and Nature

b. Memory Processes: Retention, Recall and Recognition

c. Forgetting: Nature and Causes

9. Thinking

a. Definition and Nature

b. Tools of Thinking: Imagery; Language; Concepts

c. Kinds of Thinking

d. Problem Solving; Decision Making; Reasoning

10. Individual differences

a. Definition concepts of;

b. Intelligence, personality, aptitude, achievement

RECOMMENDED BOOKS

1. Atkinson R. C., & Smith E. E. (2000). Introduction to psychology (13th ed.). Harcourt Brace College Publishers.

2. Fernald, L. D., & Fernald, P. S. (2005). Introduction to psychology. USA: WMC Brown Publishers.

3. Glassman, W. E. (2000). Approaches to psychology. Open University Press. Hayes, N. (2000). Foundation of psychology (3rd ed.). Thomson Learning. Lahey, B. B. (2004). Psychology: An introduction (8th ed.). McGraw-Hill Companies, Inc.

4. Leahey, T. H. (1992). A history of psychology: Main currents in psychological thought. New Jersey: Prentice-Hall International, Inc.

5. Myers, D. G. (1992). Psychology. (3rd ed.). New York: Wadsworth Publishers.

6. Ormord, J. E. (1995). Educational psychology: Developing learners. Prentice- Hall, Inc.

SOC-0021 SOCIOLOGY Credit Hrs. 03

Objective:

The course is designed to introduce the students with sociological concepts and the discipline. The focus of the course shall be on significant concepts like social systems and structures, socio-economic changes and social processes. The course will provide due foundation for further studies in the field of sociology.

Course Outline:

Introduction

Definition, Scope, and Subject Matter, Sociology as a Science, Theoretical perspective, Historical background of Sociology

Basic Concepts

Group, Community, Society, Types of Society, Associations (Non-Voluntary, Voluntary), Organization (Informal, Formal), Social Interaction, Levels of Social Interaction, Process of Social Interaction (Cooperation, Competition, Conflict, Accommodation, Acculturation and diffusion, Assimilation, Amalgamation,

Social Groups

Definition & Functions, Types of social groups (In and out groups, Primary and Secondary group, Reference groups, Informal and Formal groups, Pressure groups).

Culture

Definition, aspects and characteristics of Culture, Material and non-material culture, Ideal and real culture, Elements of culture (Beliefs, Values, Norms and social sanctions, Organizations of culture, Traits, Complexes, Patterns, Ethos, Theme), Other related concepts (Cultural Relativism , Sub Cultures, Ethnocentrism and Xenocentrism, Cultural lag).

Socialization & Personality

Personality, Factors in Personality Formation, Socialization, Agencies of Socialization, Role & Status. Social Stratification, Types of Social Stratification.

Deviance and Social Control

Deviance and its types, Social control and its need, Forms of Social control, Methods & Agencies of Social control.

Collective Behavior

Collective behavior, its types, Crowd behavior, Public opinion, Propaganda, Social movements Leadership

Social Institution

Religious Institution, Political Institution, Family, Educational Institution, Economic Institution

Social Change and Development

Social change, cultural change, significance of social and cultural change, Theories of social change

Text/Reference Books:

1. Anderson, Margaret and Howard F. Taylor. (2001). Sociology the Essentials. Australia: Wadsworth.
2. Brown, Ken. (2004). Sociology. UK: Polity Press
3. Gidden, Anthony. (2002). Introduction to Sociology. UK: Polity Press.

4. Macionis, John J. (2006). 10th Edition Sociology New Jersey: Prentice-Hall
5. Tischler, Henry L. (2002). Introduction to Sociology 7th ed. New York: The Harcourt Press.
6. Frank N Magill. (2003). International Encyclopedia of Sociology. U.S.A: Fitzroy Dearborn Publishers
7. Macionis, John J. (2005). Sociology 10th ed. South Asia: Pearson Education
8. Kerbo, Harold R. (1989). Sociology: Social Structure and Social Conflict. New York: Macmillan Publishing Company.
9. Koening Samuel. (1957). Sociology: An Introduction to the Science of Society. New York: Barnes and Nobel.
10. Lee, Alfred Mclung and Lee, Elizabeth Briant.(1961). Marriage and The family. New York: Barnes and Noble, Inc.
11. Leslie, Gerald et al. (1973). Order and Change: Introductory Sociology Toronto: Oxford University Press.
12. Lenski, Gevbard and Lenski, Jea nm. (1982). Human Societies. 4th edition New York: McGraw-Hill Book Company.
13. James M. Henslin. (2004). Sociology: A Down to Earth Approach. Toronto: Allen and Bacon.