CURRICULUM

BS IN PHYSICS
(Four Years Program)
SESSION (2013-2017)

DEPARTMENT OF PHYSICS
UNIVERSITY OF SARGODHA
SARGODHA, PAKISTAN

ACADEMIC PROGRAMME BEING OFFERED
AT THE DEPARTMENT OF PHYSICS

BS PHYSICS PROGRAMME:

Program Duration: 4 Years (8 Semesters)Teaching System: Semester

System Start of Session: Fall (September) 2013

Course Code	Course Title	Credit Hours
Semester-I		
PHYS 1101	Mechanics-I	3
PHYS 1102	Waves and Oscillations	3
MATH 1103	Applications of Differentials	3
ENGL 1104	English-I	3
PKST 1105	Pakistan Studies	2
Total		**14**
Semester-II		
PHYS 2101	Mechanics-II	3
PHYS 2102	Electricity Magnetism-I	3
MATH 2103	Techniques of Integration	3
ENGL 2104	English-II	3
ISLM 2105	Islamic Studies	2
Total		**14**
Semester-III		
PHYS 3101	Electricity and Magnetism-II	3
PHYS 3102	Fundamentals of Quantum Mechanics	3
PHYS 3203	Physics Lab-I	3
MATH 3104	Calculus	3
MATH 3105	Ordinary Differentials Equations	3
ENGL 3106	English-III	3
Total		**18**
Semester-IV		
PHYS 4101	Basics of Electronics and Nuclear Physics	3
PHYS 4102	Theory of Thermodynamics	3
PHYS 4203	Physics Lab-II	3
MATH 4104	Vectors and Tensors Analysis	3
MATH 4105	Linear Algebra	3
STAT 4106	Theory of Error Analysis	3
Total		**18**

Course Code	Course Title	Credit Hours
Semester-V		
PHYS 5101	Methods of Mathematical Physics-I	3
PHYS 5102	Classical Mechanics-I	3
PHYS 5103	Electrodynamics-I	3
PHYS 5104	Electronics	3
PHYS 5205	Electronics Lab	3
Total		**15**
Semester-VI		
PHYS 6101	Methods of Mathematical Physics-II	3
PHYS 6102	Classical Mechanics–II	3
PHYS 6103	Electrodynamics-II	3
PHYS 6104	Quantum Mechanics-I	3
PHYS 6105	Solid State Physics-I	3
PHYS 6206	Modern Physics Lab	3
Total		**18**
Semester-VII		
PHYS 7101	Statistical Mechanics	3
PHYS 7102	Atomic and Molecular Physics	3
PHYS 7103	Plasma Physics	3
PHYS 7104	Quantum Mechanics-II	3
PHYS 7105	Solid State Physics-II	3
	Optional Course*	3
Total		**18**
Semester-VIII		
PHYS 8101	Computational Physics	3
PHYS 8102	Laser Physics	3
PHYS 8103	Relativity and Cosmology	3
PHYS 8104	Nuclear and Elementary Particle Physics	3
	Optional Course*/Project†	3
Total		**15**
		Tot al Credit Hours: 130

Optional Courses*		
PHYS 7126	Advanced Electronics	3
PHYS 7127	Physical and Geometrical Optics	3
PHYS 7128	Physics of Nanotechnologies	3
PHYS 7129	Methods of Experimental Physics	3
PHYS 8225	Advanced Electronics LAB ☼	3
PHYS 8126	Introduction to Quantum Computing	3
PHYS 8127	Particle Physics	3
PHYS BSPr	Project†	3

(*) Students may take any one of the optional courses offered at the department, in each semester.

(†) A project of 03 credit hours can also be opted in the 8th semester.

(☼) Advanced Electronics LAB will be compulsory requirement for the students taking Advanced Electronics as an Optional Course.

COURSE OUTLINE

Semester-I

PHYS 1101   Mechanics-I_____   Cr.H-3

Units and Dimensions, Review of vectors, Motion in one/two/three dimensions, Newtonian mechanics, Friction, Drag force, Work and kinetic/potential energy, Linear momentum, Conservation of momentum/energy, Power, System of particles, Collisions in one/two dimensions, Systems with variable mass.

Textbooks:

1. Halliday, Resnick and Krane, Physics, John Wiley & Sons Inc, 5th ed. 2007.

2. Halliday, Resnick and Walker, Fundamental of Physics, Extended. John Wiley & Sons Inc, 8th ed. 2008.

Recommended Books:

1. Young, Freedman and Ford, Seers and Zemansky's University Physics, Pearson Education Inc, 11th 2006

2. Giancoli, Physics for Scientist and Engineers with Modern Physics, 2nd ed. Prentice Hall Inc. 1988.

PHYS 1102   Waves and Oscillations   Cr.H-3

Prerequisite: Intermediate level Knowledge of optics and waves mechanics.

S.H.M & its applications, Energy consideration in SHM, SHM & uniform circular motion, combinations of Harmonic motion, Damped harmonic oscillator, Forced Oscillation, Driven harmonic oscillator, Resonance, Mechanical Waves, Traveling waves, wave speed , linear wave equation, Power & intensity in wave motion, Principle of superposition, standing waves, Interference of waves, Beats, Doppler effect & its applications, Supersonic and Shock waves, Nature of light , Measurement of speed of light by Roemer's and Fizeau's methods , Reflection, Refraction, Huygens's principle and its applications to reflection and refraction , Fermat's principle, Conditions for interference, Young's double slit experiment, Intensity distribution in double slit interference pattern, adding waves using phasor, interference from thin film, Introduction to diffraction pattern, Single slit diffraction pattern, Intensity in single slit diffraction pattern using phasor, diffraction at circular aperture, diffraction grating, x-ray Diffraction, Polarization by selective absorption, Reflection, Double Refraction, scattering & optical activity.

Recommended Books:
1. Physics Vol. I & II by Resnick, Halliday and Krane 5th Edition, John Wiley and Sons Inc, New York, 2002.
2. Fundamental of Physics by Halliday, Resnick and Walker, 8th extended Edition, John Wiley and Sons Inc, New York, 2008.
3. University Physics, 8th Edition by Sears, Zemansky and Young, Addison-Wesley, Reading (MA), USA, 2000.
4. Physics by Alonso and Finn: Addison-Wesley, Reading (M.A), USA, 1999.
5. Physics for scientist and engineers by Serway and Jewelt, 6th Edition, Thomson Brooks/cole, 2004.

MATH 1103 Applications of Differentials	Cr.H-3

Limits: Limit of a Function, Infinite Limits, The Squeeze Theorem, The Sum Law. Continuity: The Intermediate Value Theorem, Horizontal Asymptotes, Derivatives and Rates of Change, Derivatives as a Function, Derivatives of Polynomials and Exponential Functions, Power Rule, The Product and Quotient Rules, Derivatives of Trigonometric Functions, The Chain Rule, Implicit Differentiation, Exponential Growth and Decay, Hyperbolic Functions. Applications of Differentiations: The Extreme Value Theorem, Fermant's Theorem, The Mean Value Theorem, Concavity Test, Indeterminate Forms and L'Hospital Rule, Curve Sketching, Optimization Problems.

Chapter No. 2, 3 and 4 of text book.
Note: All those topics that are already covered in Intermediate classes must not be repeated in this course.

Recommended Books:
1. Text Book: Calculus Early Transcendentals by James Stewart Brooks/Cole (5th and onwards editions)
2. Calculus: A New Horizon by Anton H., John Wiley, 6th ed. (1999).
3. Calculus by Thomas G.B., Finney A.R., Addison-Wesley, 10th ed. (2002).

Section	Topics	Source
I	Part 1(Semantics): Antonyms, Synonyms, Homonyms – one word substitution	Chapter 1 (Book 5)
I	Part 2 (Syntax): Traditional Grammar a) Parts of Speech: Major word classes b) Further classifications (regular, countable; uncountable; singular; plural), c) Pronouns d) Verbs e) Adjectives f) Adverbs g) Minor word classes: Preposition, h) Conjunctions i) Interjections, Auxiliary verbs an Determiners j) Kinds of verbs: finite and non finite	Chapter 1 (Book 3) Chapter 2 (Book 1) Chapter 4 (Book 2)
II	Part 3 (Syntax) Modern Grammar – k) Sentence Structure: l) Types of sentences based on function m) Mood n) Transformation, Inversion of sentences o) Analysis of Complex sentences p) Subject, Predicate, Complements, direct & indirect objects q) Phrases r) Syntactical rules (subject & verb agreement) s) Synthesis of sentences • Clauses – types and functions	Chapter 24, 25 (Book 2) Chapter 26 (Book 3) Chapter 7 (Book 5)
II	Part 4 (syntax): Tense and voice a) Structure of tenses b) Function, Conversion into negative and interrogative. c) Active and Passive voice and usage d) Conditionals Punctuation	Chapter 17 &18 (Book 3) Chapter 30 (Book 3)
III	Part 5 (Narration): e) Direct and Indirect speech f) Rules of conversion	Chapter 31 (Book 3)
III	Part 6 (Structural words): -Articles and Practical usage	Chapter 83 (Book 1)
III	Part 7 (Discourse): Composition and comprehension • Precis Writing • Essay Writing	Chapter 32 (Book 5) Chapter 38 (Book 2)

Recommended Text:

1) Eastwood, J (2005) Oxford Practice Grammar. UK: Oxford.

2) Martin & Wren (2007) *High School, English Grammar & Composition*. New Delhi: S Chand & Company Limited.

3) Martinet & Thomson (1992) *A practical English Grammar*. UK: Oxford.

4) Swan, M (2005) *Practical English Usage*. UK: Oxford University Press.

5) Shah, Sayyid (2006) *Exploring the world of English*. Lahore: Ilmi Kitab Khana.

PKST 1105   Pakistan Studies   Cr.H-2

Two Nation Theory and Ideology of Pakistan: Historical background of creation of Pakistan, Two Nation Theory in its historical context definition and interpretations, Quaid-i-Azam and his political ideas. Political Dynamics of Pakistan: Constitutional development in Pakistan. (1947-78), Salient features of constitution of Pakistan 1973, Institutions of Pakistan: political parties, bureaucracy, army, judiciary and media, Problems, of Pakistan as a federal State. Socio-Economic Issues of Pakistan: Economical problem, Social and demographic Issues. Diplomatic Dynamics of Pakistan: Determination and objectives of Pakistan's foreign policy, Pakistan's relations with its neighboring countries, Pakistan and the Muslim World (A comprehensive review of foreign policy of Pakistan).

Recommended Books:
1. Pakistan's Political, Economic, and Diplomatic Dynamics, by Javed Ahmad Sheikh Lahore: Kitabistan Paper Products.
2. Other relevant readings for the individual subjects shall be recommended by the teacher during the course.

Semester-II

PHYS 2101   Mechanics- II   Cr.H-3

Pre-requisite: Mechanics – I.

Rotational dynamics, Moment of inertia, Principles of parallel and perpendicular axis theorem, Determination of moment of inertia of various shapes, Rotational dynamics of rigid bodies and its effect on the application of torque, Angular momentum and its conservation, Effect of torque on the angular momentum, Measurement of gravitational constant, Free fall acceleration and Gravitational force, Gravitational effect of spherical mass distribution, The motion of planets and Kepler laws in detail, Motion of satellite and its energy consideration in planetary and satellite motion, Bulk properties of matter, Fluid statistics, Fluid dynamics, Inertial and non-inertial frames of references, Theory of relativity, Postulates of special theory of relativity, Galilean transformation equations, Lorenz transformation and its consequences, Transformation of velocities, Variation of mass with velocity, mass energy relation and its importance, Relativistic energy and momentum, General theory of relativity.

Recommended Books:
1. Physics by D. Halliday, R. Resnick and K. S. Krane, John Wiley & Sons Inc., 5th Ed. (2007).
2. Fundamental of Physics by D. Halliday, R. Resnick and J. Walker, Extended. John Wiley &

Sons Inc., (2008).
3. University Physics by Young, Freedman and Ford, Seers and Zemansky's Pearson Education Inc., (2008).
4. Physics for Scientist and Engineers by Giancoli, Prentice Hall Inc., 5th Ed. (2007).
5. Physics for scientist and engineers by Serway and Jewelt, 6th Edition, Thomson Brooks/cole, 2004.

PHYS 2102   Electricity and Magnetism-I   Cr.H-3

Electric charge (properties/quantization/conservation), Coulombs law in free space, Electric field due to discrete/continuous charges distributions, Electric dipole, Electric flux, Gauss's law and its applications, Electric potential due to discrete/continuous charges distributions, Work and Electric potential energy, Capacitors and capacitance, Capacitance for various geometries, Capacitance with Dielectrics, Electric Current, current density, Resistance and resistivity, Microscopic and macroscopic forms of Ohm's Law, Energy transfer in electric circuit, Power in electric circuits, Calculating current in a single loop and multiple loop by using Kirchhoff laws, Circuit analysis, Growth and decay of current in RC-circuits and its analytical treatment.

Recommended Books:
1. Physics by D. Halliday, R. Resnick and K. S. Krane, John Wiley & Sons Inc., 5th Ed. (2003).
2. Fundamental of Physics by D. Halliday, R. Resnick and J. Walker, Extended. John Wiley & Sons Inc., (2008).
3. University Physics by Young, Freedman and Ford, Seers and Zemansky's Pearson Education Inc., (2008).
4. Physics for Scientist and Engineers by Giancoli, Prentice Hall Inc., 4th Ed. (2007).
5. Field and Wave Electromagnetic by David K. Cheng, Addison-Wesley, (1989).

MATH 2103   Techniques of Integration   Cr.H-3

Integrals: Area between curves, Volumes, Work, Average Value of a Function. Techniques of Integration: Integration by parts, Trigonometric Integrals, Trigonometric Substitution, Integration of Rational Functions by Partial Fraction, Approximate Integration, Improper Integration. Further Applications of Integration: Arc Length, Area of a Surface of Revolution, Applications, Probability. Chapter No. 6, 7 and 8 of text book.
Note: All those topics that are already covered in Intermediate classes must not be repeated in this course.

Recommended Books:
1. Text Book: Calculus Early Transcendentals by James Stewart Brooks/Cole (5th and onwards editions)
2. Calculus: A New Horizon by Anton H., John Wiley, 6th ed. (1999).
3. Calculus by Thomas G.B., Finney A.R., Addison-Wesley, 10th ed. (2002).

ENGL 2104   English-II   Cr.H-3

Topic	Source	Section

Writing as a process: Strategies for generating ideas, Strategies for planning, Strategies for drafting, Strategies for developing, Strategies for revising and editing	Ch 1, Book 1	Section A
Paragraph Skills: Introducing a paragraph: Organization of a paragraph, Topic sentences, Controlling idea, Supporting sentences and details, Connecting sentences Concluding sentences, Selecting a title	Ch 3, Book 1	Section A
Revising a paragraph: First stage draft (for description) First stage draft (for narration) First stage draft (for exposition) Second stage drafts: all patterns of development	Ch 4, Book 1	Section A
Editing: Editing review , Editing problems for all patterns of development Proofreading: How to proofread and prepare your final manuscript	Ch 4, Book 1	Section A
Essays: Essay form, Introductory paragraphs, Thesis sentence, Developing body paragraphs, Concluding paragraphs	Ch 12, Book 1	Section A
Personal Letters: Letters of : Invitation, Regrets, Routines	Part 3, Book3 Part 5, Book 3	Section B
Official Writing: Writing an application, CV and Memo, Joining reports, Leaving reports, Notifications, Meeting notices Minutes of meeting	Part 3, Book3 Part 5, Book 3	Section B
Business Letters: Sales/persuasive letters, Bad news messages, Good news message	Part 3, Book3 Part 5, Book 3	Section B
Sentence Skills	Unit 11 A, Book4 Unit 12 A, Book4	Section B

Recommended Text:
1. Brannan, B. ,(2003), *A Writer's Workshop: Crafting paragraph, building essays*, New York, McGraw Hill
2. Wong ,(2002), *Paragraph Essentials: A writing guide,* Boston, Houghton Mifflin
3. Bovee, C.L. et.al ,(2002), *Business Communication Today*, India, Pearson Education
4. Maimon, E. P. & Peritz, J. H ,(2003), *A Writer's Resource: A handbook for writing and research,* NY, McGraw Hill

5. Kennedy, X. J., Kennedy, M. D. & Holladay, S. A ,(1999), The *Bedford Guide for College Writer*, Bedford, St. Martin's
6. Burton, S. H. ,(2000), *Mastering Practical Writing*, NBF

ISLM 2105   Islamic Studies   **Cr.H-2**

باب اول: مطالعہ قرآن و حدیث

باب دوم: مطالعہ سیرت

باب سوم: مطالعہ تہذیب و تمدن

باب اول: مطالعہ قرآن و حدیث (Topical Study of Quran & Hadith)

موضوعات

۱ـ توحید (دلائل کا عقلی و نقلی مطالعہ، تفکر و تدبر)

آیات

۱ـ للہ ما فی السموٰت و ما فی الارض و ان تبدوا ما فی انفسکم او تخفوہ یحاسبکم بہ اللہ فیغفر لمن یشاء و یعذب من یشآء واللہ علیٰ کل

شیءٍ قدیرٌ. (البقرۃ: ۲۸۴)

۲ـ الم تروا ان اللہ سخر لکم ما فی السموٰت و ما فی الارض و اسبغ علیکم نعمہ ظاہرۃ و باطنۃ و من الناس من یجادل فی اللہ بغیر علم و لا

ھدی و لا کتاب منیر. (لقمان: ۲۰)

۳ـ ربنا لا تواخذنا ان نسینا و اخطانا و لا تحمل علینا اصرا کما حملتہ علی الذین من قبلنا ربنا و لا تحملنا ما لا طاقۃ لنا بہ و اعف عنا

و اغفر لنا و ارحمنا انت مولانا فانصرنا علی القوم الکافرین. (البقرۃ: ۲۸۶)

۴ـ سنریہم اٰیٰتنا فی الاٰفاق و فی انفسہم حتی یتبین لہم انہ الحق اولم یکف بربک انہ علی کل شیءٍ شہید. (حٰم السجدۃ: ۵۳)

ان فی خلق السموٰت و الارض و اختلاف اللیل و النہار لاٰیٰت لاولی الالباب. (اٰل عمران: ۱۹۰)

۵ـ الذین یذکرون اللہ قیاما و قعودا و علی جنوبہم و یتفکرون فی خلق السموٰت و الارض ربنا ما خلقت ہذا باطلا سبحانک فقنا

عذاب النار. (اٰل عمران: ۱۹۱)

احادیث

۶ـ عن عمر بن الخطاب قال: قال رسول اللہ ﷺ حین سئل عن الایمان ان تومن باللہ و ملائکتہ و کتبہ و رسلہ و الیوم الاٰخر و تومن

بالقدر خیرہ و شرہ (متفق علیہ)

۲ـ رسالت (الہامی کتب و ملائکہ پر ایمان، آداب نبوی، اطاعتِ رسول اور ختم نبوت)

آیات:

۱ـ اٰمن الرسول بما انزل الیہ من ربہ و المومنون کل اٰمن باللہ و ملائکتہ و کتبہ و رسلہ لا نفرق بین احد من رسلہ و قالوا سمعنا و اطعنا غفرانک

ربنا و الیک المصیر (البقرۃ: ۲۸۵)

۲ـ یایہا الذین اٰمنوا لا تقدموا بین یدی اللہ و رسولہ و اتقوا اللہ ان اللہ سمیع علیم. (الحجرات: ۱)

واخری، تحبونها ن سرٌمن الله وفتح قریب وبشر المؤمنین .(الصف: ۱۳)

احادیث

١ . عن ابن عمر قال: قال رسول الله ﷺ بنی الاسلام علی خمس شهادة ان لاال، الا الله وان محمدا عبده ورسوله واقام الصلوة وایتاء الزکوة والحج و صوم رمضان (متفق علیه)

۲ . عن شرمة بن محمد قال: قال رسول الله ﷺ مروا الصبی الصلوة اذا باغ سبع سنین واذا بلغ عشر سنین فاضربو ه علیها ، سنن ابو داود . جامع ترمذی)

٣ . عن ابی هریرة قال: قال رسول ﷺ من اتاه الله مالا فلم یو د زکوة مثل له مال یوم القیامة شجاعا اقرع له زبیتان یطوقه یوم القیامة ثم یاخذ بلهزمتیه (یعنی شدقیه) ثم یقول انا مالک ، وانا کنزک ثم تلاو لا یحسبن الذین یبخلون بما آتهم الله من فضله هوخیر لهم بل هو شرلهم سیطوقون ما بخلوا به یوم القیامة ..... الخ (بخاری)

٥ . عن علی قال: قال رسول الله ﷺ من ملک، زاد راحلته تبلغه الی بیت الله ولم یحج فلا علیه ان یموت یهودیا اونصرانیا وذلک ان الله تبارک وتعالی یقول و لله علی الناس حج البیت من استطاع الیه سبیلا (= امع ترمذی)

۵ صفات مومنین

آیات

١ . و عباد الرحمن الذین یمشون علی الارض هونا و اذاخاطبهم الجاهلو ن قالوا سلما .(الفرقان: ١)

۲ . والذین یبیتون لربهم سجدا و قیاما .(الفرقان: ۲)

٣ . والذین یقولون ربنا اصرف عنا عذاب جهنم ان عذابها کان غراما .(الفرقان: ٣)

٤ . انها ساءت مستقرا و مقاما .(الفرقان: ۴)

٥ . والذین اذا انفقوا لم یسرفوا ولم یقتروا و کان بین ذالک قواما .(الفرقان: ۵)

۲ . والذین لا یدعون مع الله الها آخرو لایقتلون النفس التی حرم الله الا با حق و لا یزنون و من یفعل ذالک یلق اثاما .(الفرقان: ۲)

۷ . یضعف له العذاب یوم القیمة و یخلد فیه مهانا .(الفرقان ۷)

٨ . الا من تاب و امن وعمل صالحا فاولئک یبدل الله سیاتهم حسنت و کان الله غفورا رحیما .(الفرقان: ٨)

٩ . و من تاب وعمل صالحا فانه یتوب الی الله متابا .(الفرقان: ٩)

١٠ . والذین لا یشهدون الزور واذا مروا باللغو مروا کراما .(الفرقان: ١٠)

١١ . والذین اذا ذکروا بایت ربهم لم یخروا علیها صما و عمیانا .(الفرقان: ١١)

۱۲ . والذین یقولون ربنا هب لنا من ازواجنا ذریتنا قرة أعین و اجعلنا المتقین اماما .(الفرقان: ۱۲)

۱۳ . اولئک یجزون الغرفة بما صبروا و یلقون فیها تحیة و سلما .(الف قان: ۱۳)

۱۴ . خلدین فیها حسنت مستقرا و مقاما .(الفرقان: ۱۴)

۱۵ . قل ما یعبؤا بکم ربی لو لاد عاؤکم فقد کذبتم فسوف یکون لزاما (الفرقان: ۱۵)

٤ . والذین هم لفروجهم حافظون .(المومنون: ٤)

٥ . الا علی ازواجهم اوما ملکت ایمانهم فانهم غیر ملومین .(المومنون: ٥)

٦. والذين هم على صلوتهم يحافظون. (المومنون:٦)

٧. اولئك هم الوارثون. (المومنون:٧)

٨. الذين يرثون الفردوس. (المومنون:٨)

٩. هم فيها خالدون. (المومنون:٩)

احاديث

١. عن انس قال: قال رسول الله ﷺ والذي نفسي بيده لا يؤمن عبد حتى يحب لاخيه ما يحب لنفسه. (متفق عليه)

٢. عن النعمان بن بشير قال: قال رسول الله ﷺ ترى المؤمنين في تراحمهم و توادهم وتعاطفهم كمثل الجسد اذا اشتكى عضو تداعى له سائر الجسد بالسهر والحمى. (متفق عليه)

٦. آداب معاشرت

١. وان طائفتان من المومنين اقتتلوا فاصلحوا بينهما فان بغت احداهما على الاخرى فقاتلوا التي تبغي حتى تفيء الى امر الله فان فآئت فاصلحوا بينهما بالعدل واقسطوا ان الله يحب المقسطين. (الحجرات:٩)

٢. انما المومنون اخوة فاصلحوا بين اخويكم واتقوا الله لعلكم ترحمون. (الحجرات:١٠)

٣. يايها الذين امنوا لايسخر قوم من قوم عسى ان يكونوا خيرا منهم ولانساء من نساء عسى ان يكن خيرا منهن ولا تلمزوا انفسكم ولا تنابزوا بالالقاب بئس الاسم الفسوق بعد الايمان ومن لم يتب فاولئك هم الظالمون. (الحجرات:١١)

٤. يا ايها الذين امنوا اجتنبوا كثيرا من الظن ان بعض الظن اثم ولا تجسسوا ولا يغتب بعضكم بعضا ايحب احدكم ان ياكل لحم اخيه ميتا فكرهتموه واتقوا الله ان الله تواب رحيم. (الحجرات:١٢)

٥. يايها الذين اناخلقناكم من ذكر وانثى وجعلناكم شعوبا وقبائل لتعارفوا ان اكرمكم عند الله اتقاكم ان الله عليم خبير. (الحجرات:١٣)

احاديث

عن ابي هريرة ان رسول الله ﷺ قال: ان المفلس من امتي من يأتي يوم القيامة بصلاة و صيام وزكوة، وياتي قدشتم هذا، وقذف هذا، واكل مال هذا، وسفك دم هذا، و ضرب هذا، فيعطى هذا من حسناته، و هذا من حسناته، فان فنيت حسناته قبل ان يقضى ما عليه اخذ من خطاياهم فطرحت عليه ثم طرح في النار

٧. دعوت واقامت دين

١. ومن اظلم ممن افترى على الله الكذب و هو يدعى الى الاسلام والله لا يهدي القوم الظالمين. (الصف:٢١)

٢. يريدون ليطفئوا نور الله بافواههم، والله متم نوره ولو كره الكافرون. (الصف:٢٢)

٣. هو الذي ارسل رسوله بالهدى ودين الحق ليظهره على الدين كله ولو كره المشركون. (الصف:٢٣)

احاديث

١. عن ابي سعيد الخدري عن رسول الله ﷺ قال من راى منكم منكرا فليغيره بيده فان لم يستطع فبلسانه فان لم يستطع فبقلبه و ذالك اضعف الايمان. (مسلم)

٢. عن عبدالله بن عمر قال: قال رسول الله ﷺ الا كلكم راع و كلكم مسؤل عن رعيته فالامام الذي على الناس راع وهو مسؤل عن رعيته والرجل راع على اهل بيته وهو مسؤل عن رعيته و المرأة راعية على بيت زوجها وولده وهي مسؤلة عنهم وعبدالرجل راع على

٢. يايها الذين امنوا لا ترفعوا اصواتكم فوق صوت النبي ولا تجهروا له بالقول كجهر بعضكم لبعض ان تحبط اعمالكم و انتم لا تشعرون. (الحجرات:٢).

٣. ان الذين يغضون اصواتهم عند رسول الله اولئك الذين امتحن الله قلوبهم للتقوى لهم مغفرة واجر عظيم. (الحجرات:٣)

٤. ولو انهم صبروا حتى تخرج اليهم لكان خيرا لهم والله غفور رحيم. (الحجرات:٥)

٥. ان الذين ينادونك من وراء الحجرات اكثرهم لا يعقلون. (الحجرات:٥)

٦. يايها الذين امنوا ان جاءكم فاسق بنبا فتبينوا ان تصيبوا قوما بجهالة فتصبحوا على ما فعلتم نادمين. (الحجرات:٦)

٧. واعلموا ان فيكم رسول الله لو يطيعكم في كثير من الامر لعنتم ولكن الله حبب اليكم الايمان وزينه في قلوبكم وكره اليكم الكفر والفسوق والعصيان اولئك هم الراشدون. (الحجرات:٧)

٨. فضلا من الله ونعمة والله عليم حكيم. (الحجرات:٨)

٩. النبي اولى بالمؤمنين من انفسهم وازواجه امهتهم واولوا الارحام بعضهم اولى ببعض في كتاب الله من المؤمنين والمهاجرين الا ان تفعلوا الى اوليائكم معروفا، كان ذلك في الكتاب مسطورا. (الاحزاب:٦)

١٠. ان الله وملائكته يصلون على النبي يايها الذين امنوا صلوا عليه وسلموا تسليما. (الاحزاب:٥٦)

١١. ان الذين يؤذون الله ورسوله لعنهم الله في الدنيا والاخرة واعد لهم عذابا مهينا. (الاحزاب:٥٧)

١٢. لقد كان لكم في رسول الله أسوة حسنة لمن كان يرجو الله واليوم الاخر وذكر الله كثيرا. (الاحزاب:٢١)

١٣. ما كان محمد ابا احد من رجالكم ولكن رسول الله وخاتم النبيين وكان الله بكل شيء عليما. (الاحزاب:٤٠)

احاديث

عن العباس بن عبدالمطلب قال :قال رسول الله ﷺ ذاق طعم الايمان من رضى بالله ربا وبالاسلام دينا وبمحمد رسولا

٣. آخرت

آيات

١. يايها الذين امنوا اتقوا الله ولتنظر نفس ما قدمت لغد واتقوا الله ان الله خبير بما تعملون. (الحشر:١٨)

٢. ولا تكونوا كالذين نسوا الله فانسهم انفسهم اولئك هم الفاسقون. (الحشر:١٩)

حديث

عن ابن مسعود عن النبي ﷺ لا تزول قدما ابن آدم حتى يسئل عن خمس عن عمره فيما افناه وعن شبابه فيما ابلاه وعن ماله من اين اكتسبه وفيما انفقه وماذا عمل فيما علم (جامع ترمزي)

٤. عبادات (نماز، زكوة، روزه، حج، جهاد)

١. قد افلح المؤمنون الذين هم في صلاتهم خاشعون. (المومنون:١)   ٢. والذين هم عن اللغو معرضون. (المومنون:٢)

٣. والذين هم للزكوة فاعلون. (المومنون:٣)

٤. يايها الذين امنوا هل ادلكم على تجارة تنجيكم من عذاب اليم. (الصف:١٠)

٥. تؤمنون بالله ورسوله وتجاهدون في سبيل الله باموالكم وانفسكم ذلكم خير لكم ان كنتم تعلمون. (الصف:١١)

يغفر لكم ذنوبكم ويدخلكم جنات تجري من تحتها الانهر ومساكن طيبة في جنت عدن ذلك الفوز العظيم. (الصف:١٢)

مال سیده وهو مسؤل عنه الا فكلكم راع و كلكم مسؤل عن رعیته (متفق علیه)

٣ـ قال رسول اللـه ﷺ یجاء الرجل یوم القیامته فیلقی فی النار فتندلق اقتابه فی النار فیطحن فیها كطحن الحمار بر حاه فیجتمع اها النار علیه فیقولون، ای فلان ماشانک، الس كنت تأمر نا بالمعروف وتنهانا عن المنكر ؟ قال كنت امركم ولا اتـه ونہاكم عن المنكر واتـه

احادیث

١ـ عن عبدالله قال: قال رسول الله ﷺ طلب كسب الحلال فریضة بعد الفریضة (بیهقی: شعب الایمان)

٢ـ عن ابی سعد قال : قال رسول الله ﷺ التاجر الصدوق الامین مع النبیین والصدیقین والشهداء (جامع ترمذی)

باب دوم: مطالعہ سیرت (Seerah Study)

١ـ مطالعہ سیرت کی اہمیت

٢ـ تزکیہ نفس اور تعمیر شخصیت کا نبوی منہاج

٣ـ تشکیل معاشرت اور اسوۂ حسنہ

۴ـ ریاست مدینہ، مواخات اور میثاق مدینہ

۵ـ غزوات النبیؐ، مقاصد و حکمت

۶ـ خطبہ حجۃ الوداع

باب سوم: مطالعہ تہذیب و تمدن (Study of Culture)

١ـ تہذیب کا مفہوم، اسلامی تہذیب کی خصوصیات

٢ـ بنیادی انسانی حقوق

٣ـ تہذیب انسانی کے ارتقاء میں مسلمانوں کا کردار

۴ـ اسلام کا نظریہ علم

۵ـ طبیعی علوم، حیاتیاتی علوم اور معاشرتی علوم میں مسلمانوں کا کردار

۶ـ مکالمہ بین المذاہب

Semester-III

PHYS 3101   Electricity and Magnetism-II   Cr.H-3

Magnetic field, Magnetic forces on a single point charge/current carrying conductor, Torque on a current carrying loop and magnetic dipole, Biot & Savart Law and its analytical treatment and application, Ampers law and its applications, Electromagnetic induction and its laws, Inductance, Inductance for various configurations, LR circuits, Growth and decay of current in RL circuits, Electromagnetic Oscillation (Qualitative and Quantative analysis using differential equations), Forced electromagnetic oscillations and resonance, Alternating current circuits, Single loop RLC circuits (series and parallel), Power in AC circuits and phase angles, Maxwell's equations (integral/differential forms), Electromagnetic waves, Poynting vector. Magnetic properties of materials.

Recommended Books:
1. Physics by D. Halliday, R. Resnick and K. S. Krane, John Wiley & Sons Inc., 5th Ed. (2003).
2. Fundamental of Physics by D. Halliday, R. Resnick and J. Walker, Extended. John Wiley & Sons Inc., (2008).
3. University Physics by Young, Freedman and Ford, Seers and Zemansky's Pearson Education Inc., (2008).
4. Physics for Scientist and Engineers by Giancoli, Prentice Hall Inc., 4th Ed. (2007).
5. Field and Wave Electromagnetic by David K. Cheng, Addison-Wesley, (1989).

PHYS 3102   Fundamentals of Quantum Mechanics   Cr.H-3

Particle-like Properties of Electromagnetic Radiations: Black Body Radiation, Plank's Radiation Law and Quantum of Energy, Derivation of Stefan's Law and Wien's Displacement Law from Planck's Radiation Law, Quantization of Energy, Light Quantization and Photoelectric Effect. The Compton Effect. Wave-like Properties of Particles: Wave Nature of Matter and De-Broglie Hypothesis and its Experimental Verification, Wave Packet and its Localizations in Space and Time, Heisenberg Uncertainty Principle and its Applications. Bohr Model of the Atom: Hydrogen Spectrum, Bohr Theory of Atomic Structure, Bohr Theory of the Hydrogen Atom, Bohr Correspondence Principle, Experimental Evidence for Quantization and Determination of Critical Potential (Frank-Hertz Experiment), Deficiencies of the Bohr Model Characteristics of Vector Atomic Model (Space Quantization, Angular Momenta and Magnetic Momenta), Orbital Angular Momentum. Quantum Mechanics: Quantum Mechanics and its Postulates, Quantum Operators and their Properties, Eigen Value and Eigen Functions, Schrödinger Wave Equation (Time Dependent and Time Independent), Application of Time Independent Schrödinger Wave Equation, Probability Density using the Wave Function of the State,

Recommended Books:
1. Physics by D. Halliday, R. Resnick and K. S. Krane, John Wiley & Sons Inc., 5th Ed. (2003).
2. Fundamental of Physics by D. Halliday, R. Resnick and J. Walker, Extended. John Wiley & Sons Inc., (2008).
3. University Physics by Young, Freedman and Ford, Seers and Zemansky's Pearson Education Inc., (2008).
4. Physics by M. Alonso and E. J. Finn: Addison-Wesley, USA, (1999).
5. Concepts of Modern Physics by Arthur Beiser, 6th Edition, McGraw Hill, USA, (2003).

PHYS 3203   Physics LAB-I   Cr.H-3

The following experiments are recommended for BS Physics LAB-I. Minimum number of experiments to be performed is six **(06)** from each lab**.** Teachers are requested to emphasize on graphical analysis, error calculation and on system of S.I. units in the beginning of session.

- Modulus of Rigidity by Static & Dynamic method (Maxwell's needle, Barton's Apparatus).
- Surface tension of water by capillary tube method.
- To determine the value of "g" by compound pendulum/Kater's Pendulum.
- To determine Horizontal/Vertical distance by Sextant.
- To study the laws of vibration of stretched string using sonometer.
- To determine the stopping potential by photo cell.
- Measurement of resistance using a Neon flash bulb and condenser
- Conversion of a galvanometer into Voltmeter & an Ammeter

MATH 3104   Calculus   Cr.H-3

Parametric Equations: Curves defined by Parametric Equations, Calculus with Parametric Curves. Polar Coordinates: Introduction, Areas and Lengths in Polar Coordinates, Conic Sections, Conic Sections in Polar Coordinates. Infinite Sequence and Series: Sequences, Series, The Integral Test and Estimates of Sums, The Comparison Tests, Alternating Series, Absolute Convergence and the Ratio and Root Test, Strategy for Testing Series, Power Series, Functions as Power Series, Taylor and Maclaurin Series.
Chapter No. 10 and 11 of text book.
Note: All those topics that are already covered in Intermediate classes must not be repeated in this course.

Recommended Books:
1. Text Book: Calculus Early Transcendentals by James Stewart Brooks/Cole (5th and onwards editions)
2. Calculus: A New Horizon by Anton H., John Wiley, 6th ed. (1999).
3. Calculus by Thomas G.B., Finney A.R., Addison-Wesley, 10th ed. (2002).

MATH 3105   Ordinary Differential Equations   Cr.H-3

Introduction, Mathematical Modeling of First and Second Order Differential Equations (ODEs), Solutions and Applications of First Order Differential Equations, Formation and Solutions of Higher Order Linear Differential Equations, Differential Equations with Variable Coefficients, Sturm-Liouville (S-L) System and Boundary-Value Problems, Series Solution and its Limitations, The Frobenius method.

Recommended Books:

1. Mathematical Methods for Physicists by George Arfken and Hans J. Weber, (6th and onwards editions) Acad Press.
2. Differential Equations with boundary-value problems, by D. G. Zill, M. R. Cullen, PWS Publishing Co. (1997).
3. Advanced Engineering Mathematics, Erwin Kreyszig, (2007).

4. Calculus Early Transcendentals by James Stewart Brooks/Cole (5th and onwards editions)

ENGL 3106   English-III   **Cr.H-3**

Lecture	Topics	Book
1-5	• Language as a tool of communication • Communication is a process • Communication is transaction	1, 2 & 3
6-8	• Levels of communication • Communication networks	1 , 2 & 3
9-11	• The process of human communication • The importance of communication skills to you	1& 2
12-15	• Basic communication principles • How does communication work • Communicating internally	1,2 & 3
16-18	• The role of communication in business • Why business needs to communicate • How business communicates	1, 3
19-21	• Classification of barriers to communication	1, 3
22-27	• Definition of noise • Are you listening? • Why do people have problem listening	1, 2 & 3
28-31	• Listening for information • Empathic listening	1,2, & 3
32-35	• Active listening • Active listening in business	1 & 2
36-40	• Implications of active listening • Passive listening in business	1 , 2 & 3
41-45	Interpersonal relationship • Speaking skills • Presentation skills • Group discussion	1,2

Recommended Text (Latest Editions):

1. Saundar Hybels and Richard L. Weaver, "Communicating Effectively"

2. Raymond V. Lesikar and Marie E. Flatly, "Basic business communication"

3. Meenakshi Raman & Sangeeta Sharma, "Technical communication"

4. Pamela Angell, "Business communication Design"

PHYS 4101   Basics of Electronics and Nuclear Physics   Cr.H-3

Basic Electronics: Energy Bands in Solids, P-type and N-type Semiconductor Materials, P-N Junction (diode Structure), Characteristics and Application as Rectifiers, Transistor (basic Structure and Operation), Characteristics of Transistors, Load Line of a Transistor, Applications of a Transistor, Logic Gates and their basic Applications. Nuclear Structure and Radioactivity: Nuclear Structure and the Basic Properties of the Nucleus (Nuclear Size, Binding Energy, Angular Momentum of the Nucleus, Magnetic Moment and parity) Meson Theory of Nuclear Force. Radioactivity and Laws of Radioactive Decay, Conservation Laws in Radioactive Decays. Radioactive Isotopes and Carbon Dating. Nuclear Reactions: Types of Nuclear Reactions and their Q-values, The Compound Nucleus, Nuclear Fission and Fusion Applications of Nuclear Physics.

Recommended Books:
1. Physics by D. Halliday, R. Resnick and K. S. Krane, John Wiley & Sons Inc., 5th Ed. (2003).
2. Fundamental of Physics by D. Halliday, R. Resnick and J. Walker, Extended. John Wiley & Sons Inc., (2008).
3. University Physics by Young, Freedman and Ford, Seers and Zemansky's Pearson Education Inc., (2008).
4. Concepts of Modern Physics by Arthur Beiser, 6th Edition, McGraw Hill, USA, (2003).
5. Fundamentals of Quantum Chemistry by J. E. House, 2nd Edition, Elsevier Academic Press, USA, (2004).
6. Physics by M. Alonso and E. J. Finn: Addison-Wesley, USA, (1999).
7. Electronic Devices and Circuit Theory By Robert Boylestad and Louis Nashelsky, Prentice Hall, (2002).
8. Principles of Electric Circuits By T.L Floyd, Pearson Prentice Hall, (2007).
9. Electronic Devices by T.L. Floyd, Merril Publishing Company Columbus (1988).
10. Electronic Principles by A.P. Malvino, Tata McGraw Hill, New Delhi (1988).
11. Electronic Devices & Circuits by D.B. Bell, Reston Publishing Company Inc., Virginia (1980).
12. Electronic; Design Circuit & Systems by C.J. Savant Jr. M.S. Roden, G.L. Carpenter, The Bengamin/Cummings Publishing Co. California (1991).

PHYS 4102   Theory of Thermodynamics   Cr.H-3

Kinetic Theory of Gases. Derivation of Fundamental Equation of Kinetic Theory of Gases, Maxwell Distribution of Molecular Speeds and Energies, Modification of Kinetic Theory for Real Gas, The Van der Waals Equation, Zeroth Law of Thermodynamics and Thermal Equilibrium, Definition and Formulation of the First Law of Thermodynamics, Calculation of Work Done, Consequences of the First Law of Thermodynamics, Definition & Measurement of Enthalpy, The Joule-Thomson Experiment, Carnot Cycle and Efficiency Measurements, Second Law of Thermodynamics and the Concept of Entropy, Entropy and Entropy Measurements for Reversible and Irreversible Process. Combined First and Second law of Thermodynamics, Entropy Changes in the Ideal Gases, The Third Law of Thermodynamics and its Uses, Definition & Mathematical Expressions of Free Energy, Helmoltz Energy and Gibbs Energy, The Maxwell Relationship, Transfer of Heat, Distribution and Mean Values, Mean Free Path and Microscopic Calculations of Mean Free Path, Brownian Motion.

Recommended Books:

1. Fundamental of Classical and Statistical thermodynamics Bimalendu N. Roy Wiley & Sons Inc.,
2. Physics by D. Halliday, R. Resnick and K. S. Krane, John Wiley & Sons Inc., 5th Ed. (2003).
3. Fundamental of Physics by D. Halliday, R. Resnick and J. Walker, Extended. John Wiley & Sons Inc., (2008).
4. University Physics by Young, Freedman and Ford, Seers and Zemansky's Pearson Education Inc., (2008).

PHYS 4203 Physics LAB-II   Cr.H-3

The following experiments are recommended for BS Physics LAB-I. Minimum number of experiments to be performed is six **(06)** from each lab**.** Teachers are requested to emphasize on graphical analysis, error calculation and on system of S.I. units in the beginning of session.

- To determine frequency of AC supply by CRO.
- Measurement of low resistance coil by a Carey Foster Bridge.
- Resonance frequency of an acceptor circuit
- Resonance frequency of a Rejecter Circuit.
- Determination of ionization potential of mercury.
- Characteristics of a semiconductor diode (Compare Si with Ge diode)
- Setting up of half & full wave rectifier & study of following factors
- To setup a single stage amplifier and measure its voltage gain.
- To set up and study various logic gates (AND, OR, NAND etc) using diode and to develop their truth tables.

MATH 4104 Vectors and Tensors Analysis   Cr.H-3

Vector Analysis: Review of Vectors Algebra, Vector Differentiation and Gradient, Divergence and Gauss's Theorem, Vector Integration, Green's Theorem in Plane, Curl and Stoke's theorem. Curvilinear Coordinates: Orthogonal Coordinates in R^3, Jacobian for Polar Coordinates, Differential Vector Operator in Curvilinear Coordinates, Circular Cylindrical Coordinates, Spherical Polar Coordinates. Tensor Analysis: Covariant and Contravariant Tensors, Symmetric and Antisymmetric Tensors, Direct Product and Contraction, Quotient Rule, Pseudotensors, Dual Tensors, Metric Tensors, Christoffel Symbols, Covariant Derivative, Geodesics, Parallel Transport, Tensor Derivative Operators.

Recommended Books:
1. Mathematical Methods for Physicists by George Arfken and Hans J. Weber, (6th and onwards editions) Acad Press.
2. Differential Equations with boundary-value problems, by D. G. Zill, M. R. Cullen, PWS Publishing Co. (1997).
3. Cartesian Tensors by F. I. Zafar and M. S. Zafar. Majeed Book Depot, Lahore.

MATH   4105 Linear Algebra   Cr.H-3

Matrices: Addition, Multiplication, Transpose, Matrices and Systems of Linear Equations, Block Matrices. Polynomial in Matrices, Invertible Matrices, Complex Matrices, Elementary Matrices and Applications, Quadratic Forms, Simlarity. Vector Space: Vector Spaces, Subspaces, Linear Combination, Linear Spans, Basis and Dimension, Linear Combination and Vector Space, Change of Basis. Orthogonality, Inner Product Spaces, Cauchy-Schwarz Inequality, Applications, Porjections, Inner Products and Matrices, Normed Vector Spaces.

Recommended Books:
1. Schaum's Outline of Theory and Problem of Linear Algebra. Seymour Lipschutz. Mc-Graw Hill
2. Mathematical Methods for Physicists by George Arfken and Hans J. Weber, (6th and onwards editions) Acad Press.
3. Advanced Engineering Mathematics, Erwin Kreyszig, (2007).
4. Mathematical Physics by E. Butkov, Addison-Wesley London

PHYS 4106	Theory of Error Analysis	Cr.H-3

Preliminary Description of Error Analysis, How to Report and Use Uncertainties, Discrepancy, Comparison of Measured and Accepted Values, Comparison of Two Measured Numbers, Checking Relationships with a Graph, Significant Figures and Fractional Uncertainties, Multiplying Two Measured Numbers, Propagation of Uncertainties, The Square-Root Rule, Independent Uncertainties in a Sum, Arbitrary Functions of One Variable, General Formula for Error Propagation, Statistical Analysis of Random Uncertainties, Random and Systematic Errors, The Mean and Standard Deviation, The Normal Distribution, Histograms and Distributions, Limiting Distributions, The Normal Distribution, The Standard Deviation as 68% Confidence Limit, Justification of the Mean as Best Estimate, Justification of Addition in Quadrature, Standard Deviation of the Mean, Acceptability of a Measured Answer, Rejection of Data, Chauvenet's Criterion, Weighted Averages, Least-Squares Fitting, Calculation of the Constants A and B and their uncertainty, Least-Squares Fits to Other Curves, Covariance and Correlation, Covariance in Error Propagation, Coefficient of Linear Correlation, Binomial Distribution and its Properties, Probabilities in Dice Throwing, The Poisson Distribution and its Properties, The Chi-Squared Test for a Distribution, Degrees of Freedom and Reduced Chi Squared, Probabilities for Chi Squared.

Recommended Books:

1. Data Reduction and Error Analysis for Physical Science by P. Bevington, McGraw Hill 3rd Edition 2003.
2. Errors of Observations by J.B.Toping, IOP, 1962.
3. An introduction to Error Analysis by John R.Taylor, University Science Books, California, 1982.
4. Measurements and their Uncertainties A practical guide to modern error analysis by I FAN G. HUGHES and THOMAS P. A. HASE, OXFORD UNIVERSITY PRESS

PHYS 5101   Methods of Mathematical Physics-I   ___   Cr.H-3

Functions of Complex Vairables: Calculus of Residues, Dispersion Relations, Method of Steepest Descents. Gamma Functions: Diagamma and Polygamma Functions, Stirling's Series, Beta Functions, Incomplete Gamma Functions. Strum-Liouville Theory (Orthogonal Functions): Hermite Operators, Completeness of Eigen Functions, Green's Functions-Eigen Function Expansion. Bessel Functions: Bessel Functions of first kind, Orthogonality, Neumann Functions, Hankel Functions, Modified Bessel Functions, Spherical Bessel Functions.

Recommended Books:
1. Mathematical Methods for Physicists by George Arfken and Hans J. Weber, (6th and onwards editions) Acad Press.
2. Advanced Engineering Mathematics, Erwin Kreyszig, (2007).
3. Mathematical Physics by E. Butkov, Addison-Wesley London
4. Complex Variables by M.R.Spiegel, Schaum's Outline Series, McGraw Hill, New York.
5. Introduction to Mathematical Physics by C.W. Wong, Oxford University, Press, New York (1991).
6. Foundations of Mathematical Physics by Hassani, Prentice Hall International Inc., Singapore (1991).
7. Mathematical Physics by ChattopadhyayWiley Eastern Limited, New Delhi, (1990).
8.

PHYS 5102   Classical Mechanics-I   Cr.H-3

Kinematics of particle motion, Galilean transformations, The Newtonian formulation of mechanics, Integration of Newton's equation of motion, Kinematics of system of particle motion Collision between particles, centre of mass co-ordinate system, scattering cross section in L and C system, scattering by central force field, Central force motion, Two body problem and reduced mass, General solution of problems of motion in central force field, inverse square law of force, Kepler's laws of planetary motion, Applications of central force motion, Some methods in the calculus of variations, Euler's equation, The "second form" of Euler's equation.

Recommended Books:
1. Classical Mechanics by H. Goldstein, 2nd. Edn., Addison Wesley, Reading, Massachusetts (1980).
2. Classical Mechanics by Tai L. Chow, John Wiley & Sons (1995).
3. Classical dynamics of particles and systems by S. T. Thorntom, J. B. Marion , Brooks/Cole, (2004).
4. Dynamics by S.N. RasbandJohn Wiley & Sons, New York (1983).
5. Classical Mechanics by R.A. Matzner & L.C. ShepleyPrentice Hall Inc., London (1991).

PHYS 5103   Electrodynamics-I   Cr.H-3

Differential/integral calculus; Orthogonal coordinate systems (cartesian/cylindrical/ spherical); Electrostatics in free space: Electrostatic force/field/potential/energy for discrete (a single point charge/a collection of point source charges) and continuous (line/surface/volume) charge distributions, Divergence/curl of E, Electrostatic boundary conditions (on E, *V*, and D), Conductors,

Capacitors; Boundary value problems: Solutions of Laplace's equation for various symmetries (cartesian/ cylindrical/spherical), Method of Images for various symmetries; Electric monopole/ dipole/quadrupole/octopole etc., Electric dipole moment for line/surface/volume charge; Electrostatics in matter: Polarization P, Bound surface/volume charge, Electric displacement D, Gauss's law for D & P−differential/integral forms and its uses/applications, Electric susceptibility/permittivity/relative permittivity; Electric line/surface/volume currents−I/K/J, Equation of continuity.

Recommended Books:
1. Introduction to Electrodynamics, David J. Griffiths, 4th Edition, Addison-Wesley, USA, (2012).
2. Field and Wave Electromagnetics, David K. Cheng, 2nd Edition, Pearson Education, USA, (2004).
3. The Feynman Lectures on Physics Volume II, Richard P. Feynman, Robert B. Leighton, and Matthew Sands, Addison-Wesley, USA, (2011).
4. Classical Electromagnetic Theory, Jack Vanderlinde, 2nd Edition, Kluwer Academic, USA, (2004).
5. Electromagnetic Field Theory Fundamentals, by Bhag S. Guru and Hüseyin R. Hiziroğlu, 2nd Edition, Cambridge, UK, (2004).
6. Foundations of Electromagnetic Theory, John R. Reitz, Frederick J. Milford, and Robert W. Christy, 4th Edition, Pearson Addison-Wesley, USA, (2009).
7. Electromagnetic Fields and Energy, H. A. Haus and J. R. Melcher, 1st Edition, Prentice Hall, USA, (1989).
8. Electromagnetic Fields and Waves, Paul Lorrain and Dale R. Corson, 3rd Edition, W. H. Freeman, USA, (1988).
9. Classical Electrodynamics, John D. Jackson, 3rd Edition, John Wiley & Sons, USA, (1998).

PHYS 5104   Electronics   Cr.H-3

Semiconductor Diode And Applications: Semiconductor Diode, Characteristics Curves, DC & AC resistance, Diode Equivalent circuit, Series and Parallel Diode configuration with DC load, Rectification, Half and Full wave rectifier circuit with and without filter circuit, Zener Diode, Light emitting diode.   Bipolar Junction Transistor: Transistor and transistor operation, Transistor Configuratios (CB, CE,CC),Current amplification factors, Load line and Operating Conditios, DC biasing (voltage divider bias C-E amplifier),Design of voltage divider bias C-E amplifier, Transistor switching network. Field Effect Transistors: Introduction of FETs, Construction and basic operation JFET, Characteristics and parameter of JFETs, JFETs biasing (voltage divider bias), The metal oxide semiconductor FET(MOSFET), MOSFET parameters and characteristics, Low and High frequency response of FET amplifiers. Negative Feedback Amplifiers: Negative feedback amplifiers,General characteristics of Negative feedback amplifiers, Classification of negative feedback amplifiers, voltage series feedback amplifier. Integrated amplifier: The Differential amplifier (modes of operation, common mode rejection ratio), Operational Amplifier and its parameters, Op-amp configuration with negative feedback ,Op-amp applications (voltage summing, voltage buffer, voltage comparators), Op- amp as differentiator and integrator. Oscillators: Oscillator Principles and conditions for oscillation, Oscillator with LC feedback circuits, Transistor RC phase shift oscillator, Crystal oscillators, UJT relaxation oscillator, Multivibrators,   Schmitt trigger.

Recommended Books:
1. Electronic Devices and Circuit Theory By Robert Boylastad and Louis Nashelsky, Prentice Hall, (2002).
2. Principles of Electric Circuits by T.L Floyd, .E. Merril Pub. Co, (1981).
3. Integrated Electronics by J. Millman & C.C. Halkias, McGraw Hill, (2008).
4. Electronic Devices by T.L. Floyd, Merril Publishing Company Columbus (1988).
5. Electronic Principles by A.P. Malvino, , Tata McGraw Hill, New Delhi (1988).

6. Electronic Devices & Circuits by D.B. Bell, Reston Publishing Company Inc., Virginia (1980).
7. Electronic; Design Circuit & Systems by C.J. Savant Jr. M.S. Roden, G.L. Carpenter, The Bengamin/Cummings Publishing Co. California (1991).
8. Basic electronics by B. Grob, McGraw-Hill, (2003).

PHYS 5205   Electronics LAB   Cr.H-3

The following practicals are recommended for Electronics LAB. Minimum number of practicals to be performed is six.

- To construct from discrete components OR, AND, NOT, NAND, NOR exclusive OR Circuits and verify their truth tables.
- Design a fixed and self bias and voltage divider bias transistor To construct a single stage CE transistor voltage amplifier and study gain, input impedance, output impedance, and half power points by sine/square wave testing and effect of bias on the output and measurement of distortion
- To construct and study the wave forms at the base and collector of the transistors of a free running a multivibarator.To construct and study of the height, duration and time period of the output pulses in a monostable and Bistabale multivibrators with reference to the input Trigger
- To study of RC integrators and differentiators.
- Design an inverting and non-investing D.C. amplifier, measurement of parameters of a given IC operational amplifier.
- Design and study the application of operational amplifier (current to voltage converter, instrumentation amplifier, buffer, voltage clamp, integrator, and differentiator. Low and high pass filter half-wave rectifier etc.)
- To construct a phase shift or Wein bridge oscillator and measure its frequency by 741,555timer

Recommended Books:
1. Experimental Electronics b y R.J. Higgings (McGraw-Hill).

Semester-VI

PHYS 6101   Methods of Mathematical Physics-II   Cr.H-3

Legendre Functions: Generating Functinos, Recurrence Relations, Orthogonality, Associated Legendre Functions, Spherical Harmonics, Orbital Angular Momentum Operators, Legender Function of the second kind, Laguerre Functions, Hermite Functions, Chebyshev Polynomials. Fourier Series: Definition and general properties of Fourier series, Uses and Applications of Fourier Series, Gibbs Phenomenon, Discrete Fourier Transform. Integral Transforms: Development of Fourier Integral, Fourier Transforms and Inversion Theorem, Fourier Transforms of Derivatives, Convolution Theorem, Momentum Representation, Transfer Functions, Laplace Transform and its Application, Inverse Laplace Tranform.

Recommended Books:
1. Mathematical Methods for Physicists by George Arfken and Hans J. Weber, (6th and onwards editions) Acad Press.
2. Advanced Engineering Mathematics, Erwin Kreyszig, (2007).

3. Mathematical Physics by E. Butkov, Addison-Wesley London
4. Complex Variables by M.R.Spiegel, Schaum's Outline Series, McGraw Hill, New York.
5. Introduction to Mathematical Physics by C.W. Wong, Oxford University, Press, New York (1991).
6. Foundations of Mathematical Physics by Hassani, Prentice Hall International Inc., Singapore (1991).
7. Mathematical Physics by ChattopadhyayWiley Eastern Limited, New Delhi, (1990).

PHYS 6102   Classical Mechanics -II   Cr.H-3

Generalized co-ordinates and constraints, Configuration space, D' Alembert's principle and Lagrange 's equation, Hamilton's principle and Lagrange's equation, Integrals of motion and conservative laws, Lagrangian versus Newtonian approach to classical mechanics, Hamiltonian of dynamical system, Hamilton's canonical equations, Integrals of Hamilton's equation, Canonical transformations, Poisson bracket, Phase space and Liouville's theorem, Coupled oscillations and normal co-ordinates.

Recommended Books:
1. Classical Mechanics by H. Goldstein, 2nd. Edn., Addison Wesley, Reading, Massachusetts (1980).
2. Classical Mechanics by Tai L. Chow, John Wiley & Sons (1995).
3. Classical dynamics of particles and systems by S. T. Thorntom, J. B. Marion , Brooks/Cole, (2004).
4. Dynamics by S.N. RasbandJohn Wiley & Sons, New York (1983).
5. Classical Mechanics by R.A. Matzner & L.C. ShepleyPrentice Hall Inc., London (1991).

PHYS 6103   Electrodynamics-II   Cr.H-3

Magnetostatics in free space: B for line/surface/volume currents, Divergence/curl of B, Magnetic vector/scalar potential$-$A/V_m for line/surface/volume currents, Magnetostatics boundary conditions (on B, A, and H); Magnetic monopole/dipole/quadrupole etc., Magnetic dipole moment for line/surface/volume currents; Magnetostatics in matter: Magnetization M, Bound surface/volume currents, Auxiliary field H, Ampere's law for H & M$-$differential/integral forms and its uses/applications, Magnetic susceptibility/permeability/relative permeability; Electrodynamics: Faraday's law$-$differential and integral forms and its uses/applications, Mutual/self inductance, Magnetic energy for line/surface/volume currents, Poynting's theorem; Maxwell's equations in free space (static/non-static case), Maxwell's equations in matter; Electromagnetic waves in free space, Electromagnetic waves in matter.

Recommended Books:
1. Introduction to Electrodynamics, David J. Griffiths, 4th Edition, Addison-Wesley, USA, (2012).
2. Field and Wave Electromagnetics, David K. Cheng, 2nd Edition, Pearson Education, USA, (2004).
3. The Feynman Lectures on Physics Volume 2, Richard P. Feynman, Robert B. Leighton, and Matthew Sands, Addison-Wesley, USA, (2011).
4. Classical Electromagnetic Theory, Jack Vanderlinde, 2nd Edition, Kluwer Academic, USA, (2004).
5. Electromagnetic Field Theory Fundamentals, by Bhag S. Guru and Hüseyin R. Hiziroğlu, 2nd Edition, Cambridge, UK, (2004).
6. Foundations of Electromagnetic Theory, John R. Reitz, Frederick J. Milford, and Robert W. Christy, 4th Edition, Pearson Addison-Wesley, USA, (2009).

7. Electromagnetic Fields and Energy, H. A. Haus and J. R. Melcher, 1st Edition, Prentice Hall, USA, (1989).
8. Electromagnetic Fields and Waves, Paul Lorrain and Dale R. Corson, 3rd Edition, W. H. Freeman, USA, (1988).
9. Classical Electrodynamics, John D. Jackson, 3rd Edition, John Wiley & Sons, USA, (1998).

PHYS 6104   Quantum Mechanics-I   Cr.H-3

Review of Concepts of Classical Mechanics: Historical Review (Experiments and Theories), Wave Aspects of Particles, Hilbert Space and Wave Functions: Mathematical tools of Quantum Mechanics: The linear vector space, The Hilbert space, Dimensions and basis of a vector space, Square integrable wave functions, Dirac notation, Operators, Representation in discrete and continuous basis. Basic Postulates of Quantum Mechanics: The state of a system, Observables, Measurement in Quantum Mechanics, Time Evolution of the System's State (Time evolution operator, Stationary states: Time independent potentials), Conservation of probability, Time evolution of expectation values, Symmetries and Conservation Laws. General Properties of one Dimensional Schrödinger Equation: bound states (discrete spectrum) and unbound states (continuous spectrum), mixed spectrum, symmetric potentials and parity, Properties of one dimensional motion. Solution of Simple One Dimensional Systems: The free particle, The step potential, The potential barrier and well, The infinite square well potential, The finite square well potential, The harmonic oscillator

Recommended Books:

1. Introductory Quantum mechanics by R.L. Liboff, Addison Wesley Publishing Company, Reading Mass. (1980 and later editions).
2. QUANTUM MECHANICS: Concepts and Applications by Nouredine Zettili, JOHN WILEY & SONS (2001 and later editions)
3. A Modern Approach to Quantum Mechanics by J.S. TownsendMcGraw Hill Book Company, Singapore (1992).
4. Quantum Mechanics: An Introduction by W. Greiner, Addison Wesley Publishing Company, Reading Mass. (1980).
5. Quantum Mechanics, Classical Results, Modern Systems and visualized Examples by Richard W. Robinett, Oxford University Press (2006).
6. Theory of Quantua by Bialynicki-Birula, M. Cieplak & J. Kaminski, Oxford University Press, New York (1992).
7. Relativistic Quantum Mechanics by W. GreinerSpringer Verlag, Berlin (1990).
8. Quantum Mechanics by F. Schwabe, Narosa Publishing House, New Delhi (1992).
9. Quantum Physics by S. Gasiorowicz, Wiley, (2003).
10. Introduction to Quantum Mechanics by David J. Griffiths PRENTICE Hall, Int., Inc, (2005).

PHYS 6105   Solid State Physics-I   Cr.H-3

Crystal structure in 2D and 3D, fundamental types of lattices, index system for crystal planes, simple crystal structures, X-ray diffraction, Braggs law, reciprocal lattice, Diffraction of waves by crystals, scattered wave amplitude, Brillouin zones, crystal binding and elastic constants, Classification of Solids, ionic crystals, covalent crystals, Ionic Radii, II-VI and III-V compounds, Molecular crystals, metals, Cohesive energy, The Lenard Jones Potential, Density, Cohesive energy and Bulk Modulus of crystalline solids, The Madelung constant, Cohesion in Covalent crystals, elastic waves in cubic crystals. Vibration of crystals with monatomic basis, two atoms per primitive basis, quantization of elastic waves, normal vibration modes and phonon, phonon momentum, inelastic scattering by phonons, Phonon heat capacity, lattice heat capacity, Einstein and Debye models. Sommerfeld model

of free electron theory, Energy levels in one dimension, free electron gas in three dimension. DC and AC electrical conductivity of metals

Recommended Books:
1. Introduction to Solid State Physics by C. Kittle, 7th Edition, John Wiley & Sons, Inc. (2005).
2. Solid state physics by Neil W. Ashecroft, N. David Mermin, CBS Publishing Asia Ltd. (2003).
3. Solid State Physics by J. S. Blakemroe, Cambridge University Press (1991).
4. Elementary solid state physics, by M. A. Omar, (2003).
5. Basic elements of crystallography by N G Szwachi and T Szwacka (2010)
6. Solid State Physics and electronics by R K Puri and V K Babbar (2007)

PHYS 6206   Modern Physics LAB   Cr.H-3

The following practical are recommended for Modern Physics LAB. Minimum numbers of practical to be performed are six**.**
- To determine the Cauchy's constants using Spectrometer.
- Measurement of Wavelength of Mercury Light using Michelson Interferometer.
- To determine the charge to mass ratio (e/m) of electron by fine beam tube method.
- Determination of Speed of Light using Optical Fiber.
- To measure Plank's constant by studying photoelectric effect.
- Characteristics of G. M tube, Radiation Detection, shielding and analysis.
- Radio Frequency Measurements (Determination of dielectric constants of solids).
- To study the characteristics of a Geiger-Muller counter and to examine the attenuations of beta particles in Al-and Pb foils.
- Measurement of the half life of a radio nuclide. To study the pulse-height as a function of the H.H.T. in a scintillation counter.
- Determination of Hg lamp spectra using HR4000 spectrometer
- Measurement of the spectrum of gama rays from a radioisotope. Shielding and attenuation of gamma rays.
- The Frank-hertz experiment (Measurement of excitation potential of Hg).
- AC circuits and dielectric constants of water and ice.
- Radio frequency measurement. Skin effect, etc.
- Experiments with transmission lines.
- Source strength of Co60 by gamma coincidence methods.
- To examine the stopping-power of various substances for thermal neutrons.
- Determination of the charge on an electron (e) by Millikan's method.
- Determination of the Rydberg constant from the spectrum of hydrogen.
- To study the Zeeman effect for a line in the spectrum of helium.
- Electron spin resonance (E.S.R.) by microwave absorption.
- The measurement of the Hall effect in germanium and silicon.
- To determine the energy gap in silicon and Germanium.

Recommended Books:
1. Experiments in Modern Physics by H.Mark and H.T. Olsono. (McGraw-Hill).
2. Experiments in Modern Physics by A.C. Melissinos. (Academic).

PHYS 7101   Statistical Mechanics   Cr.H-3

Review of thermodynamics: Mathematical formulation of first and second law of thermodynamics, Maxwell's relation, Reduction of derivatives, General conditions of equilibrium. Partition Function: Partition Function, Relations of partition function with thermodynamical variables, examples (collection of simple harmonic oscillators, Half spin paramagnet. Basic Principles of statistical Mechanics: Microscopic and macroscopic states, Phase Space, Ensemles,Liouvillie theorem, Formation of Microcanonical, Canonical and Grand canonical partition function. Maxwell distribution of molecular speed: Probability of the particle in quantum state, Density of states in k-space,single particle density of states in energy, Maxwell-Boltzman Distribution Function, Validity of Maxwell-Boltzman statistics, Evaluation of constants α and β, Maxwell Speed distribution function. Theory of ideal Fermi System: Fermi-Dirac Distribution Function, Examples of the Fermi system (free electron theory of metals, Electrons in stars, electrons in white dwarf stars). Theory of Bose System: Bos-Einstein Distribution Function, Black body radiation, the photon gas, ideal bose gas model of liquid helium, Einstein's model of vibration in a solids, Debye's model of vibration in a solids.
Advanced Topics: Fluctuations, Bose-Einstein Condensation, Introduction to density matrix approach

Recommended Books:
1. Statistical Physics by F. Mandl, ELBS/John Willey, (1998).
2. Fundamentals of Statistical and Thermal Physics by F. Reif, Mc Graw Hill, (1988).
3. Introductory Statistical Mechanics by Roger Bowley and Mariana Sanchez, (1999).
4. Statistical Mechanics by B.K. Agarwal and Melvin Eisner, John Wiley & Sons, (1988).
5. Statistical Mechanics by R.K. Pathria, Butterworth-Heinemann, (1996).
6. Introduction to statistical mechanics by SK Sinha Narosa Publishing House PVT.LTD (2007)

PHYS 7102   Atomic and Molecular Physics   Cr.H-3

The Thomson model, The Rutherford model, Alpha-Particle Scattering, Electron orbits, Sommerfeld model, Atomic Spectra of hydrogen atom, Nuclear Motion and Reduced Mass, The Correspondence principle, The Frank-Hertz and Stern-Gerlach Experiments, Quantum Theory of the Hydrogen Atom, Quantum numbers, Total Quantum numbers, Orbital Quantum number, Magnetic Quantum Number, Spin-orbit interaction, Exclusion principle, Electron configuration in many electron-atoms, Hund's rules, Coupling of angular momenta, LS-coupling, jj-coupling, Origin of Spectral lines, Selection Rules, One electron Spectra, Two-electron Spectra, Relative intensities in a multiplet, X-ray spectra. Atoms in Magnetic and Electric fields: Space quantization, Magnetic moment and Bohr Magneton, Zeeman Effect, Paschen-Back effect, Stark effect.
Molecular Physics: The chemical bond, Molecular formation, Electron sharing, The H_2 molecular ion, The linear combination of atomic orbits method, The H_2 molecule, The ionic bond, Theories of bonding, The valence-bond approach, Molecular orbits. Molecular Spectra (Diatomic Molecules): Rotational energy levels spectra, Vibrational energy levels, Vibration-Rotation spectra, Electron spectra, Dissociation energy, Pre-dissociation energy, Frank-Condon principle.

Recommended Books:
1. Atomic and Quantum Physics by H. Haken and H. C. Wolf, Springer, (1994)
2. Perspective of Modern Physics by Beiser, McGraw-Hill, (1988)
3. Spectrophysics by Anne, P. Thorn, 2nd ed. Chapman and Hall, (1988).
4. Physics of atoms and molecules by B.H. Bransden and C.J.Joachain, Longmans, London, (1983).

5. Introduction to Atomic Spectra by White McGraw-Hill, (1986)
6. Principles of Modern Physics by R. B. Leighton (Latest Ed.).
7. Fundamentals of Modern Physics by R. M. Eisberg, (John Wiley and Sons).
8. Atomic Physics, C. J. Foot, Oxford University Press, (2005).

PHYS 7103   Plasma Physics   Cr.H-3

Introduction, Occurrance of plasma. Concept of temperature. Debye shielding. The plasma parameter. Criteria for plasma. Applications of plasma physics. Single-particle motion in electromegnatic field. Uniform and nonuniform E and B fields. Time-variant E and B fields. Fluid description of plasma. Wave propagation in plasma. Derivation of dispersion relations for simple electrostatic and electromagnetic modes. Low temperature plasmas and their applications, Magnetic fusion plasmas, Laser produced plasmas, inertial confinement fusion, X-ray lasers and Particle accelerators.

Recommended Books:
1. Fundamentals of Plasma Physics, P. M. Bellan, CUP, (2004).
2. The Physics of Plasmas, T.J.M. Boyd and J.J. Sanderson, CUP, (2003).
3. Introduction to plasma Physics by R. J. Glasston and P. H. Rutherford, IOP Publishing, (1995)
4. Plasma Physics: An Introductory Course edited by R.Dendy Cambridge, Cambridge University Press, (1993)
5. J. A. Bittencourt, Fundamentals of Plasma Physics, Pergamon Press, 1986.
6. Introduction to plasma Physics and Controlled Fusion by F.F.Chen, Plenum, (1984).

PHYS 7104   Quantum Mechanics-II   Cr.H-3

Orbital angular momentum, The eigenvalues and eigen functions of L^2 and L_z, Matrix representation of angular, momentum operators, Addition of angular momenta. Schrödinger Equation in Three Dimensions (3D problems in Cartesian and Spherical coordinates), Approximate Methods (Time independent perturbation theory for non degenerate and degenerate levels, the variational method, The WKB approximation, Time dependent perturbation theory),Identical Particles and Second Quantization (Many Particles Systems, Systems of Identical Particles, The Pauli Exclusion Principle), Theory of Scattering, The Interaction of Quantum Systems with Radiation (Classical Treatment of Incident Radiation, Quantization of the electromagnetic Field, Transition Rates for Absorption and Emission of Radiation, Transition Rates within the Dipole, The Electric Dipole Selection Rules).

Recommended Books:
1. Introductory Quantum mechanics by R.L. Liboff, Addison Wesley Publishing Company, Reading Mass. (1980 and later editions).
2. QUANTUM MECHANICS: Concepts and Applications by Nouredine Zettili, JOHN WILEY & SONS (2001 and later editions)
3. A Modern Approach to Quantum Mechanics by J.S. TownsendMcGraw Hill Book Company, Singapore (1992).
4. Quantum Mechanics: An Introduction by W. Greiner, Addison Wesley Publishing Company, Reading Mass. (1980).
5. Quantum Mechanics, Classical Results, Modern Systems and visualized Examples by Richard W. Robinett, Oxford University Press (2006).
6. Theory of Quantua by Bialynicki-Birula, M. Cieplak & J. Kaminski, Oxford University Press, New York (1992).
7. Relativistic Quantum Mechanics by W. GreinerSpringer Verlag, Berlin (1990).
8. Quantum Mechanics by F. SchwableNarosa Publishing House, New Delhi (1992).
9. Quantum Physics by Gasiorowicz, John Wiley & Sons, Inc., Singapore, (2003).
10. Introduction to Quantum Mechanics by David J. Griffiths, PRENTICE Hall, Int., Inc, (2005).

PHYS 7105   Solid State Physics-II   Cr.H-3

Solid state problem, free electron approximation, density of states, Fermi Dirac distribution, **k**-space, concept of Fermi energy and the Fermi surface, free electron description of Heat capacity, electrical conductivity of metals, Hall effect, Nearly free electron model, origin of the energy gap, , Bloch functions, Concept of hole, reduced, periodic & extended zone schemes, motion of electrons in a periodic potential, crystal momentum, effective mass, physical interpretation of the effective mass, Kronig-Penney model, Calculation of band structure, Tight-Binding method, Semiconductors, intrinsic and extrinsic semiconductors, intrinsic carrier concentration, mobility, impurity conductivity donor states, acceptor states, thermal ionization of donors and acceptors, simple description of pn-junction and rectification, Transistors, Semiconductors heterostructures and outline of solid state lasers, Optical properties of solids, Diamagnetism and Paramagnetism, Larmor Diamagnetism, Pauli Paramagnetism, Conduction electrons Diamagnetism, introduction to superconductivity.

Recommended Books:
1. Introductory Solid States Physics – H. P. Myers (latest edition)
2. Solid States Physics - S.O. Pillai (2005)
3. Problem in Solid State Physics – S.O. Pillai (2005)
4. Solid States Physics – A.J. Dekkar(latest edition)
5. Solid states Physics – Wahab (2005)
6. Solid States Physics – Ibach & Luth(latest edition)
7. Solid state physics by Neil W. Ashecroft, N. David Mermin, CBS Publishing Asia Ltd. (2003)

Semester-VIII

PHYS 8101   Computational Physics   Cr.H-3

Preparatory Concepts: A brief introduction of the computer languages C++ or FORTRAN (different data types, variables and constants, selection structures, repetition structures, arrays, built in functions, user defined functions etc.) and known software packages of computation Mathematica®, MATLAB, MAPLE (only one), Numerical Techniques: Numerical Solutions of equations, Interpolation and Extrapolation, Numerical integration and differentiation and solution of differential equations. Modeling & Simulations: Basic concepts of modeling and simulation, relation between modeling and simulation. Case Study: 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 (only one).

Recommended Books:
1. Introduction to Computational Physics by M. L. De Jong,, Addison Wesley Publishing Company Inc., Massachusetts (1991).
2. C++: The Complete Reference (4th edition) by Herbert Schildt, Osborne/McGraw-Hill (2000).
3. A First Course in COMPUTATIONAL PHYSICS by Paul L. DeVries, John Wiley and Sons, Inc. (1994).
4. Computational Physics by S.T. Koonini, The Benjamin/Coming Publishing Inc., California (1986).
5. Computational Techniques in Physics by P.K. Macheown & D.J. Merman, Adm Hilger, Bristol (1987).
6. An Introduction to Computer Simulation Methods by H. Gould & J. TobochnikAddison Wesley Publishing Company, Rading Massachusetts (1988).
7. Numerical Methods for Engineers with Personal Computer Applications by S.C. Chapra & R.P. Chanle, McGraw Hill Book Company, New York (1965).
8. Schaum's Outlines of Mathematica (2nd edition) by Eugene Don, McGraw-Hill (2009).

9. Fortran 77 & Numerical Methods for Engineers & Scientists by Larry Nyhoof and Sanford Leestma, Macmillan Pub Compay, USA (1995)

PHYS 8102   Laser Physics   Cr.H-3

Introduction to Lasers, Properties of laser beam, Electromagnetic waves and photons, Energy levels, Transition and spectral lines, Spontaneous and Stimulated emission, Stimulated Absorption, Line shape function, Black-Body Radiation, Relation between Einstein *A* and *B* Coefficients, Conditions for large stimulated emissions, Gain coefficient, Threshold Gain coefficient, Line-broadening mechanism, The metastable level, Population inversion, The three and four-level system, Rate equations, Optical resonators, Conditions for steady state oscillation in a two mirror Resonator, Cavity resonance frequencies, Longitudinal and Transverse modes in a cavity, Pumping Process, Pulsed vs Continuous emission, Threshold condition and output power, Optimum output coupling, Laser tuning, Oscillation and pulsations in lasers, Q-Switching and mode-locking methods, Phase velocity, Group Velocity, Dispersion and Pulse Width, Non-linear crystals, Laser Systems (Solid state lasers, Ruby Laser, Nd:YAG and Nd:Glass lasers, Semiconductor lasers: Homojunction lasers, Double Hetrostructure lasers, Gass Lasers: Helium Neon laser, CO_2 laser, Nitrogen laser and Excimer laser, Free-Electro and X-ray lasers), Laser Applications.

Recommended Books:
1. Principles of lasers by O. Svelto, Plenum press new York & London (1992).
2. Lasers by J. Eberly and P. Milonni, Wiley, New York. (1988).
3. Quantum Optics by Scully and Zubairy, Cambridge university press (1997).
4. Lasers by A.E. SiegmanUniversity, Science Books Mill Valley, C. A. (1986).
5. Laser Theory by H. Haken, Springer, Berlin (2003).
6. Laser Fundamentals by W. T. Silfvast, Cambridge University press, (2003).
7. Understanding lasers b y J. Hecht, Howard W. Sams & Company, USA (1988).
8. Lasers, Principles and Applications by J. Wilson and J. F. B. Hawkes, Prentice Hall, New York, (1988).
9. Lasers and Electro-Optics: Fundamental and Engineering by Christopher C. Davis, Cambridge University press, (1996).

PHYS 8103   Theories of Relativity and Cosmology   Cr.H-3

Lorentz Transformations, Relativity of Simultaneity, Time Dilation (Twins Paradox), Length Contraction (Ladder Paradox), Velocity Transformation and Velocity Addition, Relativistic Mechanics, Minkowski Spacetime, Line Element, Four-Vectors, Force Equation in relativity, Rest Mass, Kinetic and Total Energy, Conservation of Energy and Momentum, Elements of Tensor Calculus, Manifolds and Coordinates, Curves and Surfaces, Tensor Fields, Lie Derivative, Geodesics, Parallel Transport, Riemann Tensor, Metric Tensor, Christoffel Symbols, General Relativity, Principles of General Relativity, Equation of Geodesics, Einstein's Field Equations, Cosmology, Newtonian Cosmology, Cosmological Redshift, Hubble's Law, The Big Bang, Expansion Rate.

Recommended Books:
1. Dynamics and Relativity by J. R. Forshaw and A. G. Smith. John Wiley and Sons (2009).
2. The Special Theory of Relativity by D. Bohm. Routledge (2009).
3. Relativity Demystified D. MacMohan Mc Graw-Hill (2006).
4. Dynamics and Relativity, by W.D.McComb, Oxford University Press, (1999).
5. Introduction to Cosmology, by J.V.Narlikar, Cambridge University Press, (1989).
6. Introducing Einstein's Relativity, by R.D.D'Inverno, Oxford University Press, (1992).
7. General Theory of Relativity by P. M. Dirac. John Wiley and Sons (1975).
8. Theory of Relativity based on Physical Reality by L. Janossy Academia Kiado, Budapest (1971).

PHYS 8104   Nuclear and Elementary Particle Physics   Cr.H-3

Nuclear Physics: Basic properties of Nucleus: Size and mass of the nucleus. Nuclear spin, magnetic dipole moment, electric quadropole moment, parity and statistics, Detectors, Passage of charged particle through matter, ionization chamber, proportional counter, scintillation counter, semi-conductor detector, emulsion technique, bubble chamber, Particle Accelerators: Linear accelerator, Van de Graff, Betatron, synchrocyclotron, proton synchrotron, Nuclear Forces, Yukawa theory, proton-proton and neutron-proton scattering, charge independence of nuclear force, isotopic spin, Liquid drop model, shell model, collective model, Conservation laws of nuclear reaction, Q-value of nuclear reaction, threshold energy, transmutation by photons, proton, deuterons and alpha particles, excited states of nucleus, energy levels, level width, Cross section from nuclear reactions, compound nucleus theory of nuclear reactions, limitation of compound nucleus theory, resonances, Breit-Wigner formula, direct reactions, theory of fission and spontaneous fission, nuclear chain reaction and applications, Thermonuclear Reactions, Fusion and thermonuclear process, energy released in nuclear fusion, formation of heavy elements, semi-carbon nitrogen cycle controlled nuclear fusion.
Elementary Particle Physics: Introduction, Fundamental Interactions, Classification of elementary particles, Parameters of elementary particles, The massless bosons, The leptons, The mesons, The baryons, The eight fold way, Quarks, colour, charm.

Recommended Books:

1. Introductory Nuclear Physics by Krane, (2008).
2. Concepts of Modern Physics by Beiser, (2002).
3.   Nuclear Physics by A.E.S Green, McGraw Hill Book Co. (1995).
4.   Nuclei and particles by E. Serge. W. A. Banjamin Inc (1977).
5. Nuclear Physics by I. Kaplan, Addison-Wesley (1980).
6. Nuclear Physics (Vol I and II) by G. Chatwal, Dominant Publisher and Distribution, (2007).
7. B. Povh, K. Rith, C. Scholtz, F. Zetsche, Particle and Nuclei, (1999).

DETAILS OF OPTIONAL COURSES

PHYS 7126   Advanced Electronics   Cr.H-3

Number Systems and Operations (Number systems their introversion) Codes (BCD,Excess-3, Gray) error detection and correction codes, Parity codes, Seven-segment Display Code
Logic Gates and Related Devices, Logic Families- significance and types, Boolean Algebra and Simplification Techniques, Combitional Logic Design, Flip-Flops , Sequential Logic Circuits (Registers and application of shift register), Ripple Counters, Synchronous Counter, Microprocessors
 Introduction to Microprocessors, Inside a Microprocessor, Arithmetic Logic Unit (ALU), Register File, Control Unit, Basic Microprocessor Instructions, Data Transfer Instructions, Arithmetic Instructions, Logic Instructions, Discussion on 8085/8088, 8086 processor family, Intel Microprocessor hierarchy, Microcontrollers, Introduction to the Microcontroller, Applications, Inside the Microcontroller, Central Processing Unit (CPU), Random Access Memory (RAM), Read Only Memory (ROM), Special-Function Registers, Peripheral Components, Microcontroller Architecture, Architecture to Access Memory, Eight-Bit Microcontrollers,-Bit Microcontrollers , 32-Bit Microcontrollers, Interfacing (Peripheral Devices with a Microcontroller, LEDs, Electromechanical Relay, Keyboards Seven-Segment Displays), Modulation, Modulation; the power spectrum in AM, the diode modulator for AM, detection of AM signals, AVC, The SSB system of modulation, the frequency spectrum, bandwidth , generation of FM and AM. The superhetrodyne receiver, a radar system. Radio communication, Production of radio transmitter block diagram. Propagation of radio waves system Formation of ionosphere layers and their variations.

Recommended Books:
1. Digital Logic and Computer Design, by Morris Mono, Prentice Hall, (1995).
2. Electronic and Radio Engineering, by F.E Terman McGraw-Hill
3. The Design of /Small-Scalle Embedded Systems by, Tim Wilmshurst, Palgrave (2003).
4. Principles and Application of Digital Electronics, by Larry D. Jones, Macmillan Publishing Company, (1993).
5. Digital system design and Micro Possessor, by J.C. BORTIE (NBF).
6. Micro Electron, by McMillan McGraw Hill.
7. Digital Electronics, by Tocheim (1999).
8. Programming and Interfacing, by Barrey B. Brey, Intel UPS Architecture Prentic Hall (1998).
9. Digital Fundamental, by T.L. Floyd, (2002).
10. Digital Logic and Computer Design, 4th Edition by Morris Mono, Prentice Hall, (2011).

PHYS 7127   Physical and Geometrical Optics   Cr.H-3

Light - A historical perspective, Production and measurement of light, Geometrical Optics, The thick lens, Cylindrical lenses and astigmatism, Aberration theory, Controlling light through optical system, Optical instruments, Light as waves, Interference phenomena, Interference applications, Polarized light, Fraunhofer diffraction, Fiber otics, Non-linear Optics.

Recommended Books:
1. Optics and Vision, by L. S. Pedrotti and F. L. Pedrotti, Prentice Hall, (1998).
2. Optics, by Eugene Hecht, Addison-Wesley, (1998).
3. Optics, by Benjamin Crowell, (2000).
4. Optics, by M. H. Freenan and C. C. Hull, Elsevier, (2003).

PHYS 7128   Physics of Nanotechnologies   Cr.H-3

Introduction: The Importance of Nanoscale, Moore's law, Nanotechnology/Top down and bottom up approaches, Advances in Nanotechnology, Advantages of nanotechnology, Future prospects in nanoscience and nanotechnology, Societal impact of nanotechnology, Thin film growth: Epitaxial growth, Thin film growth techniques : Pulsed laser deposition, Molecular beam epitaxy (MBE), Sputter deposition, Chemical vapour deposition, Electron beam evaporation (EBE) etc. Nanostructures fabrication techniques: Lithography : Mask lithography : Optical lithography, Nanoimprint, Maskless lithography : Scanning electron beam lithography, Focussed ion beam lithography, Transfer techniques : Etching, Lift-off, Nanostructures characterization techniques: Microscopy techniques : Optical microscopy (Conventional light microscopy, Fluorescence microscopy etc.), Electron microscopy (Scanning electron microscopy, Transmission electron microscopy, Focus ion beam microscopy etc.), Scanning probe microscopy (Scanning tunneling microscopy, Atomic force microscopy, Near-field scanning optical microscopy), Surface/Structural analysis : Electron techniques (Reflection high energy electron diffraction, Low energy electron diffraction, Auger electron spectroscopy etc.) and X-ray techniques (X-ray diffraction, X-ray reflectivity, X-ray photoelectron spectroscopy etc.).

Recommended Books:

1) Edward L. Wolf: Nanophysics and Nanotechnology, An introduction to Modern Concept in Nanoscience, Wiley VCH, 2004

2) Par Mark A. Ratner, Daniel Ratner, Nanotechnology: A Gentle Introduction to the Next Big Idea, Prentice Hall Professional, 2003.

3) J I Goldstein et al, Scanning Electron Microscopy and X-ray Microanalysis,Kluwer Academic/Plenum Publishers, 2003.
4) David B. Williams and C. Barry Carter, Transmission electron microscopy : a textbook for materials science, Springer US, 2nd Edition 2009.
5) Andrew Zangwil, Physics at surfaces, Cambridge University Press, NY, 1988

PHYS 8225   Advanced Electronics LAB   Cr.H-3

The following practicals are recommended for Modern Physics LAB. Minimum number of practicals to be performed is six.

- using IC's construct and study RS, JK (Master slave), T and D flip-flops.
- Design and study of a half and full adder with different Boolean expression using IC's.
- Design and study different combinational circuit(BCD adder,7-segment decoder,comparater encoder, multiplexer circuits)
- To study combinational lock and led sequencer circuits
- Synchronous and asynchronous BCD counters, memory shift register with IC's.
- Design and Study of decoder, encoder, multiplexer circuits and compare the input output waveforms.
- To construct and understand an operation of arithmetic logic unit and study of different arithmetic logic operations.
- The following practical are recommended for advanced electronics lab using 8051microcontroller and 8086 microprocessor.
  1.   Programmable peripheral interface
  2.   Graphical/Character LCD
  3.   ADC and DAC
  4   External Interrupt and Timers
  5   2-Dimensional Key Board
  6   LED and SSD display controls

PHYS 8126   Introduction to Quantum Computing   Cr.H-3

Computer technology and historical background; Basic principles and postulates of quantum mechanics: Quantum states, evolution, quantum measurement, superposition, quantization from bits to qubits, operator function, density matrix, Schrodinger equation, Schmidt decomposition, EPR and Bell's inequality; Quantum Computation: Quantum Circuits, Single qubit operation, Controlled operations, Measurement, Universal quantum gates, Single qubit and CNOT gates; Breaking unbreakable codes: Code making, Trapdoor function, One time pad, RSA cryptography, Code breaking on classical and quantum computers, Schor's algorithm; Quantum Cryptography: Uncertainty principle, Polarization and Spin basis, BB84, BB90, and Ekert protocols, Quantum cryptography with and without eavesdropping, Experimental realization; Quantum Search Algorithm.

Recommended Books:
1. Quantum Computation and Quantum Information, by M. A. Nielson and I. L. Chuang, Cambridge University Press, Cambridge 2000.
2. Exploration in Quantum Computation, by C.P. Williams and S. H. Clearwater, Springer Verlag (1997).
3. The Physics of Quantum Information: Quantum Cryptography, Quantum Teleportation, Quantum Computation, by P. Bouwmester, A. Ekert, and A. Zeilinger, Springer Verlag, Berlin, Heidelberg (2000).
4. Mathematics of Quantum Computation, by A.K.Brylinsky and G. Chen, Chapman &

Hall/CRC (2002).
5. Quantum Computing explained, by David McMahon, John Wiley & Sons (2007)

PHYS 7129   Methods of Experimental Physics   Cr.H-3

Vacuum Physics: Molecular Flow and Turbulent Flow of gases, Pumping Speed, Pump down Time, Ultimate Pressure, Vacuum Pumps, Rotary Oil pumps, Sorption pumps, Diffusion pumps, Ion pumps, Cryo pumps, Turbo Molecular pumps. Vacuums Gauges, Perini gauges, The McLoed gauges, Hot Cathode Ionization gauge, Cold Cathode Ionization gauge, Mass Spectrometers for Partial Pressure Measurements. Sensor Technology: Physical Principles of sensing, Position and Displacement sensors, Level and Thickness sensors, Velocity and Acceleration sensors, Humidity sensors, Light sensors, Temperature, Pressure, Rotation, Flow, Current, Voltage, Power, Magnetic Field, Metal Detectors, Explosive and Heat sensors.

Recommended Books:
1. Sensor Technology-Handbook by J. Wilson Elsevier (2005)
2. Methods of Experimental Physics-Vacuum Physics and Technology by G. L. Weissler, R. W. Carlson. Academic Press (1979)
3. Vacuum Technology-Practice for Scientific Instruments by N. Yoshimura Springer (2008)
4. Handbook of Vacuum Science and Technology by D. M. Hoffman, J. H. Thomas, B. Singh Elsevier (1997)
5. Vacuum and Pressure Systems-Handbook by Gast Manufacturing Inc.
6. High Vacuum Techniques by J. Yarwood, Chapman Hall, (1975).
7. A Handbook of Modern Sensors-Physics, Design and Applications, by Jacob Fraden, Springer, (2004).
8. Scientific Foundations of Vacuum Technology. Saul Dushman (2nd edition, 1962, John Wiley and Sons).

PHYS 8127   Particle Physics   Cr.H-3

Particle Classification, Quantum numbers, leptons, hadrons, baryons, mesons, quarks, The Fundamental Interactions, The electromagnetic coupling, the strong coupling, the weak coupling, Symmetry Transformation and Conservation Laws, Translation in space, rotation in space, the group SU (2), systems of identical particles, parity, iso-spin charge conjugation, time reversal, G parity, CPT theorem, The Electromagnetic Field, Gauge invariance and Maxwell's equations, polarization ad photon spin, angular momentum, parity and C parity of photon, Hadron Spectroscopy, Formation experiment, partial wave formalism and the optical theorem, the Breit-Wigner resonance formula, baryon resonances, phase space considerations, production experiments, The Quark Model, The group SU (3), quarks, hadrons baryons, mesons in quark model, heave meson spectroscopy, the quarkonium model, The Standard Model (qualitative treatment only), Unification of weak and electromagnetic interactions Glashow-Salam-Weinberg Model.

Recommended Books:
1. Relatvistic Quantum Mechanics, by Bjorken, J. D. and Drell, S.D., McGraw Hill, (1995).
2. Quarks and Leptons, by Halzen, F. and Martin, A.D., John-Wiley and Sons. (1984).
3. Quantum Mechanics, by Riazuddin and Fayyazuddin, World Scientific, (1990).
4. Introduction to Elementary Particles, by Griffiths, D., John-Wiley and Sons, (1987).

PHYS BSPr   Project   Cr.H-3