COURSES OF READING AND OUTLINE OF TESTS

BS-4 YEARS PHYSICS PROGRAM

SEMESTER SYSTEM

TO BE EFFECTIVE FROM SESSION 2013-17

SCHEME OF STUDY
BS (4 YEARS) PROGRAM IN PHYSICS

SEMESTER – I			
Course Code	**Course Title**		**Credit Hours**
ENGL 101	English – I (Functional English)	C – 1	3+0
PAKS 101	Pakistan Studies	C – 2	2+0
COMP 101	Introduction to Computers & its Applications	C – 3	3+0
MATH 101	Calculus – I	C – 4	3+0
CHEM 151	Inorganic Chemistry	G – 1	3+1
PHYS 101	Mechanics – I	F – 1	3+0
PHYS 103	Physics Laboratory – I	F – 2	0+1
		Total	**19**
SEMESTER – II			
ENGL 102	English – II (Communication Skills)	C – 5	3+0
ISLS 101	Islamic Studies	C – 6	2+0
MATH 102	Calculus – II	C – 7	3+0
CHEM 161	Organic Chemistry	G – 2	3+1
PHYS 102	Mechanics – II	F – 3	3
PHYS 104	Waves & Oscillations	F – 4	3
PHYS 106	Physics Laboratory – II	F – 5	1
		Total	**19**
SEMESTER – III			
ENGL 201	English – III (Report Writing)	C – 8	3+0
MATH 201	Calculus – III	G – 3	3+0
CHEM 271	Physical Chemistry	G – 4	3+1
EDUC 111	Teaching and Learning	G – 5	3+0
PHYS 201	Electricity & Magnetism – I	F – 6	3+0
PHYS 203	Physics Laboratory – III	F – 7	0+1
		Total	**17**
SEMESTER – IV			
XXXX-xxx	English IV/U.O/Any foreign language	C - 9	3+0
CHEM 210	Analytical Chemistry	G – 6	2+0
PHYS 204	Heat & Thermodynamics	F – 8	3+0
PHYS 206	Electricity & Magnetism – II	F – 9	3+0
PHYS 208	Modern Physics & Electronics	F – 10	3+0
PHYS 210	Physics Laboratory – IV	F – 11	0+1
		Total	**15**
SEMESTER – V			
PHYS 301	Mathematical Methods of Physics – I	M – 1	3+0
PHYS 303	Quantum Mechanics – I	M – 2	3+0
PHYS 305	Classical Mechanics	M – 3	3+0
PHYS 307	Computational Physics	M – 4	2+1
PHYS 309	Analog Electronics – I	M – 5	3+0
PHYS 311	Laboratory (Spectroscopy & Modern Physics)	M – 6	2+0
		Total	**17**
SEMESTER – VI			
PHYS 302	Mathematical Methods of Physics – II	M – 7	3+0
PHYS 304	Quantum Mechanics – II	M – 8	3+0
PHYS 306	Thermal & Statistical Physics	M – 9	3+0
PHYS 308	Optics	F – 12	3+0
PHYS 310	Analog Electronics – II	M – 11	3+0
PHYS 312	Laboratory (Analog Electronics)	M – 12	0+2
		Total	**17**
SEMESTER – VII			
MNGT 112	Entrepreneurship	G – 7	3+0
PHYS 401	Nuclear Physics	M – 13	3+0
PHYS 403	Solid State Physics – I	M – 14	3+0
PHYS 405	Electromagnetic Theory – I	M – 15	3+0
PHYS 4XX	Elective – I** (Digital Electronics-I)	E – 1	3+0
PHYS 4XX	Elective – III** (Digital Electronics Laboratory)	E – 2	0+2
		Total	**17**
SEMESTER – VIII			
MNGT 111	Human Resource Management	G – 8	3+0
PHYS 402	University Option/Laser	F – 12	3+0
PHYS 404	Solid State Physics – II	M – 16	3+0
PHYS 406	Electromagnetic Theory – II	M – 17	3+0
PHYS 4XX	Elective – II** (Digital Electronics-II)	E – 3	3+0
PHYS 4XX	Elective – IV** (Project)	E – 4	0+2
		Total	**17**

Total Credit Hours = 138
General Courses = 8/7–8
Major Courses = 17/11–13

Compulsory Courses = 9/9
Foundation Courses = 12/9–10
Elective Courses = 4/4

LIST OF COURSES
ACCORDING TO HEC TEMPLATE

COMPULSORY COURSE				
Sr. No.	**Course Code**	**Course Title**	**Credit Hours**	**Semester in which course is being offered.**
C-1	ENGL 101	English-I (Functional English)	3+0	I
C-2	PAKS 101	Pakistan Studies	2+0	I
C-3	COMP 101	Introduction to Computers & its Applications	3+0	I
C-4	MATH 101	Calculus-I	3+0	I
C-5	ENGL 102	English-II (Communication Skills)	3+0	II
C-6	ISLS 101	Islamic Studies	2+0	II
C-7	MATH 102	Calculus-II	3+0	II
C-8	ENGL 201	English-III(Report Writing)	3+0	III
C-9	XXXX-xxx	Languages (Foreign/National/Regional)	3+0	IV

GENERAL COURSES (RELATED FACULTY)				
Sr. No.	**Course Code**	**Course Title**	**Credit Hours**	**Semester in which course is being offered.**
GRF-1	CHEM 151	Inorganic Chemistry	3+1	I
GRF-2	CHEM 161	Organic Chemistry	3+1	II
GRF-3	MATH 201	Calculus-III	3+0	III
GRF-4	CHEM 271	Physical Chemistry	3+1	III
GRF-5	CHEM 210	Analytical Chemistry	2+0	IV

GENERAL COURSES (OTHER FACULTY)				
Sr. No.	**Course Code**	**Course Title**	**Credit Hours**	**Semester in which course is being offered.**
GOF-1	EDUC 111	Teaching and Learning	3+0	III
GOF-2	MNGT 112	Entrepreneurship	3+0	VII
GOF-3	MNGT 111	Human Resource Management	3+0	VIII

FOUNDATION COURSE				
Sr. No.	**Course Code**	**Course Title**	**Credit Hours**	**Semester in which course is being offered.**
F-1	PHYS 101	Mechanics-I	3+0	I
F-2	PHYS 103	Physics Laboratory-I	0+1	I
F-3	PHYS 102	Mechanics-II	3+0	II
F-4	PHYS 104	Waves & Oscillations	3+0	II
F-5	PHYS 106	Physics Laboratory-II	0+1	II
F-6	PHYS 201	Electricity & Magnetism-I	3+0	III
F-7	PHYS 203	Physics Laboratory-III	0+1	III
F-8	PHYS 204	Heat & Thermodynamics	3+0	IV
F-9	PHYS 206	Electricity & Magnetism-II	3+0	IV
F-10	PHYS 208	Modern Physics & Electronics	3+0	IV
F-11	PHYS 210	Physics Laboratory-IV	0+1	IV
F-12	PHYS 308	Optics	3+0	VIII
F-13	PHYS 402	Lasers	3+0	VI

MAJOR COURSES				
Sr. No.	**Course Code**	**Course Title**	**Credit Hours**	**Semester in which course is being offered.**
M-1	PHYS 301	Mathematical Methods of Physics-I	3+0	V
M-2	PHYS 303	Quantum Mechanics-I	3+0	V
M-3	PHYS 305	Classical Mechanics	3+0	V
M-4	PHYS 307	Computational Physics	2+1	V
M-5	PHYS 309	Analog electronics-I	3+0	V
M-6	PHYS 311	Laboratory (Spectroscopy & Modern Physics)	0+2	V
M-7	PHYS 302	Mathematical Methods of Physics-II	3+0	VI
M-8	PHYS 304	Quantum Mechanics-II	3+0	VI
M-9	PHYS 306	Thermal & Statistical Physics	3+0	VI
M-10	PHYS 310	Analog Electronics-II	3+0	VI
M-11	PHYS 312	Laboratory (Analog Electronics)	0+2	VI
M-12	PHYS 401	Nuclear Physics	3+0	VII
M-13	PHYS 403	Solid State Physics-I	3+0	VII
M-14	PHYS 405	Electromagnetic Theory-I	3+0	VII
M-15	PHYS 404	Solid State Physics-II	3+0	VIII
M-16	PHYS-406	Electromagnetic Theory-II	3+0	VIII

LIST OF ELECTIVE PAPERS

PHY 4XX Elective Papers

Note:- Any suitable combination of courses comprising 12 credit hours could be opted with the permission of the Chairman and subject to the availability of experts.

OPTION-A (ADVANCED ELECTRONICS) (12 Cr. Hours)

PHYS-421	Paper A-I	Digital Electronics-I	(3 Cr. Hours)
PHYS-422	Paper A-II	Digital Electronics-II	(3 Cr. Hours)
PHYS-424	Paper A-III	Digital Electronics Laboratory.	(3 Cr. Hours)
PHYS-426	Paper A-IV	Project	(3 Cr. Hours)

OPTION-B (INSTRUMENTATION) (12 Cr. Hours)

PHYS-431	Paper B-I	Digital Computer Logic Design & Analysis	(3 Cr. Hours)
PHYS-433	Paper B-II	Instrumentation-I	(3 Cr. Hours)
PHYS-432	Paper B-III	Instrumentation-II	(3 Cr. Hours)
PHYS-434	Paper B-IV	DLD and Instrumentation Laboratory.	(3 Cr. Hours
PHYS-436	Paper B-V	Project	(3 Cr. Hours)

OPTION-C (SOLID STATE PHYSICS) (12 Cr. Hours)

PHYS-441	Paper C-I	Special Solid State Physics-I	(3 Cr. Hours)
PHYS-442	Paper C-II	Special Solid State Physics-II	(3 Cr. Hours)
PHYS-443	Paper C-III	Special Solid State Physics-III	(3 Cr. Hours)
PHYS-444	Paper C-IV	Laboratory.	(3 Cr. Hours)
PHYS-446	Paper C-V	Project	(3 Cr. Hours)
PHYS-448	Paper C-VI	Thesis.	(6 Cr. Hours)

OPTION-D (LASER PHYSICS) (12 Cr. Hours)

PHYS-451	Paper D-I	Opto-Electronics and Lasers.	(3 Cr. Hours)
PHYS-452	Paper D-II	Semiconductor Laser Devices	(3 Cr. Hours)
PHYS-454	Paper D-III	Laboratory	(3 Cr. Hours)
PHYS-456	Paper D-IV	Project	(3 Cr. Hours)
PHYS-458	Paper D-V	Thesis	(6 Cr. Hours)

OPTION-E (NUCLEAR/RADIATION PHYSICS) (12 Cr. Hours)

PHYS-461	Paper E-I	Radiation Physics.	(3 Cr. Hours)
PHYS-462	Paper E-II	Solid State Nuclear Track Detection	(3 Cr. Hours)
PHYS-464	Paper E-III	Radiation Detection & Measurement Laboratory	(3 Cr. Hours)
PHYS-466	Paper E-IV	Project	(3 Cr. Hours)
PHYS-468	Paper E-V	Thesis	(6 Cr. Hours)

OPTION-F (MATERIALS SCIENCE) (12 Cr. Hours)

PHYS-470	Paper F-I	Thermodynamics and Thermal Properties	(3 Cr. Hours)
PHYS-471	Paper F-II	Ceramics, Polymers & Composite Materials	(3 Cr. Hours)
PHYS-472	Paper F-III	Mechanical Properties and Strength of Materials-I	(3 Cr. Hours)
PHYS-473	Paper F-IV	Mechanical Properties and Strength of Materials-II	(3 Cr. Hours)
PHYS-474	Paper F-V	Solid State Reactions and Materials Technology	(3 Cr. Hours)
PHYS-475	Paper F-VI	Material Science Laboratory	(3 Cr. Hours)
PHYS-476	Paper F-VII	Project	(3 Cr. Hours)
PHYS-478	Paper F-VIII	Thesis	(6 Cr. Hours)
PHYS-477	Paper F-IX	Amorphous & Polycrystalline Materials	(3 Cr. Hours)
PHYS-479	Paper F-X	Physics of Magnetic Oxides	(3 Cr. Hours)

OPTION-G (MEDICAL PHYSICS)			**(12 Cr. Hours)**
PHYS-481	Paper G-I	Medical Physics-I	(3 Cr. Hours)
PHYS-482	Paper G-II	Medical Physics-II	(3 Cr. Hours)
PHYS-483	Paper G-III	Biophysics	(3 Cr. Hours)
PHYS-484	Paper G-IV	Medical Physics Laboratory	(3 Cr. Hours)
PHYS-486	Paper G-V	Project	(3 Cr. Hours)
PHYS-488	Paper G-VI	Thesis	(6 Cr. Hours)

LIST OF ADDITIONAL ELECTIVE COURSES

PHYS-491	Plasma Physics	(3 Cr. Hours)
PHYS-492	Surface Physics	(3 Cr. Hours)
PHYS-493	Fluid Dynamics	(3 Cr. Hours)
PHYS-494	Methods of Experimental Physics	(3 Cr. Hours)
PHYS-495	Environmental Physics	(3 Cr. Hours)
PHYS-496	Introduction to Quantum Computing	(3 Cr. Hours)
PHYS-497	Particle Physics	(3 Cr. Hours)
PHYS-498	Computer Simulation	(3 Cr. Hours)
PHYS-499	Experimental Nuclear Physics	(3 Cr. Hours)
PHYS-490	Relativity and Cosmology	(3 Cr. Hours)

LIST OF LANGUAGES

Any one language from option A,B and C can be selected in consultation with the course coordinator subject to the availability of experts.

Option-A (Foreign)

ARAB-xxx	Arabic	(3 Cr. Hours)
XXXX-xxx	Persian	(3 Cr. Hours)
XXXX-xxx	Hindi	(3 Cr. Hours)
XXXX-xxx	French	(3 Cr. Hours)
XXXX-xxx	German	(3 Cr. Hours)
XXXX-xxx	Chinese	(3 Cr. Hours)
XXXX-xxx	Japanese	(3 Cr. Hours)
XXXX-xxx	Russian	(3 Cr. Hours)

Option-B (National)

Only for foreign students.

URDU -xxx	Urdu	(3 Cr. Hours)

Option-C (Regional)

Any one Regional Languages of Pakistan other than mother tongue.

XXXX-xxx	Punjabi	(3 Cr. Hours)
XXXX-xxx	Pushto	(3 Cr. Hours)
XXXX-xxx	Sindhi	(3 Cr. Hours)
XXXX-xxx	Balochi	(3 Cr. Hours)
XXXX-xxx	Kashmiri	(3 Cr. Hours)
XXXX-xxx	Brohi	(3 Cr. Hours)
XXXX-xxx	Siraiki	(3 Cr. Hours)
XXXX-xxx	Hindkoh	(3 Cr. Hours)

COURSE OUTLINE

OF

COMPULSORY COURSES

FOR

BS – 4 YEARS PROGRAM

IN PHYSICS

Course Title: English – I (Functional English) **Credit Hours:** 03
Course Code: ENGL – 101 **Course Type:** Compulsory-1

Objectives:

- Enhance language skills and develop critical thinking.

Course Contents:

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 019 435405 7 Pages 20-27 and 35-41.
4) Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression
5) 1992. ISBN 0 19 453402 2

Course Title: Pakistan Studies **Credit Hours:** 02
Course Code: PAKS – 101 **Course Type:** Compulsory-2

Objectives

- Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan.
- Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Course Outline

Historical Perspective: (a) Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah. (b) Factors leading to Muslim separatism. (c) People and Land, (i) Indus Civilization, (ii) Muslim advent (iii) Location and geo-physical features.

Government and Politics in Pakistan: Political and constitutional phases: (a) 1947-58, (b) 1958-71 (c) 1971-77 (d) 1977-88 (e) 1988-99(f) 1999 onward

Contemporary Pakistan: (a) Economic institutions and issues, (b) Society and social structure, (c) Ethnicity, (d) Foreign policy of Pakistan and challenges, (e) Futuristic outlook of Pakistan

Books Recommended

1) Burki, Shahid Javed. *State & Society in Pakistan*, The Macmillan Press Ltd 1980.
2) Akbar, S. Zaidi. *Issue in Pakistan's Economy.* Karachi: Oxford University Press, 2000.
3) S.M. Burke and Lawrence Ziring. Pakistan's Foreign policy: Historical analysis. Karachi: Oxford University Press, 1993

4) Mehmood, Safdar. *Pakistan Political Roots & Development.* Lahore, 1994.
5) Wilcox, Wayne.*The Emergence of Banglades.,* Washington: American Enterprise, Institute of Public Policy Research, 1972.
6) Mehmood, Safdar. *Pakistan Kayyun Toota,* Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7) Amin, Tahir. *Ethno - National Movement in Pakistan,* Islamabad: Institute of Policy Studies, Islamabad.
8) Ziring, Lawrence. *Enigma of Political Development.* Kent England: WmDawson & sons Ltd, 1980.
9) Zahid, Ansar. *History & Culture of Sindh.* Karachi: Royal Book Company, 1980.
10) Afzal, M. Rafique. *Political Parties in Pakistan,* Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11) Sayeed, Khalid Bin. *The Political System of Pakistan.* Boston: Houghton Mifflin, 1967.
12) Aziz, K.K. *Party, Politics in Pakistan,* Islamabad: National Commission on Historical and Cultural Research, 1976.
13) Muhammad Waseem, Pakistan Under Martial Law, Lahore: Vanguard, 1987.
14) Haq, Noor ul. *Making of Pakistan: The Military Perspective.* Islamabad: National Commission on Historical and Cultural Research, 1993.

Course Title: Introduction to Computers **Credit Hours:** 03
Course Code: COMP – 101 **Course Type:** Compulsory-3
Objectives

Course Contents:
Computer (Definition), Function of computer in different fields, what is Soft copy and what is Hard copy. Types of Computers, processing cycle of computer, definition of Hardwar and Software, Input and output Devices of computer, system of software, application of software & Customized software, MS-Word: Word processing, Assignment making, MS-Power Point, Presentation making.

Laboratory:
General introduction of Computer, Downloading of Software, MS-Power Point and MS-Word student were assigned to write their C.V. using MS-Word. Spreadsheet, Database applications, Multimedia applications, Business applications, Tools of Statistical analyzing using computer, Lab: Spreadsheet Description, Quiz and students were assigned to the presentations. Presentation Topic 1: Internet, history of Internet ARPA'S Net, topic 2: Internet Explorer, Different Web browser E-mail, topic3: Payroll, payroll in Finance, topic 4: Payroll in HR, topic 5: Virus (Computer), types of virus, topic 6: production and Accounts, topic 7: Multimedia applications, topic 8: power point, topic 9: Business applications topic, 10: Market planning, topic 11: application Software, Quiz of presentations, review of the whole course

Course Title: Calculus - I **Credit Hours:** 03
Course Code: MATH – 101 **Course Type:** Compulsory-4
Prerequisite(s): Mathematics at intermediate level
Objectives:
This is the first course of the basic sequence, Calculus I-III, serving as the foundation of advanced subjects in all areas of mathematics. The sequence, equally, emphasizes basic concepts and skills needed for mathematical manipulation. Calculus I & II focus on the study of functions of a single variable.

Course Outline:
Limits and continuity; derivative of a function and its applications; optimization problems; mean value theorem (Taylor's theorem and the infinite Taylor series with applications) and curve sketching; anti-derivative and integral; definite integral and applications; the fundamental theorem of calculus; inverse functions (Chapters 1-6 of the text)

Recommended Books:
1. Anton H, Bevens I, Davis S, *Calculus: A New Horizon* (8th edition), 2005, John Wiley, New York
2. Stewart J, *Calculus* (3rd edition), 1995, Brooks/Cole (suggested text)
3. Thomas GB, Finney AR, *Calculus* (11th edition), 2005, Addison-Wesley, Reading,Ma, USA

Course Title: English – II (Communication Skills) **Credit Hours:** 03
Course Code: ENGL – 102 **Course Type:** Compulsory-5

Objectives:

- Enable the students to meet their real life communication needs.

Course Contents

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 019 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.

Course Title: Islamic Studies **Credit Hours:** 02
Course Code: ISLS – 101 **Course Type:** Compulsory-6

Objectives

- This course is aimed at:
- To provide Basic information about Islamic Studies
- To enhance understanding of the students regarding Islamic Civilization
- To improve Students skill to perform prayers and other worships
- To enhance the skill of the students for understanding of issues related to faith and religious life.

Introduction to Quranic Studies: Basic Concepts of Quran, History of Quran, Uloom-ul –Quran

Study of Selected Text of Holly Quran: Verses of Surah Al-Baqra Related to Faith(Verse No-284-286), Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18), Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11), Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77), Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154)

Study of Sellected Text of Holly Quran: Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.), Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment, Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14)

Seerat of Holy Prophet (S.A.W) I: Life of Muhammad Bin Abdullah (Before Prophet Hood), Life of Holy Prophet (S.A.W) in Makkah, Important Lessons Derived from the life of Holy Prophet in Makkah

Seerat of Holy Prophet (S.A.W) II: Life of Holy Prophet (S.A.W) in Madina, Important Events of Life Holy Prophet in Madina, Important Lessons Derived from the life of Holy Prophet in Madina

Introduction To Sunnah: Basic Concepts of Hadith, History of Hadith, Kinds of Hadith, Uloom –ul-Hadith, Sunnah & Hadith, Legal Position of Sunnah

Selected Study from Text of Hadith

Introduction to Islamic Law & Jurisprudence: Basic Concepts of Islamic Law & Jurisprudence, History & Importance of Islamic Law & Jurisprudence, Sources of Islamic Law & Jurisprudence, Nature of Differences in Islamic Law, Islam and Sectarianism

Islamic Culture & Civilization: Basic Concepts of Islamic Culture & Civilization, Historical Development of Islamic Culture & Civilization, Characteristics of Islamic Culture & Civilization, Islamic Culture & Civilization and Contemporary Issues

Islam & Science: Basic Concepts of Islam & Science, Contributions of Muslims in the Development of Science, Quranic & Science

Islamic Economic System: Basic Concepts of Islamic Economic System, Means of Distribution of wealth in Islamic Economics, Islamic Concept of Riba, Islamic Ways of Trade & Commerce

Political System of Islam:

Basic Concepts of Islamic Political System, Islamic Concept of Sovereignty, Basic Institutions of Govt. in Islam

Islamic History: Period of Khlaft-E-Rashida, Period of Ummayyads, Period of Abbasids

Social System of Islam: Basic Concepts Of Social System Of Islam, Elements Of Family, Ethical Values Of Islam

Reference Books:

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

Course Title: Calculus – II **Credit Hours:** 03

Course Code: MATH – 102 **Course Type:** Compulsory-7

Prerequisite(s): Calculus I

Objectives:

This is the second course of the basic sequence Calculus I-III serving as the foundation of advanced subjects in all areas of mathematics. The sequence, equally, emphasizes basic concepts and skills needed for mathematical manipulation. As continuation of Calculus I, it focuses on the study of functions of a single variable.

Course Outline:

Continuation of Calculus I: Techniques of integration; further applications of integration; parametric equations and polar coordinates; sequences and series; power series representation of functions (Chapters 7-10 of the text)

Recommended Books:

1. Anton H, Bevens I, Davis S, *Calculus: A New Horizon* (8th edition), 2005, John Wiley, New York
2. Stewart J, *Calculus* (3rd edition), 1995, Brooks/Cole (suggested text)
3. Thomas GB, Finney AR, *Calculus* (11th edition), 2005, Addison-Wesley, Reading,Ma, USA

Course Title: English – III (Technical Writing & Presentation Skills) **Credit Hours:** 03
Course Code: ENGL – 201 **Course Type:** Compulsory-8
Objectives:

- Enhance language skills and develop critical thinking

Course Contents:
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, Progress report writing
Note: Extensive reading is required for vocabulary building
Recommended books:

1) Technical Writing and Presentation Skills, Essay Writing and Academic Writing
2) Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
3) College Writing Skills by John Langan. Mc-Graw Hill Higher Education. 2004.
4) Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.
5) Presentation Skills, Reading
6) The Mercury Reader. A Custom Publication. Compiled by norther Illinois University. General Editiors: Janice
7) Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students)

Course Title: English – IV/ University Option/Language(Foreign/National/Regional) **Credit Hours:** 03
Course Code: XXX – xxx **Course Type:** Compulsory-9

COURSE OUTLINE

OF

GENERAL COURSES

FOR

BS – 4 YEARS PROGRAM

IN PHYSICS

Course Title: Inorganic Chemistry **Credit Hours:** 03
Course Code: CHEM – 151 **Course Type:** General-1

Objectives

The program is aimed that the student should learn:

- The Development of periodic law and properties of elements in a systematic way
- The principal of chemical bonding
- Chemistry of acid and bases
- Chemistry of p-block Elements

The Periodic Law and Periodicity: Development of Periodic Table; Classification of elements based on *s, p, d* and *f* orbitals, group trends and periodic properties in *s, p, d* and *f* block elements, i.e., atomic radii, ionic radii, ionization potential, electron affinities, electronagetivities and redox potential.

Principles of Chemical Bonding: Types of chemical bonding; ionic bonding; the localized bond approach: VB theory, hybridization and resonance; the delocalized approach to bonding: molecular orbital theory as applied to diatomic and polyatomic molecules, three center bonds, bonding theory of metals and intermetallic compounds; conductors, insulators and semiconductors; bonding in electron deficient compounds; hydrogen bonding.

Acids and Bases: Concepts of acids and bases including SHAB concept, relative strength of acids and bases, significance of pH, pKa, pKb and buffer solutions. Theory of Indicators, solubility, solubility product, common ion effect and their industrial applications

Chemistry of p-block Elements: Chemistry and structure of *p*-block elements; main emphasis on the chemistry and structure of noble gases and their compounds, chemistry and structure of interhalogens, pseudohalogens and
polyhalides. Prediction of shapes of molecules using VSEPR model and hybridization

PRACTICALS (CHEM-151, 1-Credit Hour)

Laboratory Ethics and safety measures:

Awareness about the toxic nature of chemicals and their handling, cleaning of glassware, safe laboratory operations

Qualitative analysis:

Analysis of four ions (two anions and two cations) from mixture of salts

Quantitative analysis:

Laboratory work illustrating topics covered in the lecture of

Recommended Books:

1. Huheey, J. E., Keiter, E. A. and Keiter, R. L., "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Ed., Harper and Row, New York, 2001
2. Cotton, F. A., Wilkinson, G. and Gaus, P. L., "Basic Inorganic Chemistry", 3rd Ed., Wiley, New York, 1995
3. Clyde Day, M. & Selbin, J., "Theoretical Inorganic Chemistry", 2nd Ed., Van Nustrand Reinhold, 1969
4. Lee, J.D., "Concise Inorganic Chemistry", Chapman and Hall, 5th Edition,1996
5. Shriver, D. F., Atkins, P. W. and Langford, C. H., "Inorganic Chemistry", Oxford University Press, 2nd Edition, 1994
6. Bassette, J., Denney, G. H. and Mendham, J., "Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis" English Language Book Society, 4th Edition, 1981
7. Vogel, A. I., "A Textbook of Micro and Semi-micro Qualitative Inorganic Analysis" Longman Green & Co. 1995

Course Title: Organic Chemistry **Credit Hours:** 03+1
Course Code: CHEM – 161 **Course Type:** General-2

Objectives

Introduction to Organic Chemistry: Organic chemistry-the chemistry of carbon compounds; the nature of organic chemistry-a historical perspective.

Chemical Bonding and Properties of Organic Molecules: Localized and delocalized chemical bonding; concept of hybridization leading to bond angles, bond lengths, bond energies and shape of

organic molecules; dipole moment; inductive and field effects; resonance; aromaticity; tautomerism; hyperconjugation; hydrogen bonding; acids and bases; factors affecting the strengths of acids and bases.

Classes and Nomenclature of Organic Compounds: Classification of organic compounds; development of systematic nomenclature of organic compounds; IUPAC nomenclature of hydrocarbons and heteroatom functional groups.

Functional Group Chemistry: A brief introduction to the chemistry of hydrocarbons, alkyl halides, alcohols, phenols, ethers, aldehydes, ketones, amines, and carboxylic acids and their derivatives.

Recommended Literature

(Latest available editions of the following books)

1. Clayden, J., Greeves, N., Warren, S. and Wothers, P., "Organic Chemistry", Oxford University Press, New York.
2. Loudon, G. M., "Organic Chemistry", Oxford University Press, New York
3. Sorrell, T. N., "Organic Chemistry", Viva Books Private Ltd., New Delhi.
4. Finar, I. L., "Organic Chemistry", Vol. 1, Pearson Education, Delhi.
5. Carey, F. A., "Organic Chemistry", McGraw-Hill, New York.
6. Ahluwalia, V. K. and Goyal, M., "A Text Book of Organic Chemistry", Narosa Publishing House, New Delhi
7. March, J., "Advanced Organic Chemistry", John Wiley & Sons, New York.
8. Bansal, R. K., "Organic Reaction Mechanisms", Tata McGraw-Hill Publishing Company Ltd., New Delhi.
9. Pine, S. H., "Organic Chemistry", National Book Foundation, Islamabad.
10. Bailey Jr., P. S. and Bailey, C. A., "Organic Chemistry-A Brief Survey of Concepts and Applications", Prentice-Hall, New Jersey.

Supplementary Literature

(Latest available editions of the following books)

1. Morrison, R. T. and Boyd, R. N., "Organic Chemistry", Prentice-Hall of India, New Delhi.
2. Carey, F. A. and Sundberg, R. J., "Advanced Organic Chemistry Part A: Structure and Mechanisms", Kluwer Academic /Plenum Publishers, New York.
3. Sykes, P., "A Guide Book to Mechanism in Organic Chemistry", Longman, London.
4. Hand, C. W. and Blewitt, H. L., "Acid-Base Chemistry", Macmillan Publishing Company, New York.
5. McMurry, J., "Organic Chemistry", Brooks/Cole Publishing Company, California.
6. Solomons, T. W. G. and Fryhle, C. B., "Organic Chemistry", John Wiley & Sons, New York.
7. Panico, R., Powell, W. H. and Richer, J. C., "A Guide to IUPAC Nomenclature of Organic Compounds", Jain-Interscience Press,Delhi.
8. Streitwieser Jr., A. and Heathcock, C.H., "Introduction to Organic Chemistry", Macmillan Publishing Company, New York.
9. Fox, M. A. and Whitesell, J. K., "Organic Chemistry", Jones and Bartlett Publishers, London.

PRACTICAL (CHEM-16,11-Credit Hour)

Laboratory work illustrating topics covered in the lecture of Chem-161

Course Title: Calculus – III **Credit Hours:** 03

Course Code: MATH – 201 **Course Type:** General-3

Prerequisite(s): Calculus II

Objectives:

This is the third course of the basic sequence Calculus I-III serving as the foundation of advanced subjects in all areas of mathematics.

Course Outline:

This course covers vectors and analytic geometry of 2 and 3 dimensional spaces; vector- valued functions and space curves; functions of several variables; limits and continuity; partial derivatives; the chain rule; double and triple integrals with applications; line integrals; the Green theorem; surface area and surface integrals; the Green, the divergence and the Stokes theorems with applications (Chapters 11-14 of the text)

Recommended Books:

1. Anton H, Bevens I, Davis S, *Calculus: A New Horizon* (8th edition), 2005, John Wiley, New York
2. Stewart J, *Calculus* (3rd edition), 1995, Brooks/Cole (suggested text)
3. Thomas GB, Finney AR, *Calculus* (11th edition), 2005, Addison-Wesley, Reading,Ma, USA

Course Title: Physical Chemistry **Credit Hours:** 03+1
Course Code: CHEM – 271 **Course Type:** General-4

Physical States of Matter:
Ideal and real gases, equations of state, critical phenomenon and critical constants. Molecules in motion: collision diameter and mean free path. Physical properties of liquids: surface tension, viscosity, refractive index etc. and their applications. Brief account of interactions among the molecules in liquids. Packing of atoms in solids. Unit cells and crystal systems. Method of crystal structure analysis. Brief account of polymers and composite materials with special emphasis on superconductors, semi-conductors etc. Introduction to plasma

Chemical Thermodynamics:
Laws of thermodynamics and their applications. Thermodynamic functions: internal energy, enthalpy, entropy and free energy. Relation between thermodynamic functions. van't Hoff's equation. Heat capacities, concept of entropy and probability.

Chemical Kinetics:
Rate of reaction. Rate law, order and molecularity of the reactions. Zero, first and second order reactions. Determination of reaction order and its rate constant. Effect of temperature on the reaction rate. Concepts of chemical equilibrium. Le-Chatelier's principle and its applications. Elementary concepts underlying complex and fast reactions.

Solution Chemistry:
Ideal and non-ideal solutions. Raoult's and Henery's laws and their applications. Molecular interactions in solutions. Colligative properties. Distillation and concept of azeotropic mixture.

Surface Chemistry:
Concept of interfaces. Adsorption and adsorption isotherms: Freundlich and Langmuir adsorption isotherms. Catalysis, colloids emulsion and their industrial applications.

Electrochemistry:
Basic concepts of electrochemistry. Ions in solution. Measurement of conductance and Kohlrausch's law. Debye-Hueckel theory and activity coefficient. Application of conductance measurement. Electrode potential. Electrochemical cell. Application of electrode potential

Practicals (Chem-171) (1-Cr. Hr.)
- Determination of viscosity and parachor values of liquids.
- Determination of percent composition of liquid solutions viscometrically.
- Determination of refractive index and molar refractivity.
- Determination of percent composition of liquid solutions by refractive index measurements.
- Determination of molecular weight of a compound by elevation of boiling point (ebullioscopic method).
- Determination of molecular weight of a compound by lowering of freezing point (cryoscopic method).
- Determination of heat of solution by solubility method.
- Determination of heat of neutralization of an acid with a base.
- Kinetic study of acid catalyzed hydrolysis of ethyl acetate.
- Determination of partition coefficient of a substance between two immiscible liquids.

Books Recommended (Theory)

1. Alberty R. "Physical Chemistry" 17th ed., John Wiley and Sons (1987).
2. Atkins, P.W. "Physical Chemistry" 6th ed., W.H. Freeman and Co. New York (1998).
3. Laidler K.J. "The World of Physical Chemistry" 1st ed., Oxford University Press (1993).
4. Laidler K.J., John H.M. and Bryan C.S. "Physical Chemistry" 4th ed., Houghton Mifflin Publishing Company Inc.(2003).
5. Peter P.A. "Chemical Thermodynamics" Oxford University Press (1983).
6. Brain S.E. "Basic Chemical Thermodynamics" 4th ed., E.L.B.S. Publishers (1990).
7. Barrow G.M. "Physical Chemistry" 5th ed., McGraw Hill (1992).

Books Recommended (Practicals)

1. Jaffar M. "Experimental Physical Chemistry" University Grants Commission (1989).
2. Levitt B.P. "Findlay's Practical Physical Chemistry" 9th ed., Longman Group Limited (1978).
3. Shoemaker D. "Experiments in Physical Chemistry" 5th ed., McGraw Hill Publishing Company Limited (1989).

Course Title: Teaching & Learning Strategies **Credit Hours:** 03
Course Code: EDUC – 111 **Course Type:** General-5

Objectives:

After studying this course, the students will be able to:

- Examine the role of teacher
- Generate awareness of the different classroom teaching-learning strategies
- Use various teaching learning strategies for effective classroom learning
- Develop appropriate lesson plan according to the nature of the subject matter
- Use various teaching aids for effective teaching learning activities
- Assess students learning in the class and improve his/her teaching in the light of feedback

Course Contents:

Teacher's Role in Conducive Learning Environment:

Facilitator, Guide/Counselor, Instructor, Leader

Approaches to Teaching:

Teacher – led Approaches, Lecture, Demonstration, Lecture – cum – Demonstration, Child-centered approaches, Group Work/Discussion, Inquiry (Problem solving, discovery), Use of ICT, Questioning

Planning and Managing Teaching:

Need for Planning, Daily, Weekly and yearly plans, Lesson planning, Effective lesson presentation strategies

Use of Teaching Aids:

Role of teaching aids in classroom teaching-learning process, Selection and use of appropriate teaching aids, Kinds of teaching aids, Electronic (Radio, TV, Projectors, and Computers), Non-Electronic (Boards, Charts, Models, Posters, etc.), Print (Books, Journals, Newspapers and Magazines, etc.)

Techniques of Assessing Students Learning:

Classroom observations (Checklist/Rating scales), Portfolio, Anecdotal record

Recommended Books:

1. Ornstein A.C. "Strategies for effective teaching" (1990) Harper Collins
2. Child-Centered Curriculum (Unit III), Children Resources International (2004) Islamabad
3. Assessing Children's Development through Observations (Chapter II), Children Resources International (2004) Islamabad

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Course Title: Analytical Chemistry **Credit Hours:** 02+0
Course Code: CHEM – 210 **Course Type:** General-6

Objectives

Course Goals

This course will introduce you to the vocabulary and concepts used in basic Analytical Chemistry.
You will learn the details of steps involved in the preparation and analysis of a sample, the chemical basis and various techniques of analysis.

You will also learn and use statistical methods to determine the precision and accuracy of experimental results.
Graded assignments, quizzes, class tests and a *final exam* will test your understanding of the material dealing with these goals.
To develop skills needed to solve analytical problems in a quantitative manner, particularly with the aid of the spreadsheet tools.
Teaching laboratory skills that will give students confidence in their ability to obtain high-quality analytical data.

Course Description

• Introduction to Analytical Chemistry
• Measuring Apparatus
• Expression of Quantities and Concentrations
• Basic Approach to Equilibrium
• Errors in Chemical Analyses and Quality of Results
• Chemicals and reagents
• Use and handling of standards
• Sampling
• Errors
• Precision, Accuracy, Signal-to-noise ratio, Limits of detection and
• Statistical Evaluation of Data
• Quality Control and Quality Assurance

Course Title: Human Resource Management **Credit Hours:** 03
Course Code: MNGT – 111 **Course Type:** General – 7

Objectives:

- To aid the students in having a clear understanding about the concepts, methods and techniques and issues involved in managing human resource
- To facilitate employing maintaining and promoting a motivated force in an organization

Course Contents:

Basics of Human Resource Management, Features of HRM, HRM and personal Management, Management and present field, Personal function, Job design and analysis, Human resource planning, Recruitment and selection, Testing interviewing and assessment, Performance appraisal and management by objectives, Career development, Training people and motivation, Quality of working life leadership, Participative management, Discipline, union and management, Collective bargaining, Grievance and arbitration, Compensation administration, Health and safety, Employees rights.

Recommended Books:

1. "Managing Human Resources" (Gary Dessler 7th ed., Prentice Hall).

Course Title: Entrepreneurship **Credit Hours:** 03
Course Code: MNGT – 112 **Course Type:** General – 8

Objective:

Entrepreneurship is an important component in the process of economic development. The purpose of this course is to analyze the theories of entrepreneurship and to go for case studies of successful entrepreneurs.

Introduction:

The concept of entrepreneurship, Economist view of entrepreneurship, Sociologist view, Behavioral approach, Entrepreneurship and Management

The Practice of Entrepreneurship:

The process of entrepreneurship, Entrepreneurial Management, The entrepreneurial business, Entrepreneurship in service institutions, new venture

Entrepreneurship and Innovation:

The innovation concepts, Importance of innovation for entrepreneurship, Sources of innovative opportunities, The innovation process, Risks involved in innovation.

Developing Entrepreneur:
Entrepreneurial profile, Trait approach to understanding entrepreneurship, Factors influencing entrepreneurship, the environment, Socio cultural factors, support systems.

Entrepreneurship Organization:
Team work, Networking organization, Motivation and compensation, Value system, Entrepreneurship and SMES: Defining SMEs, Scope of SMEs, Entrepreneurial, managers of SME, Financial and marketing problems of SMEs.

Entrepreneurial Marketing:
Framework for developing entrepreneurial marketing, Devising entrepreneurial marketing plan, Entrepreneurial marketing strategies, Product quality and design

Entrepreneurship and Economic Development:
Role of entrepreneur in the economic development generation of services, Employment creation and training, Ideas, knowledge and skill development, The Japanese experience

Case Studies of Successful Entrepreneurs:

Text Books:

1. Paul Burns and Jim Dew Hurst: Small Business and Entrepreneurship.
2. P.N. Singh: Entrepreneurship for Economic Growth.
3. Peter F. Drucker: Innovation and Entrepreneurship Peter F. Drucker.
4. John B. Miner: Entrepreneurial Success.

COURSE OUTLINE

OF

FOUNDATION COURSES

FOR

BS – 4 YEARS PROGRAM

IN PHYSICS

Course Title: Mechanics – I **Credit Hours:** 03
Course Code: PHYS – 101 **Course Type:** Foundation-1
Pre-requisite: A Level Physics and F.Sc. (Physics + Math)

Objectives:

- To give concept of vector and their various properties.
- To give basic understanding of laws of motion and their applications is daily life.
- To give mathematical concept and expressions of various physical parameters used in mechanics.

Vector Analysis:

Review of Vector in 3 dimensions and fundamental Operations, Direction, Cosines, Spherical polar coordinates, Cylindrical Coordinates. Vector and scalar triple products, gradient of a scalar, Divergence and curl of a vector, Physical significance of each type, Divergence of a vector, flux, curl and line integral (mutual relation).Vector identities, Divergence Theorem, Stokes Theorem and their derivation, physical importance and applications to specific cases.

Particle Dynamics:

Dynamics of uniform, circular motion, the banked curve, Equations of motion, Deriving kinetic equations for x(t), v(t) via integration, Constant and variable forces, normal forces and contact forces, special examples, Time dependent forces, Obtaining x(t), v(t) for this case using integration method, Effect of drag forces on motion, Applying Newton's Laws to obtain v(t) for the case of motion with time dependent (Integration approach) drag (viscous) forces, terminal velocity, Projectile motion with and without air resistance, Non inertial frames and Pseudo forces, Qualitative discussion to develop understanding, Calculation of pseudo forces for simple cases (linearly accelerated reference frames), Centrifugal force as an example of pseudo force, Coriolis force.

Work, Power and Energy:

Work done by a constant force, work done by a variable force (1-2dimension), (Essentially a review of grade-XII concepts via integration technique to calculate work done (e.g. in vibration of a spring obeying Hooke's Law), Obtaining general expression for work done (2-dimensional case) and applying to simple cases e.g. pulling a mass at the end of a fixed string against gravity, Work energy theorem, General proof of work energy theorem: Qualitative review of work energy theorem, Derivation using integral calculus, Basic formulae and applications, Power, Energy changes with respect to observers in different inertial frames, Conservation of Energy in 1, 2, and 3 dimensional conservative systems, Conservative and non conservative forces: Conservation of energy in a system of particles, Law of conservation of total energy of an isolated system.

Systems of Particles:

Two particle systems and generalization to many particle systems, Centre of mass, Position, velocity and equation of motion, Centre of mass of solid objects, Calculation of Centre of Mass of solid objects using integral calculus, Calculating C.M. of Uniform Rod, Cylinder and Sphere, Momentum Changes in a system of variable mass, Derivation of basic equation, application to motion of a rocket (determination of its mass as a function of time).

Collisions:

Elastic Collisions, Conservation of momentum during collision in one and two dimensions, Inelastic collision, Collisions in centre of Mass reference frame (One and two dimensions), Simple applications, obtaining velocities in C.M. frame.

Recommended Books:

1. Halliday, D. Resnick, Krane, Physics, Vol. I & II, John Wiley, 5th ed. 1999
2. D. Kleppner and R. Kolenkow, An Introduction to Mechanics, McGraw Hill, 1978
3. M. R. Speigel, Vector Analysis and an Introduction to Tensor Analysis, Mc-Graw Hill, 1959

Course Title: Laboratory – I **Credit Hours:** 01
Course Code: PHYS – 103 **Course Type:** Foundation-2
Pre-requisite: Intermediate with Physics and Math or A level Physics
Objectives
To develop the experimental capability of students in understanding the concept of Mechanics;
1. Modulus of Rigidity by Static & Dynamic method (Maxwell's needle, Barton's Apparatus).
2. To study the damping features of an oscillating system using simple pendulum of variable mass.
3. Measurement of viscosity of liquid by Stoke's / Poiseulli's method.
4. Surface tension of water by capillary tube method.
5. To determine the value of "g" by compound pendulum / Kater's Pendulum.
6. To study the dependence of Centripetal force on mass, radius, and angular velocity of a body in circular motion.
7. Investigation of phase change with position in traveling wave and measurement of the velocity of sound by CRO.
8. Determination of moment of inertia of a solid/hollow cylinder and a sphere etc.
9. To study the conservation of energy (Hook's law).
Recommended Books:
1. D. H. Marrow, Selected Experiments in Physical Sciences, Longman.
2. Nelkon and Ogborn, Advanced Level Practical Physics, Heimann Educational Books
3. Nolan and Bigliani, Experiments in Physics, Surjeet Pub Ind.
4. C. K. Bhattacharya, University Practical Physics, CBS Publishing

Note: At least five experiments to be performed and Universities may opt. for other experiments according to the available facilities

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Course Title: Mechanics – II **Credit Hours:** 03
Course Code: PHYS – 102 **Course Type:** Foundation-3
Pre-requisite: A Level Physics and F.Sc. (Physics + Math)
Objectives:
- To give the basic concept of rotational motion, law of gravitation, physical properties of matter and relativistic mechanics
- Uses of above concepts in daily life in a scientific way

Rotational Dynamics:
Relationships between linear & angular variables, scalar and vector form. Kinetic energy of rotation, Moment of Inertia, Parallel axis and Perpendicular axis theorems, Proof and Illustration, application to simple cases, Determination of moment of inertia of various shapes i.e. for disc, bar and solid sphere, Rotational dynamics of rigid bodies, Equations of rotational motion and effects of application of torques, Combined rotational and translational motion, Rolling without slipping.
Angular Momentum:
Angular Velocity, Conservation of angular momentum, effects of Torque and its relation with angular momentum, Stability of spinning objects, Discussion with examples, The spinning Top, Effects of torque on the angular momentum, precessional motion.
Gravitation:
Gravitational effect of a spherical mass distribution, its mathematical treatment, Gravitational Potential Energy (develop using integration techniques), calculation of escape velocity, Gravitational field & Potential, Universal Gravitational Law. Radial and transversal velocity and acceleration, Motion of Planets and Keplers' Laws (Derivation & explanation) Motion of Satellites, Energy considerations in planetary and satellite motion, Qualitative discussion on application of gravitational law to the Galaxy.
Bulk Properties of Matters:
Elastic Properties of Matter, Physical basis of elasticity, Tension, Compression & shearing, Elastic Modulus, Elastic limit. Poisson's ratio, Relation between three types of elasticity, Fluid Statics, Variation of

Pressure in fluid at rest and with height in the atmosphere, Surface Tension, Physical basis; role in formation of drops and bubbles, Viscosity, Physical basis, obtaining the Coefficient of viscosity, practical example of viscosity; fluid flow through a cylindrical pipe (Poiseulle's law).

Special Theory of Relativity:

Inertial and non inertial frame, Postulates of Relativity, The Lorentz Transformation, Derivation, Assumptions on which inverse transformation is derived, Consequences of Lorentz transformation, Relativity of time, Relativity of length, Relativity of mass, Transformation of velocity, variation of mass with velocity, mass energy relation and its importance, relativistic momentum and Relativistic energy, (Lorentz invariants) $E^2=c^2 p^2+m_o^2c^4$

Recommended Books:

1. Halliday, D. Resnick, Krane, Physics, Vol. I & II, John Wiley, 5th ed. 1999
2. D. Kleppner and R. Kolenkow, An Introduction to Mechanics, McGraw Hill, 1978
3. M. R. Speigel, Vector Analysis and an Introduction to Tensor Analysis, Mc-Graw Hill, 1959

Course Title: Waves & Oscillations **Credit Hours:** 03
Course Code: PHYS – 104 **Course Type:** Foundation-4
Pre-requisite: A Level Physics and F.Sc. (Physics + Math)

Objective:

- To understand the basics of waves, mechanism of wave production, propagation and interaction with other waves.
- Use of basic concept of waves in their application in daily life.

Harmonic Oscillations:

Simple harmonic motion (SHM), Obtaining and solving the basic equations of motion x(t), v(t), a(t), Longitudinal and transverse Oscillations, Energy considerations in SHM. Application of SHM, Torsional oscillator, Physical pendulum, simple pendulum, SHM and uniform circular motion, Combinations of harmonic motions, Lissajous patterns, Damped harmonic motion, Equation of damped harmonic motion, Quality factor, discussion of its solution, Forced oscillations and resonances, Equation of forced oscillation, Discussion of its solution, Natural frequency, Resonance, Examples of resonance.

Waves in Physical Media:

Mechanical waves, Travelling waves, Phase velocity of traveling waves, Sinusoidal waves, Group speed and dispersion, Waves speed, Mechanical analysis, Wave equation, Discussion of solution, Power and intensity in wave motion, Derivation & discussion, Principle of superposition (basic ideas), Interference of waves, Standing waves.

Phase changes on reflection.

Sound:

Beats Phenomenon, Analytical treatment

Coupled Oscillators and Normal modes:

Two coupled pendulums, General methods of finding normal modes, Beats in coupled oscillations, Two coupled masses, Two coupled LC circuits, Energy relations in coupled oscillations, Forced oscillations of two coupled oscillators, Many coupled oscillator.

Normal Modes of Continuous systems:

Transverse vibration of a string, Longitudinal vibrations of a rod, Vibrations of air columns, Normal modes, Fourier methods of analyzing general motion of a continuous system, Atomic vibrations.

Recommended Books:

1. Halliday, D. Resnick, Krane, Physics, Vol. I & II, John Wiley, 5th ed. 1999
2. N.K. Bajaj, The Physics of Waves & Oscillations, Tata McGraw-Hill Publishing company Limited, 1986.
3. H. J. Pain, The Physics of Vibrations and Waves, 5th Edition 1999.

Course Title: Laboratory – II **Credit Hours:** 01
Course Code: PHYS – 106 **Course Type:** Foundation-5
Pre-requisite: Intermediate with Physics and Math or A level Physics
Objectives

- To develop the understanding of students in measuring the thermal and optical parameters and to remove the fear of students to use various gadgets in laboratory

List of Experiments:

1. To determine thermal *emf* and plot temperature diagram.
2. Determination of temperature coefficient of resistance of a given wire.
3. Determination of "J" by Callender – Barnis method.
4. The determination of Stefan's constant.
5. Calibration of thermocouple by potentiometer.
6. To determine frequency of AC supply by CRO.
7. To determine Horizontal/Vertical distance by Sextant.
8. The determination of wavelength of Sodium –D lines by Newton's Ring.
9. The determination of wavelength of light/laser by Diffraction grating.
10. Determination of wavelength of sodium light by Fresnel's biprism.
11. The determination of resolving power of a diffraction grating.
12. Measurement of specific rotation of sugar by Polarimeter & determination of concentration in a given solution.
13. To study the combinations of harmonic motion (Lissajous figures).
14. To study the parameters of waves (Beats phenomenon).
15. To determine the Thermal conductivity of good and bad conductors using Lee's and Searl's apparatus.
16. To study the laws of vibration of stretched string using sonometer.
17. To determine the stopping potential by photo cell.

Recommended Books:

1. D. H. Marrow, Selected Experiments in Physical Sciences, Longman.
2. Nelkon and Ogborn, Advanced Level Practical Physics, Heimann Educational Books
3. Nolan and Bigliani, Experiments in Physics, Surjeet Pub Ind.
4. C. K. Bhattacharya, University Practical Physics, CBS Publishing

Note: At least nine experiments to be performed and Universities may opt for other experiments according to the available facilities

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Course Title: Electricity & Magnetism – I **Credit Hours:** 03
Course Code: PHYS – 201 **Course Type:** Foundation-6
Pre-requisite: A Level Physics and F.Sc. (Physics + Math)
Objectives

- To give the concept of electric field, electrical potential and dielectrics
- To understand the DC circuits
- To know the effect of magnetic field and basic magnetic properties of materials

Electric Field:

Field due to a point charge: due to several point charges. Electric dipole, Electric field of continuous charge distribution e.g. Ring of charge, disc of charge, infinite line of charge. Point charge in an electric field. Dipole in an electric field, Torque and energy of a dipole in uniform field, Electric flux: Gauss's law; (Integral and differential forms) and its application, Charge in isolated conductors, conductor with a cavity, field near a charged conducting sheet. Field of infinite line of charge, field of infinite sheet of charge, field of spherical shell and field of spherical charge distribution

Electric Potential:

Potential due to point charge, potential due to collection of point charges, potential due to dipole. Electric potential of continuous charge distribution, Poisson's and Laplace equation without solution,

Field as the gradient or derivative of potential, Potential and field inside and outside an isolated conductor

Capacitors and dielectrics:

Capacitance, calculating the electric field in a capacitor, Capacitors of various shapes, cylindrical, spherical etc and calculation of their capacitance, Energy stored in an electric field, Energy per unit volume, Capacitor with dielectric, Electric field of dielectric. An atomic view, Application of Gauss's Law to capacitor with dielectric

D C Circuits:

Electric Current, current density J, resistance, resistivity, ρ, and conductivity, σ, Ohm's Law energy transfer in an electric circuit. Equation of continuity. Calculating the current in a single loop, multiple loops, voltages at various elements of a loop. Use of Kirchhoff's Ist & 2^{nd} law, Thevenin theorem, Norton theorem and Superposition theorem,

Growth and Decay of current in an RC circuit and their analytical treatment.

Magnetic Field Effects and Magnetic Properties of Matter:

Magnetic force on a charged particle, magnetic force on a current, Recall the previous results. Do not derive. Torque on a current loop. Magnetic dipole: Energy of magnetic dipole in field. Discuss quantitatively, Lorentz Force with its applications in CRO. Biot-Savart Law: Analytical treatment and applications to a current loop, force on two parallel current changing conductors. Ampere's Law, Integral and differential forms, applications to solenoids and toroids. (Integral form), Gauss's Law for Magnetism: Discuss and develop the concepts of conservation of magnetic flux, Differential form of Gauss's Law. Origin of Atomic and Nuclear magnetism, Basic ideas.Bohr Magneton. Magnetization, Defining M, B, μ. Magnetic Materials, Paramagnetism, Diamagnetism, Ferromagnetism - Discussion. Hysteresis in Ferromagnetic materials.

Recommended Books:

1. F. J. Keller, W. E. Gettys, M. J. Skove *Physics Classical and Modern (2nd ed)*, McGraw-Hill, Inc., 1993
2. A. F. Kip *Fundamentals of Electricity and Magnetism (2nd Ed.)*, McGraw-Hill Book Co., 1969.
3. D. Halliday, R. Resnick, K. S. Krane *Physics (Vol-II)*, John Willey & sons, Inc., 1992.
4. D. N. Vasudeva *Magnetism and Electricity*, S. Chand & Co., 1959.
5. J A Edminister *Schaum's Outline Series; Theory & Problems of Electromagnetism*, McGraw-Hill Book Co. 1986

Course Title: Laboratory – III **Credit Hours:** 01

Course Code: PHYS – 203 **Course Type:** Foundation-7

Pre-requisite: F.Sc. level Physics and Electricity and Magnetism – I

Objectives:

- To know the electrical circuit elements, their experimental measurement and to give understanding of electrical circuits and use of CRO

List of Experiments

1. Measurement of resistance using a Neon flash bulb and condenser
2. Conversion of a galvanometer into Voltmeter & an Ammeter
3. To study the characteristics of Photo emission and determination of Plank's constant using a Photo cell
4. Calibration of an Ammeter and a Voltmeter by potentiometer
5. Charge sensitivity of a ballistic galvanometer
6. Comparison of capacities by ballistic galvanometer.
7. To study the B.H. curve & measure the magnetic parameters.
8. Measurement of low resistance coil by a Carey Foster Bridge.
9. Resonance frequency of an acceptor circuit
10. Resonance frequency of a Rejecter Circuit.
11. Study of the parameter of wave i.e. amplitude, phase and time period of a complex signal by CRO.
12. Measurement of self/mutual inductance.
13. Study of electric circuits by black box.
14. To study the network theorems (Superposition, Thevenin, Norton).
15. To study the application of Lorentz force by CRO.

Note: At least eight experiments to be performed and Universities may opt for other experiments according to the available facilities.

Recommended Books:

1. G L Squires, Practical Physics, 3rd Edition, Cambridge University Press
2. Nolan and Bigliani, Experiments in Physics, Surjeet Pub Ind.
3. C K Bhattacharya, University Practical Physics, CBS Publishing.

Note: At least five experiments to be performed and Universities may opt for other experiments according to the available facilities.

Course Title: Heat & Thermodynamics **Credit Hours:** 03
Course Code: PHYS – 204 **Course Type:** Foundation-8
Pre-requisite: A Level Physics and F.Sc. (Physics + Math)

Objectives

- To give the concept of heat and temperature
- To give the concept of classical distribution function
- To understand the laws of thermodynamics and their application

Statistical Mechanics:

Statistical distribution and mean values, Mean free path and microscopic calculations of mean free path. Distribution of molecular speeds, Distribution of energies, Maxwell distribution, Maxwell-Boltzmann energy distribution, Internal energy of an ideal gas. Brownian motion, Qualitative description. Diffusion, Conduction and viscosity.

Heat and Temperature:

Temperature, Kinetic theory of the 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. Van der Waals equation of state.

Thermodynamics:

Review of previous concepts. First law of thermo-dynamics and its applications to adiabatic, isothermal, cyclic and free expansion. Reversible and irreversible processes, Second Law of thermodynamics, Carnot theorem, Carnot engines. Heat engine. Refrigerators. Calculation of efficiency of heat engines. Thermodynamic temperature scale:

Absolute zero: Entropy, Entropy in reversible process, Entropy in irreversible process. Entropy & second law. Entropy & probability. Thermodynamic functions: Thermodynamic functions (Internal energy, Enthalpy, Gibb's functions, Entropy, Helmholtz functions) Maxwell's relations, TdS equations, Energy equations and their applications. Low Temperature Physics, Liquification of gases, Joule-Thomson effect and its equations. Thermoelectricity,Thermocouple, Seabeck's effect, Peltier's effect, Thomson effect

Recommended Books:

1. J. F. Lee and F. W. Sears, Thermodynamics, Addison-Wesley 1954.
2. A. J. Pointon, Introduction to Statistical Physics, Longman 1967.
3. M. W. Zemansky, Heat and Thermodynamics, 3rd Edition, McGraw Hill, 1951.
4. Reif, Statistical Physics, Berkley Physics series, McGraw Hill 1965.
5. M. M. Abbott, Schaum's Outline of Thermodynamics, McGraw- Hill Professional Book Group, 1995.

Course Title: Electricity & Magnetism – II **Credit Hours:** 03
Course Code: PHYS – 206 **Course Type:** Foundation-9
Pre-requisite: F.Sc. level Physics and Electricity and Magnetism I
Objectives:

- To understand the laws of electromagnetic induction
- To understand the AC circuits
- To know the generation and propagation of Electromagnetic waves

Inductance:
Faraday's Law of Electromagnetic Induction, Review of emf, Faraday Law and Lenz's Law, Induced electric fields, Calculation and application using differential and integral form, Inductance, "Basic definition". Inductance of a Solenoid; Toroid. LR Circuits, Growth and Decay of current, analytical treatment. Energy stored in a magnetic field, Derive. Energy density and the magnetic field. Electromagnetic Oscillation, Qualitative discussion. Quantitative analysis using differential equatins. Forced electromagnetic oscillations and resonance
Alternating Current Circuits:
Alternating current, AC current in resistive, inductive and capacitative elements. Single loop RLC circuit, Series and parallel circuits i.e. acceptor and rejector, Analytical expression for time dependent solution. Graphical analysis, phase angles. Power in A.C circuits: phase angles, RMS values, power factor.
Electro-Magnetic Waves (Maxwell's Equations):
Summarizing the electro- magnetic equations, (Gauss's law for electromagnetism, Faraday Law, Ampere's Law). Induced magnetic fields & displacement current. Development of concepts, applications. Maxwell's equations, (Integral & Differential forms) Discussion and implications. Generating an electro- magnetic wave. Travelling waves and Maxwell's equations. Analytical treatment; obtaining differential form of Maxwell's equations, obtaining the velocity of light from Maxwell's equations. Energy transport and the Poynting Vector. Analytical treatment and discussion of physical concepts.
Recommended Books:

1. F. J. Keller, W. E. Gettys, M. J. Skove *Physics Classical and Modern (2nd ed.)*, McGraw-Hill, Inc., 1993.
2. A. F. Kip *Fundamentals of Electricity and Magnetism (2nd Ed.)*, McGraw-Hill Book Co., 1969.
3. D. Halliday, R. Resnick, K. S. Krane *Physics (Vol-II)*, John Willey & sons, Inc., 1992.
4. D. N. Vasudeva *Magnetism and Electricity*, S. Chand & Co., 1959.
5. JA Edminister *Schaum's Outline Series; Theory &Problems of Electromagnetism*, McGraw-Hill Book Co., 1986.

Course Title: Electronics & Modern Physics **Credit Hours:** 03
Course Code: PHYS – 208 **Course Type:** Foundation-10
Pre-requisite: Intermediate with Physics and Math or A level Physics
Objectives:

- To give the concept of modern physics
- To know the nuclear structure and radioactivity
- To know some nuclear reactions and production of nuclear energy
- To give basic understanding of Plasma and LASER

Electronics:
Basic crystal structure, free electron model, energy band in solid and energy gaps, p-type, n-type semiconductor materials, p-n junction diode, its structure. characteristics and application as rectifiers. Transistor, its basic structure and operation, transistor biasing for amplifiers, characteristics of common base, common emitter, common collector, load line, operating point, hybrid parameters (common emitter), Transistor as an amplifier (common emitter mode), Positive & negative feed back R.C. Oscillators, Monostable multi- vibrator (basic), Logic gates OR, AND, NOT, NAND, NOR and their basic applications.

Origin of Quantum Theory: Black body radiation, Stefan Boltzmann-, Wiens- and Planck's law, consequences. The quantization of energy, Photoelectric and Compton effect, Line spectra, Explanation using quantum theory.

Wave Nature of Matter: Wave behaviour of particle (wave function etc.) its definition and relation to probability of particle, d'Broglie hypothesis and its testing, Davisson- Germer Experiment and J.P. Thomson Experiment, Wave packets and particles, localizing a wave in space and time.

Atomic Physics: Bohr's theory (review), Frank-Hertz experiment, energy levels of electron, Atomic spectrum, Angular momentum of electrons, Vector atom model, Orbital angular momentum. Spin quantization, Bohr's Magnetron. X-ray spectrum (continuous and discrete) Moseley's law, Pauli's exclusion principle and its use in developing the periodic table.

Recommended Books:

1. Robert M Eisberg, Fundamentals of Modern Physics, John Wiley & Sons 1961
2. Sanjiv Puri, Modern Physics, Narosa Publishing House, 2004.
3. Paul A. Tipler and Ralph A. Llewellyn, Modern Physics 3rd edition, W H Freeman and Company 2000.
4. Arthur Beiser, Concepts of Modern Physics (fifth edition) McGraw-Hill 1995.
5. Robert M. Eisberg and Robert Resnick, Quantum Physics of Atoms, molecules, Solids, Nuclei and Particles, 2nd edition, John Wiley & Sons, 2002.
6. D. Halliday, R. Resnick, K. S. Krane, *Physics,* John Willey & sons, Inc., 1992.

Course Title: Laboratory – IV **Credit Hours:** 01

Course Code: PHYS – 210 **Course Type:** Foundation-11

Pre-requisite: F.Sc. level Physics and Electricity and Magnetism – I

Objectives:

- To develop understanding and uses of electronic devises including GATS, Transistors.
- To understand the behavior of nuclear radiation including beta and gamma radiation.

List of Experiments

1. Determination of e/m of an electron.
2. Determination of ionization potential of mercury.
3. Characteristics of a semiconductor diode (Compare Si with Ge diode)
4. Setting up of half & full wave rectifier & study of following factors
    a. Smoothing effect of a capacitor
    b. Ripple factor & its variation with load.
    c. Study of regulation of output voltage with load.
5. To set up a single stage amplifier & measure its voltage gain and bandwidth.
6. To set up transistor oscillator circuit and measure its frequency by an oscilloscope.
7. To set up and study various logic gates (AND, OR, NAND etc) using diode and to develop their truth table.
8. To set up an electronic switching circuit using transistor LDR and demonstrate its use as a NOT Gate.
9. Characteristics of a transistor.
10. To study the characteristic curves of a GM counter & use it to determine the absorption co-efficient of β-particle in Aluminum.
11. Determination of range of α particles.
12. Mass absorption coefficient of lead for γ-rays using G.M counter.
13. Use of computer in the learning of knowledge of GATE and other experiments.

Recommended Books:

1. G L Squires, Practical Physics, 3rd Edition, Cambridge University Press
2. Nolan and Bigliani, Experiments in Physics, Surjeet Pub Ind.
3. C K Bhattacharya, University Practical Physics, CBS Publishing.

Note: At least five experiments to be performed and Universities may opt for other experiments according to the available facilities.

Course Title: Optics **Credit Hours:** 03
Course Code: PHYS – 308 **Course Type:** Foundation – 12
Pre-requisite: Intermediate with Physics and Math or A level Physics
Objectives:

- To understand the concept of reflections, refraction, interference, diffraction and polarization
- To develop understanding about the optical devices

Propagation of Light:
Introduction, The laws of reflection and refraction, The electromagnetic approach, Familiar aspects of the interaction of light and matters, The Stok's treatment of reflection and refraction, Photons and the laws of reflection and refraction.
Geometric Optics – Paraxial Theory:
Introductory remarks, Lenses, Stops, Mirrors, Prisms, Fiber Optics, Optical systems, Thick lenses and lens systems, Analytical ray tracing, Aberrations.
Polarization:
The nature of polarized light, Polarizers, Dichroism, Birefringence, Scattering and polarization, Polarization by reflection, Retarders, Circular polarizers, Polarization of polychromatic light, Optical activity, Induced optical effects – optical modulators, A mathematical description of polarization.
Interference & Diffraction:
General considerations, Conditions for interference, Wave front-splitting interferometers, Amplitude-splitting interferometers, Dielectric films-double-beam interference, Types and localizations of interference fringes, Multiple-beam interference, The Fabry-Perot interferometer, Applications of single and multiplayer films, Application of interferometery, The rotating Sagnac interferometer, Preliminary considerations, Fraunhofer diffraction, Fresnel diffraction, Kirchhoff's scalar diffraction theory, Boundry diffraction waves.
Sundry Topics from Contemporary Optics:
Imagery- the spatial distribution of optical information, Lasers and laser light, Holography, Nonlinear optics
Recommended Books:

1. Eugene Hecht/Alfred Zajac, Optics, Addison Wesley Publishing Co.1980.
2. Francis A. Jenkins and Harvey E. White, Fundamental of Optics, 4th edition, Kosaido Printing Co. Ltd., Tokyo.
3. Helmut F. Wolf, Hand Book of Fiber Optics, Theory & Application, Granada 1979, USA.

Course Title: Lasers **Credit Hours:** 03
Course Code: PHYS – 402 **Course Type:** Foundation – 13
Pre-requisite: Quantum Mechanics – I and Atomic Physic
Objectives:

- Develop fundamental concepts about lasers
- Learn the principles of spectroscopy of molecules and semiconductors
- Understand the optical resonators and laser system.
- Applications of lasers

Introductory Concepts:
Spontaneous Emission, Absorption, Stimulated Emission, Pumping Schemes, Absorption and Stimulated Emission Rates, Absorption and Gain Coefficients, Resonance Energy Transfers, Properties of Laser Beam, Monochromaticity, Coherence, Directionality, Brightness
Spectroscopy of Molecule and Semiconductors:
Electronic Energy Levels, Molecular Energy levels, Level Occupation at Thermal Equilibrium, Stimulated Transition, Selection Rules, Radiative and Nonradiative Decay, Semiconductor
Optical Resonators:
Plane Parallel (Fabry-Perot) Resonator, Concentric (Spherical) Resonator, Confocal, Resonator, Generalized Spherical Resonator, Ring Resonator, Stable Resonators, Unstable Resonators, Matrix Formulation of Geometrical Optics, Wave Reflection and Transmission at a Dielectric Interface, Stability Condition Standing and Traveling Waves in a two Mirror Resonator, Longitudinal and

Transverse Modes in a Cavity, Multilayer Dielectric Coatings, Fabry-Perot Interferometer, Small Signal Gain and Loop Gain.

Pumping Processes:

Optical pumping: Flash lamp and Laser, Threshold Pump Power, pumping efficiency, Electrical Pumping: Longitudinal Configuration and Transverse Configuration, Gas Dynamics Pumping, Chemical Pumping.

Continuous Wave (CW) and pulsed lasers:

Rate Equations, 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, and Group-Delay Dispersion, Line broadening.

Lasers Systems:

Solid State Lasers, Ruby Laser, Nd YAG & Nd Glass Lasers and Semiconductor Lasers, Homojunction Lasers Double-Heterostructure lasers, Gas lasers, Helium Neon Laser, CO_2 laser Nitrogen Laser and Excimer Lasers, Free-Electron and X-Ray Lasers

Laser Applications:

Material Processing, Surface Hardening, Cutting Drilling, Welding etc, Holography, Laser Communication, Medicine, Defense Industry, Atmospheric Physics.

Recommended Books:

1. O. Svelto, Principles of Lasers, Plenum Press New York & London (1992).
2. J. Eberly and P. Milonni, Lasers, Wiley, New York (Latest Edition) Scully and Zubairy, Quantum Optics, Cambridge University Press (1997)
3. A.E. Siegman, Laser, University Science Books, Mill Valley, C.A. (1986).
4. H. Haken, Laser Theory, Springer, Berlin (Latest Edition).
5. W.T. Silfvast, Laser Fundamentals, latest edition.

COURSE OUTLINE

OF

MAJOR COURSES

FOR

BS – 4 YEARS PROGRAM

IN PHYSICS

Course Title: Mathematical Methods of Physics – I **Credit Hours:** 03
Course Code: PHYS – 301 **Course Type:** Major – 1
Pre-requisite: General Mathematics

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

Vector Analysis:

Review of vectors Algebra, Vector differentiation and gradient, Divergence and Gauss's theorem, Vector integration, Green's theorem in the plane, Curl and Stoke's theorem.

Curvilinear Coordinates and Tensors:

Curvilinear coordinate system, Gradient, Divergence and Curl in the curvilinear coordinates system, Cartesian, Spherical and Cylinderical coordinate system, Covariant and contravariant tensors, Tensor algebra, Quotient rule.

Matrices:

Linear vector spaces, Determinants, Matrices, Eigen values and eigenvectors of matrices, Orthogonal matrices, Hermitian matrices, Similarity transformations, Diagonalization of matrices.

Group Theory:

Introduction to groups, Group representation, Invariant subgroups, Discret groups-Dihedral groups, Continuous groups-O groups, SU(2) groups, Lie groups

Complex Variables:

Functions of a complex variable, Cauchy Riemann conditions and analytic functions, Cauchy integral theorem and integral formula, Taylor and Laurent series, Calculus of residue, Complex integration.

Recommended Books:

1. G. Arfken, Mathematical Physics, 2nd ed, Academic Press, 1970.
2. E. Butkov, Mathematical Physics, Addison-Wesley 1968.
3. Pipes and Harvill, Applied Mathematics for Engineers and Physicists, McGraw Hill, 1971.
4. M. R. Speigel, Complex Variables Schaum's Outline Series, McGraw Hill 1979.
5. H. P. Hsu, Fourier analysis Simon Schuster Series, 1967.

Course Title: Quantum Mechanics – I **Credit Hours:** 03
Course Code: PHYS – 303 **Course Type:** Major – 2
Pre-requisite: F.Sc with Physics and Modern Physics & Electronics

Objectives

- Understanding the behavior of quantum mechanical particle and development of Schrodinger equation in one and three dimensions
- Introduction to Quantum mechanical operators and determination of angular momentum of a quantum mechanical particle

Quantum Mechanics of One Dimensional Problem:

Review of concepts of classical mechanics, State of a system, Properties of one dimensional potential functions, Functions and expectation values, Dirac notation, Hermitian operators, Solutions of Schrodinger equation for free particles, The potential barrier problems, The linear harmonic oscillator, Particle in a box.

Formalism of Quantum Mechanics:

The state of a system, Dynamical variables and operators, Commuting and non commuting operators, Heisenberg uncertainty relations, Time evolution of a system, Schrodinger and Heisenberg pictures, Symmetry principles and conservation laws.

Angular Momentum:

Orbital angular momentum, Spin, The Eigen values and Eigen functions of L2 and Lz, Matrix representation of angular momentum operators, Addition of angular momenta.

Schrodinger Equation in Three Dimensions:

Separation of Schrodinger equation in Cartesian coordinates, Central potentials, The free particle, Three dimensional square well potential, The hydrogen atom, Three dimensional square well potential, The hydrogen atom, Three dimensional isotopic oscillator.

Books Recommended:

1. B.H. Bransden & C.J. Joachain, 'Introduction to Quantum Mechanics' Longman Scientific & Technical London (1990)
2. J.S. Townsend, 'A Modern Approach to Quantum Mechanics', McGraw Hill Book Company, Singapore (1992)
3. W. Greiner, 'Quantum Mechanics: An Introduction', Addison Wesley Publishing Company, Reading Mass. (1980)
4. R.L. Liboff, 'Introductory Quantum mechanics', Addison Wesley Publishing Company, Reading Mass. (1980)
5. Bialynicki-Birula, M. Cieplak & J. Kaminski, 'Theory of Quantua', Oxford University Press, New York (1992)
6. W. Greiner, 'Relativistic Quantum Mechanics', Springer Verlag, Berlin (1990)
7. F. Schwable, 'Quantum Mechanics', Narosa Publishing House, New Delhi (1992)
8. 8 David J. Griffiths, Introduction to Quantum Mechanics, PRENTICE Hall, Int., Inc.

Course Title: Classical Mechanics **Credit Hours:** 03
Course Code: PHYS – 305 **Course Type:** Major – 3
Pre-requisite: Mechanics I & II

Objectives:

- To develop the basic knowledge of classical world using the laws of Physics
- To develop the understanding of two bodies central force problems
- To give understanding of kinematics and dynamics of rigid bodies
- Development of Hamiltonian equation and use of canonical transformation in classical physics

Elementary Principles:

Brief Survey of Newtonian mechanics of a system of particles, constraints, Alembert's principle, Lagrange's equation and its applications, Virtual work

Variational Principles:

Calculus of variation and Hamilton's principle, Derivation of Lagrange's equation from Hamilton's principle

Two Body Central Force Problems:

Low and least action, two body problem and its reduction to one body problem, Equation of motion and solution for one body problem, Kepler's Laws Laboratory and centre of mass systems, Rutherford scattering.

Kinematics of Rigid Body Motion:

Orthogonal transformations, Eulerian angles, Euler's theorem, The Coriolis force.

Rigid Body Equation of Motion:

Angular momentum, Tensors and dyadic’s, Moment of inertia, Rigid body problems and Euler's equations.

Hamilton Equation of Motion:

Legendre transformation and Hamilton equations of motion, Conservation theorems

Canonical Transformations:

Examples of Canoical transformations, Lagrange and Poison brackets, Liouville's theorem

Books Recommended:

1. H. Goldstein, 'Classical Mechanics', 2nd. Ed. Addison Wesley, Reading, Massachusetts (1980).
2. V.I. Arnold, Mathematical Methods of Classical Mechanics Springer verlag, New York (1980).
3. S.N. Rasband, 'Dynamics', John Wiley & Sons, New York (1983)
4. R.A. Matzner & L.C. Shepley, 'Classical Mechanics', Prentice Hall Inc., London (1991).
5. N.M.J. Woodhouse, 'Introduction to Analytical Dynamics', Oxford Science Publications, Oxford (1987)

Course Title: Computational Physics **Credit Hours:** 02+01
Course Code: PHYS – 307 **Course Type:** Major – 4
Pre-requisite: Undergraduate Level Physics and Elementary Mathematics and Linear Algebra, Mathematical Methods, Basic Numerical Analysis and Analytical Tools for Numerical Analysis, Computer and Programming Skills

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, 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.

Books Recommended:

1. M. L. De Jong, 'Introduction to Computational Physics', Addison Wesley Publishing Company Inc., Massachusetts (1991)
2. S.T. Koonini, Computational Physics', The Benjamin/Coming Publishing Inc., California (1986).
3. P.K. Macheown & D.J. Merman, Computational Techniques in Physics' Adm Hilger, Bristol (1987).
4. H. Gould & J. Tobochnik, 'An Introduction to Computer Simulation Methods', Addison Wesley Publishing Company, Rading Massachusetts(1988)
5. S.C. Chapra & R.P. Chanle, 'Numerical Methods for Engineers with Personal Computer Applications, McGraw Hill Book Company, New York (1965

Course Title: Analog Electronics – I **Credit Hours:** 03
Course Code: PHYS – 309 **Course Type:** Major – 5
Pre-requisite: Modern Physics & Electronics

Objectives:

- To develop the understanding of different electronic circuit elements and devices like diode, transistors, amplifiers, oscillators and voltage regulators used in daily life alliances
- To understand the day to day electronic devices

Circuit Analysis:

Loop and Nodal Analysis, Principle of Superposition, Thevenin's Theory, Norton's Theorem, Principle of Maximum Power Transfer

Semiconductor Diodes:

Introduction to Semiconductors, PN Junction, Biasing the junction, The Diode Characteristic Curves, DC and Ac resistance, Transition and Diffusion Capacitance Reverse Recovery Time, Diode Models Zener Diode, I.E.D. Photodiode, Optical Diode Varactors, Varistors, Thermistors, Current Regulator Diodes, Schoktty Diodes, Step Recovery Diode, Tunnel Diode, Laser Diode.

Diode Applications:

Load line Analysis, Series Diode Configuration with DC Inputs, Series and Series, Parallel configurations, Hall-Wave and Full-Wave Rectifiers, Filters Clippers Clampers, Voltage Multipliers, Zener Diode as Voltage Reference and Voltage Regulator, LED Arrays.

Semiconductor Transistors:

BJT, FET, Construction, Types, Characteristics and parameters, Transistor as an Amplifier and as a Switch, VMOS, COMOS etc

Thyristors and other Devices:

Schottky Diode, SCR and its applications, SCS, Diac. Triac, UJT and it's applications PUT. Phototransistor, LASCR, Optical Couplers

Modulation and Demodulation:

Introduction, Amplitude, Frequency and Phase Modulation, Demodulation

Recommended Books:

1. T.L. Floyd, Electronics Devices, 5th edition Prentice Hall, New Jersey, U.S.A. 1999.
2. T.L. Floyd, Electronics Devices, 4th edition Prentice Hall, New Jersey, U.S.A. 1996.
3. R.L. Boylestad & L Nashelsky, Electronic Devices & Circuit Theory, 7th Edition, Prentice Hall, USA, 1999
4. Albert Paul, Malvino, Electronic Principles, 6th Edition, Glencoe, US 1993
5. J.D. Ryder & C.M. Thomson, Electronic Circuits & Systems, Prentice Hall, New Jersey, USA, 1976.
6. J. Millman & C. Halkias, Electronic Devices & Circuits, Mc Graw-Hill, International, 1968.

Course Title: Laboratory (Spectroscopy & Modern Physics) **Credit Hours:** 02

Course Code: PHYS – 311 **Course Type:** Major – 6

Pre-requisites: Laboratory I, II, III and IV

Objectives:

- To expose the students to advance level experimentation in Physics
- To make them familiar to such experiments who's out come can be used in developing future research capabilities and teaching skills
- To make the students confident in their studies by showing and measuring parameter which they have used in theoretical work

List of Experiments

1. Determination of charge to mass (e/m) ratio of an electron using a narrow fine beam tube
2. Calculation of the velocity of light by using electronic modulation method
3. Determination of the value of Cauchy's constant using a spectrometer
4. To measure the wavelength of sodium light in its wave length by using Michelson's Interferometer
5. To study the magnetic behavior of a magnetic material (B.H. curve)
6. To study the splitting in energy levels by the application of magnetic field (Zeeman Effect)
7. Study of the Splitting up of the central spectral lines of atoms within a magnetic field using a Fabry-Perot interferometer (Zeeman Effect)
8. Determination of the g-factor of a DPPH (Diphenylpikry/hydrazyl) and the half width of the absorption line using the ESR apparatus
9. Determination of crystal inter-planner spacing using x-rays diffraction.
10. Evaluation of dielectric constant of a given solid material by R.L.C. series circuit
11. Calculation of Planck's constant by photo-emission technique (photo electric effect)
12. Evaluation of critical potential of mercury using Franck Hertz experiment
13. To work out carrier concentration of given semi-conductor by using Hall Effect
14. Establishing the statistical distribution for radioactivity as Poisson's distribution
15. Evaluating the coefficient of linear absorption of a given material by G.M. Counter
16. Determination of the charge of electron by Faraday's method

Note: At least five experiments to be performed and Universities may opt for other experiments according to the available facilities.

Course Title: Mathematical Methods of Physics – II **Credit Hours:** 03
Course Code: PHYS – 302 **Course Type:** Major – 7
Pre-requisite: General Mathematics and Mathematical Methods – I
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
Differential Equations in Physics:
First and second order linear differential equations, Partial differential equations of theoretical physics, Separation of variables, Homogeneous differential equations, Frobenius series solution of differential equations, Second solution, Non-homogenous differential equations.
Special Functions:
Bessel functions and Hankel functions, Spherical Bessel functions, Legendre polynomials, Associated Legendre polynomials, Spherical harmonics Laguerre polynomials, Hermite polynomials
Fourier series:
Definition and general properties, Fourier series of various physical functions, Uses and application of Fourier series
Integral Transforms:
Integral transform, Fourier transform, Convolution theorem, Elementary Laplace transform and its application.
Boundary Value Problems and Green's Functions:
Boundary value problems in Physics, Non-homogeneous boundary value problems and Green's functions, Green's functions for one dimensional problem, Eigen function expansion of Green's function, Construction of Green's functions in higher dimensions
Books Recommended:

1. G. Arfken, Mathematical Physics, 2nd ed, Academic Press, 1970.
2. R. Bronson, 'Differential Equations' Schaum's Outline Series, McGraw Hill, New York.
3. E. Butkov, 'Mathematical Physics Addison-Weseley London .
4. M.L. Boas, 'Mathematical Methods in Physical Sciences', John Wiley & Sons, New York (1989)
5. C.W. Wong, 'Introduction to Mathematical Physics', Oxford University, Press, New York (1991)
6. Hassani, 'Foundations of Mathematical Physics', Prentice Hall International Inc., Singapore (1991)
7. Chattopadhyay, 'Mathematical Physics', Wiley Eastern Limited, New Delhi, (1990).
8. H. Cohen, 'Mathematics for Scientists & Engineers' Prentice Hall International Inc., New Jersey (1992).

Course Title: Quantum Mechanics – II **Credit Hours:** 03
Course Code: PHYS – 304 **Course Type:** Major – 8
Pre-requisite: Quantum Mechanics – I
Objectives:
- To understand the use of approximation in Quantum mechanics
- To understand the theory of scattering and interaction of quantum systems with radiation
- To understand the basics of relativistic quantum mechanics

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:
Indistinguishability of identical particles, Systems of identical particles, Quantum dynamics of identical particle systems, statistics, Symmetry of states, Fermions, Bosons.
Theory of Scattering:
Scattering experiments and cross sections, Potential scattering, The method of partial waves, The Born's approximation.

The Interaction of Quantum Systems with Radiation:
Electromagnetic field and its interaction with one electron system, Transition rates, Spontaneous emission, Selection rules for electric dipole transitions, The spin of photon and its helicity.
Relativistic Quantum Mechanics:
Schrodinger relativistic equation, Probability and current densities, Klein-Gordon equation and hydrogen atom, Dirac relativistic equation
Books Recommended:

1. B.H. Bransden & C.J. Joachain, 'Introduction to Quantum Mechanics' Longman Scientific & Technical London (1990)
2. J.S. Townsend, 'A Modern Approach to Quantum Mechanics', McGraw Hill Book Company, Singapore (1992)
3. W. Greiner, 'Quantum Mechanics: An Introduction', Addison Wesley Publishing Company, Reading Mass. (1980)
4. R.L. Liboff, 'Introductory Quantum mechanics', Addison Wesley Publishing Company, Reading Mass. (1980)
5. Bialynicki-Birula, M. Cieplak & J. Kaminski, 'Theory of Quantua', Oxford University Press, New York (1992)
6. W. Greiner, 'Relativistic Quantum Mechanics', Springer Verlag, Berlin (1990)
7. F. Schwable, 'Quantum Mechanics', Narosa Publishing House, New Delhi (1992)
8. David J. Griffiths, Introduction to Quantum Mechanics, PRENTICE Hall, Int., Inc.
9. S. Gasiorowicz, Quantum Physics, John Wiley & Sons, Inc., Singapore

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Course Title: Thermal & Statistical Physics **Credit Hours:** 03
Course Code: PHYS – 306 **Course Type:** Major – 9
Pre-requisite: F.Sc Physics and Heat and Thermodynamics
Objectives:
- To develop the understanding of thermal properties by using statistical means in thermodynamics
- Development of various statistics like Boltzmann Statistics, Bose–Einstein statistics and Fermi-Dirac Statistics
- To develop the understating of lattice dynamics in solid materials

Equilibrium Thermodynamics:
Basic postulates, fundamental equations and equations of state, response functions Maxwell's relation, reduction of derivatives.
Elements of Probability Theory:
Probabilities, distribution functions, statistical interpretation of entropy, Boltzmann H-theorem
Formulation of Statistical Methods:
Ensembles, counting of states (in classical and quantum mechanical systems, examples) partition function, Boltzmann distribution. Formation of Micro-canonical, canonical and grand canonical partition function
Partition Function:
Relations of partition function with thermodynamic variables, examples (collection of simple harmonic oscillators, Pauli and Van-Vleck Paramagnetic, Theorem of Equipartition of energy.
Statistical Systems:
Maxwell-Boltzmann, Bose-Einstein, Fermi-Dirac statistical systems, Examples of thermodynamics of these systems; Black body radiations, Gas of electrons in solids.
Statistical Mechanics of Interacting Systems:
Lattice vibrations in solids; Van der Waals Gas: mean field calculation; Ferro-magnets in Mean Field Approximation.
Advanced Topics:
Fluctuations, Bose-Einstein Condensation, Introduction to density matrix approach.

Books Recommended:

1. F. Mandl, Statistical Physics, ELBS/John Willey, 2nd Ed. 1988.
2. F. Reif, Fundamentals of Statistical and Thermal Physics, McGraw Hill, 1965.
3. A.J. Pointon, Introduction to Statistical Physics, Longman 1967.
4. C. Kittel, Elements of Statistical Physics, John Wiley 1958.

Course Title: Analog Electronics – II **Credit Hours:** 03
Course Code: PHYS – 310 **Course Type:** Major – 10
Pre-requisite: Analog Electronics – I

Objectives:

- To develop the understanding of different electronic circuit elements and devices like diode, transistors, amplifiers, oscillators and voltage regulators used in daily life alliances
- To understand the day to day electronic devices

Transistor Biasing:

Load Line, Q-Point and Various Biasing Circuits for BJI and FET stability Factor Stabilization against V_m and β Bias compensation, Thermal Runway Stability

Transistor Equivalent Circuits & Models:

DC AC equivalent circuits, T & hybrid model, important parameters

Transistor Amplifier:

BJT & FET small and large signal amplifiers, Low and high frequency response, Compound configurations, cascade connections, Darlington connections, CMOS Circuit, current source circuit, differential amplifiers, BIFET, BIMOS & CMOS differential circuit amplifiers.

Introduction to Integrated Circuits:

Introduction, classification, production cycle, fabrication of resistors, diodes & transistors

Voltage Regulators:

Power supply characteristics, Series, Shunt & switching regulators, DC voltage regulators.

Operational Amplifier:

Introduction, modes of signal operators, operational amplifiers parameters, negative feedback and its effects, frequency response, stability & compensation, OP-Amplifiers, active filters.

Oscillators & Multivibrators:

Concepts, Types, Oscillator Principles, Capital RC & RL-feedback circuits, Non-sinusoidal Oscillator, Crystal Oscillator, Astable-, Bi-stable-, Mono-stable Multivibrators, Schmitt Trigger circuit

Recommended Books:

1. T. L. Floyd, Electronics Devices, 5th edition, Prentice Hall, New Jersey, USA, 1999.
2. T.L. Floyd, Electronic Devices, 4th edition, Prentice Hall, New Jersey, USA, 1996
3. R.L. Boylestad & L. Nashelsky, Electronic Devices & Circuit Theory, 7th Ed., Prentice Hall, USA, 1999
4. Albert Paul Malvino, Electronic Principles, 6th Edition, Glencoe, USA, 1993.
5. J.D. Ryder & C.M. Thomson, Electronic Circuits & Systems, Prentice Hall, New Jersey, USA, 1976.
6. J. Millman & C.C. Halkiasm Electronics Devices & Circuits, McGraw-Hill International, 1968.

Course Title: Laboratory (Analog Electronics) **Credit Hours:** 02
Course Code: PHYS – 312 **Course Type:** Major – 11
Pre-requisites: Laboratory IV and Analog Electronics – I & II

Objectives:

- To expose the students to advance level experimentation in Physics
- To make them familiar to such experiments whose out come can be used in developing future research capabilities and teaching skills
- To make the students confident in their studies by showing and measuring parameter which they have used in theoretical work

List of Experiments:

1. Design and study of Full-wave and Bridge rectifier and measure the effect of filter elements on the DC output and ripple
2. Design a voltage doubler supply and measure the Dc voltage at key points
3. Draw the input and output characteristic curves of a transistor in common emitter configuration and determine the hybrid parameters
4. Wave shaping circuits by diodes
5. Design and study of the clapping circuits
6. Design and construct a variable voltage regulated power supply
7. Design and study of a C.E. transistor voltage amplifier
8. Design and study of transistor power amplifier
9. Design and study of class B push putt transistor power amplifier
10. Design and study of an emitter follower
11. Design and study of a transistor RC phase shift oscillator
12. Design of UTJ relaxation Oscillator
13. Design and study of AC voltage follower using Op-Amplifier
14. Design and study of AC inverting amplifier using Op-Amplifier
15. Design and study of AC non-inverting amplifier using Op-Amplifier
16. Design and study of transistor Astable Multivibrator
17. Design and study of Bistable multivibrator
18. Design and study of Monostable multivibrator

Note: At least ten experiments to be performed and Universities may opt for other experiments according to the available facilities.

Course Title: Nuclear Physics **Credit Hours:** 03
Course Code: PHYS – 401 **Course Type:** Major – 12
Pre-requisite: Modern Physics and Electronics

Objectives:

- To understand the nuclear structure using different nuclear models
- To understand the nature of nuclear forces
- To give understanding of radioactivity and nuclear reactions

History:

Starting from Bacqurel's discovery of radioactivity to Chadwick's neutron

Basic Properties of Nucleus:

Nuclear size, mass, binding energy, nuclear spin,magnetic dipole and electric quadrupole moment, parity and statistics.

Nuclear Forces:

Yukawa's theory of nuclear forces, Nucleon scattering, charge independence and spin dependence of nuclear force, isotopic spin.

Nuclear Models:

Liquid drop model, Fermi gas model, Shell model, Collective model

Theories of Radioactive Decay:

Theory of Alpha decay and explanation of observed phenomena, measurement of Beta ray energies, the magnetic
lens spectrometer, Fermi theory of Beta decay, Neutrino hypothesis, theory of Gamma decay, multipolarity of Gamma rays, Nuclear isomerism.

Nuclear Reactions:

Conservation laws of nuclear reactions, Q-value and threshold energy of nuclear reaction, energy level and level width, cross sections for nuclear reactions, compound nucleolus theory of nuclear reaction and its limitations, direct reaction, resonance reactions, Breit-Wigner one level formula including the effect of angular momentum.

Books Recommended:

1. Segre, Nuclei and Practicles, Bejamin, 1977.
2. Kaplan, Nuclear Physics, Addison-Wisely, 1980.
3. Green, Nuclear Physics, McGraw Hill, 1995.
4. Kenneth S. Krane, Introducing Nuclear Physics, 1995.
5. B. Povh, K. Rith, C. Scholtz, F. Zetsche, Particle and Nuclei, 1999.

Course Title: Solid State Physics – I **Credit Hours:** 03
Course Code: PHYS – 403 **Course Type:** Major – 13
Pre-requisite: Quantum Mechanics, Electricity Magnetism I & II, Heat and Thermodynamics, Statistical Physics

Objectives:

- To develop a basic knowledge of crystallography
- To understand the x-ray diffraction in crystal investigation
- To understand the binding forces in crystalline material
- To develop the understanding of lattice dynamics and its uses in derivation of theories of specific heat
- To understand the behavior of free electrons in metals and Fermi Energy

Course Contents:

Simple crystal structure, Principles of X-ray diffraction with the concept of reciprocal lattice, Inter-atomic forces and type of bonding, lattice vibrations: thermal, acoustic and optical properties. Free electron theory of metals. Introductory band theory of solids, Simple Fermi surfaces

Recommended Books:

1. C.Kittel, Introduction to Solid State Physics, 7th edition 1996, John Wiley
2. M.A. Omer, Elementary Solid State Physics, Addison-Weseley Pub. Co. 1974
3. S.O Pillai, Solid State Physics, New Age International Pub. 2003.

Course Title: Electromagnetic Theory – I **Credit Hours:** 03
Course Code: PHYS – 405 **Course Type:** Major – 14
Pre-requisite: Electricity & Magnetism I & II

Objectives:

- To give the basic understanding in static electromagnetic fields and time dependent electromagnetic fields
- To develop knowledge of propagation, reflection and refraction of electromagnetic waves
- To develop the understanding of skin effect and wave guides

Electrostatics:

Electric Charge, Coulombs Law, Electric Field, Electrostatic Potential, Gauss's Law, Applications of Gauss's Law, Electric Dipole, Multipole Expansion of Electric Fields.

Solution of Electrostatic Problems:

Poisson's Equation, Laplace Eqution, Uniqueness Theorem, Laplace Equation in One independent Variable, Solution to Laplace Equation in Spherical Coordinates (Zonal Harmonics), Laplace in Rectangular Coordinates, Conduction Sphere in a Uniform Electric Field. Electrostatic Images, Point Charge and conducting Sphere, Parallel Cylinders, Line Charges and Line Images.

The Electrostatic Field in Dielectric Media:

Polarization, Field Outside of a Dielectric Medium, Electric Field Inside a Dielectric, Gauss's Law in a Dielectic, The Electric Displacement, Electric Susceptibility and Dielectric Constant, Point charge in a Dielectric Fluid, Boundary Conditions on the Field Vectors, Boundary Value Problems Involving Dielectrics, Dielectric Sphere in a Uniform Electric Field.

Microscopic Theory of Dielectrics:

Molecular Field in a Dielectric, Clausius-Mossotti Equation, Induced Dipoles, A Simple Model, Polar Molecules, The Langevin-Debye Formula, Permanent Polarization, Ferro-Electricity.

Electrostatic Energy:
Potential Energy of a Group of Point Charges, Electrostatic Energy of a Charge Distribution, Energy Density of an Electrostatic Field, Energy of a System of Charged Conductors-Coefficient of Potential, Forces and Torques.

Electric Current:
Nature of the Current, Current Density, Equation of Continuity, Ohms Law, Conductivity, Steady Currents in Continuous Media, Approach to Electro-static Equilibrium, Microscopic Theory of Conduction, Joule Heating.

Text Books:
J.R. Reitz, F.J. Milford and R.W. Christy, Foundation of Electromagnetic Theory, 4th Edition, Addison Wesley Publishing Inc. Massachusetts, USA, 1993.
Munir H. Nayfesh and Morton K. Brussel, Electricity and Magnetism, 1st Edition John Wiley & Sons Inc., New York, USA, 1985.

Recommended Books:
1. Roald K. Wangsness, Electromagnetic Fields, John Wiley & Sons Inc., New Yourk, USA, 1979.
2. J.D. Jachson, Classical Electrodynamics, 2nd Edition, John Wiley & Sons Inc., New York, USA, 1975.
3. David J. Griffiths, Introduction to Electrodynamics, 1st Edition, Prentice-Hall UK, 1995.

Course Title: Solid State Physics – II **Credit Hours:** 03
Course Code: PHYS – 404 **Course Type:** Major – 15
Pre-requisite: Quantum Mechanics, Electricity Magnetism I & II, Heat and Thermodynamics, Statistical Physics

Objectives:
- To develop a basic knowledge of crystallography
- To understand the x-ray diffraction in crystal investigation
- To understand the binding forces in crystalline material
- To develop the understanding of lattice dynamics and its uses in derivation of theories of specific heat
- To understand the behavior of free electrons in metals and Fermi Energy

Course Contents:
Transport properties of solids. Boltzmann equation, Point defects and dislocations in solids, Dielectrics, Dia, Para and Ferro-magnetism, Magnetic relaxation and resonance phenomena, Superconductivity and devices,
Introduction to superconductivity with applications

Books Recommended:
1. C. Kittle, Introduction to Solid State Physics, 7th edition 1996, John Wiley.
2. S.O.Pillai, Solid State Physics, New Age International Pub, 2003
3. W.T. Read Jr. Dislocations in crystals, McGraw Hill, 1991.
4. C.M. Kachaava, Solid State Physics, Tata McGraw Hill. Co. New Delhi, 1989
5. J.R. Christman, Solid State Physics, John Wiley & Sons, New York, 1988
6. H.E. Hall, Solid State Physics, John Wiley & Sons, New York, 1982.
7. A. Guinier & R. Jullien, The Solid State, Oxford University Press, Oxford, 1989

Course Title: Electromagnetic Theory – II **Credit Hours:** 03
Course Code: PHYS – 406 **Course Type:** Major – 16
Pre-requisite: Electromagnetic Theory – I

Objectives:
- To give the basic understanding in static electromagnetic fields and time dependent electromagnetic fields
- To develop knowledge of propagation, reflection and refraction of electromagnetic waves
- To develop the understanding of skin effect and wave guides

Magnetic Field of Steady Currents:

The Definition of Magnetic Induction, Forces on Current Carrying Conductors, The Law of Biot and Savart, elementary Applications of Biot-Savart's Law, Ampere's Circuital Law, The Magnetic Vector Potential, The Magnetic Field of Distance Circuit, The magnetic Scalar Potential, Magnetic Flux.

Magnetic Properties of Matter:

Magnetization, Magnetic Field Produced by Magnetized Material, Magnetic Scalar Potential and Magnetic Pole Density, Sources of The Magnetic Field, Magnetic Intensity, The Field Equations, magnetic Susceptibility and Permeability, Hysteresis, Boundary Conditions on Field Vectors, Electromagnetic Induction, Self Induction, Matual induction, The Neumann Formula.

Maxwell's Equations:

The Generalization of Ampere's Law, Displacement Current, Maxwell's Equations and the Empirical Bases, Electromagnetic Energy, The Wave Equation, Boundary Conditions, Wave Equation with Sources, Retarded Scaler and Vector Potentials, Lorentz Condition.

Applications of Maxwell's Equations:

Plane Monochromatic Waves in Non-Conducting Media, Polarization, Energy Density and Flux, Plane Monochromatic Waves in Conduction Media, Reflection and Refraction at the Boundary of Two Non-conduction Media (Normal Incidence, Oblique incidence), Brewster's Angle, Critical Angle, Complex Fresnel's Coefficients, Reflection From a Conducting Plane, Reflection and Transmission by a Thin Layer, Interference, Propagation Between Parallel Conducting Plates, Waveguides, Cavity Resonators.

Optical Dispersion in Materials:

Drude Lorentz Harmonic oscillator model, Resonance absorption by bound charges, Cauchy's relation, The Drude Free electron theory, Kramers-Kroing relations

Radiation Emission:

Radiation from an oscillating dipole, Radiation from a half wave antenna.

Text Books:

J.R. Reitz, F.J. Milford and R.W. Christy, Foundation of Electromagnetic Theory, 4th Edition, Addison Wesley Publishing Inc. Massachusetts, USA, 1993.

Munir H. Nayfesh and Morton K. Brussel, Electricity and Magnetism, 1st Edition, John Wiley & Sons Inc., New York, USA, 1985.

Recommended Books:

1. Roald K. Wangsness, Electromagnetic Fields, John Wiley & Sons Inc., New York, USA, 1979
2. J.D. Jackson, Classical Electrodynamics, 2nd Edition, John Wiley & Sons Inc., New York, USA, 1975
3. David J. Griffiths, Introduction to Electrodynamics, 1st Edition, Prentic-Hall, UK, 1981

COURSE OUTLINE

OF

ELECTIVE COURSES

FOR

BS – 4 YEARS PROGRAM

IN PHYSICS

Paper A-I Digital Electronics-I (3 Cr. Hours)

NUMBER SYSTEMS AND CODES

Decimal, Binary, Octal, Hexadecimal Numbers and their Conversions, Codes, BCD, GRAY, excess-3, ASCII, EBCDIC, Even/Odd Parity Generator.

LOGIC GATES

Inverter, AND, OR, NAND, NOR, Ex-OR and Ex-NOR logic gates, Universal property of NAND and NOR gates, Combinational logic circuits.

BOOLEAN ALGEBRA AND LOGIC SIMPLIFICATION

Boolean Operations and Expressions, Laws and Rules of Boolean Algebra, DeMorgan's Theorem, Simplification using Boolean Algebra, Karnaugh Map, Karnaugh Map SOP and POS Minimization.

FLIP-FLOPS AND RELATED DEVICES

Introduction to Flip-Flops, R-S F/F, J-K F/F, D-Type F/F, T-Type F/F, Master Slave J-K F/F, Flip Flop Applications, One-Shots, 555 Timers.

COUNTERS

Asynchronous/Synchronous Counter operation, Up/Down Counter, Design of Synchronous Counters, Cascaded Counters, Counter Applications.

Recommended Books

1. Digital Fundamentals, (7^{th} Ed.) T.L. Floyd, Prentice Hall International Inc. (2000).
2. Digital Principles and Applications, (5^{th} Ed.) D.P. Leach and A.P. Malvino,Glencoe/McGraw Hill (1995).
3. Introduction to Digital Circuits, T.F. Bogart Jr., Glencoe/McGraw Hill (1992).
4. Digital Systems Principles and Applications, (6^{th} Ed.) R.J.Tocci, Prentice Hall, Inc.(1995).
5. Digital Electronics, (4^{th} Ed.), Bignell & Donovan, Delmar Thomson Learning.

Paper A-II Digital Electronics-II (3 Cr. Hours)

INTEGRATED CIRCUIT TECHNOLOGIES.

TTL Subfamilies and Characteristics, CMOS Subfamilies and specifications, Interfacing TTL to CMOS, Emitter Coupled Logic (ECL), Interfacing (ECL) to other Logic Families.

PROGRAMMABLE LOGIC DEVICES AND THEIR APPLICATIONS

PLD Arrays and Classifications, Programmable Array Logic, Generic Array Logic, Sequential Logic Applications of PLD's

REGISTERS

Basic Shift Register Functions, Serial In/Serial Out, Parallel In/Serial Out, Parallel In/Parallel Out Shift Registers, Bidirectional Shift Register, Shift Register Counters, Shift Register Applications.

DECODER, MULTIPLEXERS DEMULTIPLEXERS & DISPLAYS

Decoders, Multiplexers, Demultiplexers, Multiplexers and Demultiplexers ICs, Seven Segment Display, Liquid Crystal Display, Making a 3-to-8 Decoder from the Programmable Logic Devices.

INTERFACING

Digital and Analog Interfacing D/A and A/D Conversion, Troubleshooting DAC's and ADC's

MEMORIES AND INTRODUCTION TO COMPUTER

Microcomputer and its parts, Computer Memory, ROM, PROM, EPROM, EEPROM, Static RAM, Dynamic RAM, Micro-controller.

Recommended Books

1. Digital Fundamentals, (7th Ed.), T.L. Floyd, Prentice Hall International Inc. (2000).
2. Digital Principles and Applications, (5th Ed.) D.P. Leach and A.P. Malvino, Glencoe/McGraw Hill (1995).
3. Introduction to Digital Circuits, T.F. Bogart Jr., Glencoe/McGraw Hill (1992).
4. Digital Systems Principles and Applications (6th Ed.), R.J. Tocci, Prentice Hall, Inc.(1995).
5. Digital Electronics (4th Ed.), Bignell & Donovan, Delmar Thomson Learning.

Paper A-III Digital Electronics Laboratory. (3 Cr. Hours)

List of Experiments

1. **D**esign and study of logic circuits.
2. The conversion of Sr Flip-Flopinto D, T and J-K Flip Flops.
3. Half and full adder circuits.
4. Half and full subtractor circuits.
5. Parallel binary adders.
6. Parallel binary subtractor circuits.
7. Design and study of Up/Down counters.
8. Design and study of Decade Counter.
9. 7-Segment Decoder/Driver.
10. Synchronous Counters with Decoder/Driver.
11. Asynchronous Counters with Decoder/Driver.
12. Bi-directional shift registers.
13. Serial-in Serial-out shift register.
14. Serial-in Parallel-out shift register.
15. Parallel-in Serial out shift register.
16. Parallel-in Parallel-out shift register.
17. Combinational Logic using Multiplexer and Demultiplexer.
18. Digital to analog conversions.
19. Analog to digital conversion.
20. 555 Timer as Astable multivibrator.
21. 555 Timer as One-shot multivibrator.

A-IV Project (3 Cr. Hours)

OPTION-B (INSTRUMENTATION) (12 Cr. Hours)

Paper B-I Digital Computer Logic Design and Analysis. (3 Cr. Hours)

1) **INTRODUCTION**

Computer, Basic components of computers system, Introduction to operating system, Fundamental concept of Hardware and Software, Computer Language.

2) **NUMBER SYSTEM AND INTERNATIONAL DATA REPRESENTATION**

Binary Number system, Conversion to decimal number system and Viceversa, Octal Number System, Hexadecimal number system and their conversion, Octal number system and their conversion, One's and two's Complement method, Addition, Subtraction and Multiplication, 8421 BCD CODE, ASCII Code, EBSDIC code, Graycode, Fixed point, Floating point.

3) **LOGIC DESIGN**
Logic gates, Boolean Algebra, Flip-flops, Counters, Shift-Registers, Multiplexers, Demultiplexers, Decoder/Drivers, Encoders, Adders, Multipliers, RAM, ROM.

4) **MICRO PROCESSORS**
Introduction to Microprocessor, A Brief Introduction to 8086/8088 Srial/Paralell I/O IEEE, Introduction to Support Chips Interrupts.

5) **PROGRAMMING (FORTRAN/C^{++} LANGUAGE)**
Description of the Problem, Flow-Chart, Computer Programs, Constants, Variables, Symbols I/O Statements, Format Specification, Control Statements, Arithmetic Operation, Builting Mathematical Function, Function Subprogram and Subroutine Sub-Program, Files Type and Organization Handling, Introduction to Data structure.

6) **NUMERICAL ANALYSIS AND APPLICATION**
Solution of System of Linear Equations, Solution of 1st Order and 2nd Order Differential Equations, Numerical Integration, Solution of Simultaneous Equations, Least Squre Fit of Data, Computer Programs for Solving Problems

Reference Books

1. Fortran 77 for Engineers and Scientists by Horry Nyhoff Sanfor Lestma, Mc Million Publishing Company 1985, New York.
2. Digital Logic and computer Design by M. Morris Mano, 2nd Edition, Prentice Hall, Inc. Englewood Cliffs, New Jersey.
3. Applied Numerical Analysis for digital computer by M.L. Games, G.M. Smith and J.C. Walford, HARBER and Row, Publishers, New York.
4. Numerical Analysis with Fortran programming by Mc CRACKEN Daniel, Mc Graw Hill.
5. Microcomputer systems the 8086/8088 Family, Architect programming and Design by Gibson, 1984 by Prentice-Hall, Inc. Englewood Cliffs, N.J.07632.

Paper B-II INSTRUMENTATION AND CONTROL SYSTEM-I (3 Cr. Hours)

Digital Fundamentals
Number Systems, Codes, Logic gates, Combinational logic circuits, Boolean Algebra and K-Map Simplification, Flip flops and their applications D/A and A/D Converters.

Errors And Measurements
Introduction to measurements and errors, Significant figures, Random, systematic and gross errors, Accuracies and tolerance, Instrument errors.

Noise Grounding And Shielding
Thermal, Shot, Flicker and Burst noise, Signal noise ratios and noise figures, Electrically, Magnetically and electro-magnetically coupled interference, AC power line, ground faults and instrument ground, Inductive and Capacitive coupling noise.

Ac/Dc Meters And Bridges
PMMC meter construction, Motion damping, Balancing moving coil support system and Arsonoval response, Sensitivity and coil resistance, Temperature compensation, Galvanometer, DC ammeters and voltmeters, Internal meter resistance, Meter calibration, Rectifier instrument (AC), Iron-vane meter, Thermo-coupled meter, Electrostatic Voltmeters, Single and poly phase power meters, Energy measurement analogy, Digital multi-meter, Potentiometer chart recorders, AC bridge resistance capacitance and inductance, Commercial RLC bridges.

Signal Conditioning And Acquisition
Analog signal level charges, Linearization, Conversion, Filtering and impedance matching, Op-amplifier circuits in instrumentation, SCR, TRIAC, Specialized IC''s digital filtering fundamentals,

ADC and DAC data acquisition systems, Micro-computers/Micro-controllers, Interfacing data converters for computers.

Recommended Books

1. Digital Fundamentals, (7th Ed.) T.L. Floyd, Prentice Hall International Inc.(200).
2. Digital Principles and Applications (5th Ed.) D.P. Leach and A.P. Malvino, Glencoe/McGraw Hill (1995).
3. Process Control Instrumentation Technology (3rd Ed.), C.D. Johnson, John-Wiley & Sons Inc. (1998).
4. Electronics of Measuring Systems, Tran Tien Lang, John-Wiley & Sons Inc. (1987).
5. Electronics Instrumentation (3rd Ed.) J.Disfenderfer, Holt-Saunder (1985).
6. Electronics Measurement and Instrumentation, B.M. Oliver, McGraw-Hill Book Company (1975).
7. Transducer Interfacing, R.G. Seippel, Prentice Hall Inc. (1998).
8. Electronic Instruments and Measurements, L.D. Jones and A.F. Cghin, John-Wiley & Sons Inc. (1983).

Paper B-III INSTRUMENTATION AND CONTROL SYSTEM-II (3 Cr. Hours)

Thermal, mechanical and optical transducers.

Metal resistance versus temperatures, Principle and devices, Thermo resistors, Thermo couplers, Bimetallic strips, Gas vapor pressure and liquid expansion thermometers, Displacement, location and position transducers, Strain transducers, Motion, pressure and flow transducers, Electromagnetic radiations, Photo-detectors, Pyrometers, Conventional and laser olight sources, Label inspection, Turbidity and ranging.

Signal Generating & Measuring Devices

Waveform generators and analyzers, High, low and very low frequencies generators, Pulse generators, Frequency synthesizers/generators, Spectrum, Fourier wave, Disturbance and audio analyzers, Oscilloscopes, Logic analyzers, RF voltmeters, RF power measurements, Fiber optics test equipment, Noise figure meters.

Control System

Control fundamentals, Open loop and closed loop systems, transfer function, signal flow graph, gain formula, Mathematical modeling of linear electrical and mechanical systems, state variables, state equations and state diagrams, Analysis and design, Stability, controllability and observe-ability of systems, state transition matrix, transient and steady state response, root locus method, Nyquist criterion, PID Controllers, Lead-Lag Compensators, Pole-Zero Cancellations, Analog and microprocessor based control systems, design examples.

Recommended Books

1. Digital Fundamentals (7th Ed.) T.L. Floyd, Prentice Hall International Inc. (2000).
2. Digital Principles and Applications (5th Ed.) D.P. Leach and A.P. Malvino, Glencoe/McGraw Hill (1995).
3. Process Control Instrumentation Technology (3rd Ed.), C.D. Johnson, John-Wiley & Sons Inc. (1988).
4. Electronics of Measuring Systems, Tran Tien Lang, John-Wiley & Sons Inc. (1987).
5. Electronics Instrumentation (3rd Ed.), J. Disfenderfer, Holt-Saunder (1985).
6. Electronics Measurement and Instrumentation, B.M. Oliver, McGraw-Hill Book Company (1975).
7. Transducer Interfacing, R.G. Seippel, Prentice Hall Inc. (1988).

8. Electronic Instruments and Measurements, L.D. Jones and A.F. Cghin, John-Wiley & Sons Inc. (1983).
9. B.C. Kuo, Automatic Control Systems (Prentice-Hall 1987).
10. J.J.D'Azzo and C.H. Houpis, Linear Control Systems: Analysis and Design (Prentice-Hall 1985).
11. B.C. Kuo, Digital Control Systems (Holt, Rinehart and Winston 1980).

Paper B-IV DLD and Instrumentation Laboratory. (3 Cr. Hours)

Instrumentation Laboratory

1. Introduction to Oscilloscope.
2. Design and study of logic circuits.
3. The conversion of SR Flip-Flop into D, T and J-K Flip Flops
4. Half and Full adder circuits.
5. Half and Full subtractor circuits.
6. Design and study of Up/Down counters with Decoder/Driver.
7. Bi-directional Shift Registers.
8. Multiplexer and Demultiplexer.
9. D/A and A/D conversions.
10. 555 Timer as One-shot and Astable multivibrator.
11. Measurement of Impedance using RLC bridge circuit.
12. Design of various filters using Op-AMP.
13. To verify experimentally the characteristics of seven-segment LED array and to properly connect a BCD-to-Seven segment decoder/driver to seven-segment display.
14.. To learn 8421 BCD Code and to study the operation of 8421 BCD decoder.
15. To study the behaviour of OR, AND , NOR, NAND, XOR and to learn the significance of the term threshold and to observe the essential points of transfer characteristics.
16. To study the characteristics of R-S, J.K and master-slave flip-flops and also design the Mod-12 Counter.

Note:- 10 experiments will be the minimum requirement.

Reference Books

1. Fortran 77 for Engineers and Scientists by Horry Nyhoff Sanfor Lestma, Mc Million Publishing Company 1985, New York.
2. Digital Logic and computer Design by M. Morris Mano, 2nd Edition, Prentice Hall, Inc. Englewood Cliffs.
3. Fortran Computer Manual.
4. Applied Numerical Analysis for digital computer by M.L. Games, G.M. Smith and J.C. Walford, HARBER and Row, Publishers, New York.
5. Microcomputer systems the 8086/8088 Family, Architect programming and Design by Gibson, 1984 by Prentice-Hall, Inc. Englewood Cliffs, N.J.07632.

B-V Project (3 Cr. Hours)

OPTION-C (SOLID STATE PHYSICS) (9 Cr. Hours)

Paper C-I Special Solid State Physics-I (3 Cr. Hours)

1. **Elastic Constants and Elastic Waves**

   Elastic Waves, Analysis of elastic strains, Elastic compliance and stiffness constants, Elastic waves in cubic crystal, experimental determination of elastic constants.

2. **Point Defects**

Types of imperfections, lattice vacancies, Diffusion, Colour Centres, F – Centres other Centres in Alkali halites.

3. **Surface and Interface Physics**
Surface crystallography, Surface electronic structure, p-n Junctions

4. **Dislocations**
Dislocations and the Mechanical Strength of Metals, Burgers Vectors, Stress field of dislocation, low angle grain boundaries, dislocation densities, radiation damage insolids.

Text Book:
Introduction to Solid State Physics by Charles Kittel.
4^{th} & 7^{th} Edition.

Recommended Books:
1. Elementary Solid State Physics by Ali Omar.

Paper C-II Special Solid State Physics-II (3 Cr. Hours)

1. **Diffraction I: Directions of Diffracted Beams**
Diffraction, Bragg law, X-ray spectroscopy, Diffraction directions, Diffraction methods

2. **Diffraction II: Intensities of Diffracted Beams**
Scattering by an electron, Scattering by an atom, Scattering by a unit cell, Structure-factor calculations, Application to powder method, Multiplicity factor, Examples of intensity calculations.

3. **Determination of Crystal Structure**
Preliminary treatment of data, Indexing patterns of cubic crystals, Indexing patterns of noncubic crystals, Determination of the number of atoms in a unit cell, Determination of atom positions, Examples of structure determination.

Text Books:
1. Elements of X-Ray Diffraction, 2^{nd} Edition, by B.D.Cullity.

Paper C-III SPECIAL SOLID STATE PHYSICS- III (3 Cr. Hours)

Simple metals, review of free electron model, electrostatic energy, the empty core pseudopotential, free electron energy, density and bulk modulus, cohesion, electronic structure of metals, pseudopotential in the perfect lattice, electron diffraction by pseudopotential, nearly free electron bands and Fermi surfaces, scattering by defects, screening, mechanical properties, band structure energy, phonon spectrum, electron phonon interaction.

Text Book:
1. Electronic structure and the properties of solids by Walter A. Harrison,Freeman(1980).

Recommended Books:
1. Solid State Physics by Ashcroft and Mermin, Saunders College(1976).
2. Elementary Solid State Physics by M.Ali Omar, Addisson Weseley(1996).
3. Introduction to solid state physics by Charles Kittel 7^{th} edition, John Wiley (1996).
4. Solid State Physics by Ibach and Luth, Springer(1996).

Paper C-IV Laboratory (3 Cr. Hours)

Note:- Experiments related to Paper C-I,II & III shall be performed during this course.

C-V Project (3 Cr. Hours)

C-VI Thesis (6 Cr. Hours)

OPTION-D (LASER PHYSICS) (9 Cr. Hours)

Paper D-I Opto-Electronics and Lasers. (3 Cr. Hours)

1) **FUNDAMENTALS OF ELECTROMAGNETIC THEORY**
Complex function formalism, Consideration of energy and power in Electromagnetic fields, wave propagation in isotropic medium wave propagation in crystals.

2) **THE PROPAGATION OF RAYS AND BEAMS**
Lens waveguide, propagation of rays between mirrors, Rays in lenslike media, wave equation in quadratic index media, Gaussian Beams in Homogenous medium, Gaussian Beam in a lenslike Medium, ABCD law, High Order Gaussian Beam Modes in a Homogeneous Medium. High Order Gaussian Beam Modes in Quadratic Index Media.

3) **OPTICAL RESONATORS.**
Febry-Perot Etalon, Optical spectrum analyzers, optical reasonators with spherical mirrors, mode stability criteria, modes in a generalized resonator, resonance frequencies of optical resonators, losses in optical resonator, Unstable optical resonators.

4) **INTERACTION OF RADIATION AND ATOMIC SYSTEMS**.
Spontaneous transitions between atomic levels, Homogeneous and inhomogeneous broadening, induced transition absorption and amplification, the electron oscillator model of an atomic transition, atomic susceptibility gain saturation in homogeneous laser laser media; inhomogeneous media.

5) **THEORY OF LASERS OSCILLATOR**
Fabry Perot laser, Oscillation frequency, three and four level lasers, power in laser oscillators, optimum output coupling in laser oscillators, Multi mode laser oscillation and mode locking, relaxation oscillation in lasers.

6) **SOME SPECIFIC LASER SYSTEMS.**
Pumping and laser efficiency, Ruby laser, Nd-YaG laser, Neodymium-Glass laser, He-Ne laser, carbon dioxide laser, Excimer laser.

7) **SEMICONDUCTOR LASERS.**
General consideration, Semiconductor materials, stimulated emission, wave guiding, far filled pattern, threshold current density, laser operating characteristics, device structure light output and spectral distribution turn on delay, laser degradation.

Text Book

1. Optical Electronics by Amnon Yariv, CBS College Publishing USA, 1985.
2. Principles of lasers, O.Svelto, Plenum Press USA.
3. Optoelectronics, an introduction, by J.A. vilson and F.B. Hawkes, Printice Hall.
4. Laser by B.A. Lengyel, Wiley Interscience USA.
5. Physics of Semiconductor devices, S.M. Sze, Willy Interscience USA.
6. Heterostructure Lasers, H.C. CASEY and M.B. Panish, Academic Press USA.
7. Optical processes in semiconductors, J.I. Pankove, Dover publications USA.

Paper D-II Semiconductor Laser Devices (3 Cr. Hours)

1) **CRYSTAL STRUCTURE.**
Bonding and Band Structure, Dopants; Low Concentrations, High Concentrations, Band Tail States, Electron Distribution and Density of States, Electron Hole Pair Formation and Recombination, Direct and Indirect Band Gap Materials and Internal Quantum Efficiency, Recombination Viva Centres in the Forbidden Energy Gap, Minority Process other than Band to Band, Free to Bound Carrier Recombination, Exciktonic Effects, Iso-Electronic Impurity Effects on Luminescence, Donor-Acceptor Pair, Radiation, Non-Radiative RecombinationProcess, Multiphonon Emission, Non-Radiative Process Involving the Auger Effect.

2) **P-N JUNATIONS AND HETEROJUNCTIONS**
Current Voltage Characteristics, Ideal Junctions, Non-Ideal Junctions, Junction Capacitance, Heterojunctions, General Considerations, Heterojunction Band Diagram, Current Voltage Characteristics, Light Current Relationship in Spontaneous Emission, Diode Frequency Response as Limited by Carrier Life Time.

3) **STIMULATED EMISSION AND GAIN.**
Optical Gain in Two level Atomic System, Optical Gain in a Direct Band Gap Semiconductor, The Fabry Perot Cavity and Threshold condition, Laser Transitions, Pure Materials, Effect of Dopants on the Emission Wavelength.

4) **RELATION BETWEEN ELECTRICAL AND OPTICAL PROPERTIES OF LASER DIODES.**
Carrier Confinement and injected Carrier Utilization, Interfacial Recombindation and Carrier Utilization, Threshold Current Density and Differential Quantum Efficiency, Temperature Dependence of Threshold Current Density, Optical Anomalies and Radiation Confinement, Loss in Asymmetrical Heterojunction Lasers.

5) **TYPE OF LASERS**
Homo-Structure Lasers, Single Hetero-Structure Lasers, Double Hetero-Structure Lasers, Stripe Geometry.

TEXT BOOK

Semiconductor Lasers and Heterojunction LED's, by Henry Kressel and J.K. Butler, Academic Press.

Recommended Books

1. Physics of Semiconductor devices, G.H.B. Thompson, John Wiley,
2. Gallium Arsenide Laser, C.H. Gooch, John Wiley.
3. Physics of Semiconductor devices, S.M. SZE, John Wiley.

Paper D-III Laboratory (3 Cr. Hours)

Note:- Experiments related to Paper D-I&II shall be performed during this course.

D-IV Project (3 Cr. Hours)

D-V Thesis (6 Cr. Hours)

OPTION-E (NUCLEAR/RADIATION PHYSICS) (9 Cr. Hours)

Paper E-I Radiation Physics. (3 Cr. Hours)

1) **RADIOBIOLOGY**

Radiation Chemistry, Radiation Effects on Biologically Important Molecules, Biological Effects of Radiations, Modification of Radiation Injury.

2) **RADIOTHERAPY**

Clinical Treatment Planning and Calibration of Radiotherapy Equipment using Co-60 Unit and Linear Accelerator For Rotational, Interstitial and Intracavitory Radiation Treatment.

3) **ANATOMY AND MEDICAL TERMINOLOGY**

Introduction to the Human Anatomy and Medical Terminology Useful for Diagnosis and Treatment with Radiation Sources.

4) **RADIATION DOSIMETRY**

Calculation of Doses for Poin, Line, Disc and Cylindrical Sources, Area and Personnel Monitoring, Calculation of Doses from Internally Deposited Radioisotopes, Bioassays, Invivo Coonnting, Thyroid, Brain, Liver and Lung Scanning.

5) **NUCLEAR MEDICINE**

Clinical Nuclear Medicine, Clinical Diagnostic Studies, Scanning Procedures in Nuclear Medicine, Calibration of Instruments, Phe-Gamma Camera and Computer System in Nuclear Medicine.

6) **RADIATION PROTECTION**

History of radiation Damage, Radiation Units, Effect of Radiation on Body, Genetic and Somatic Effects, Target Theory and its applications, Sources of Radiation, Maximum Permissible Exposure Values, Transport of Radioactive Materials, Contamination and Decontamination Procedures.

7) **DIAGNOSTIC X-RAYS**

X-Rays and its production, Measurement of X-Rays, Interaction of X-Rays in Diagnosis, Concept of Beam Modulation in Producing System Contrast, Exposure Control to Patient, Routine Measurement in X-Ray Suits.

TEXT BOOK

1. Kaplan, I. "Nuclear Physics", Addison Wilsley Publishing Co. 1972.
Faiz M. Khan, "The Physics of Radiation Therapy, 2nd Edition, Williams & Wilkins, USA, 1993.

Paper E-II Solid State Nuclear Track Detection (3 Cr. Hours)

1) **Introduction to Nuclear Track Detectors**

Cloud, Bubble and Spark Chambers, Nuclear Collision Losses, Silver Halide Crystals, Etchable Solid State Nuclear Track Detectors, (SSNTDs).

2) **Interactions of Charged Particles with Matter**

Nuclear Collision Losses, Electronic Energy Losses, Direct Production of Atomic Displacements, Secondary Electrons, Range-Energy Relations.

3) **The Nature of Charged-Particle Tracks and Some Possible Track Formation Mechanisms in Insulting Solids**

Radiation Damage in Solids, Track-storing Materials, Track-forming Particles: Criteria for Track Formation, Experimental Studies on the Size and Structure of Latent-Damage Trails, Critical Appraisal of Track Formation Models.

4. **Track Etching: Methodology and Geometry**

Track Etching Recipes, Track Etching Geometry, Some Special Techniques for Track Parameter Measurements, Environmental Effects on Track Etching.

5) **Thermal Fading of Latent Damage Trails**

The Nature of the Annealing Process, The Effects of Pre-annealing on the Etched Tracks, Typical Annealing Temperatures for Fission Tracks in Various Materials, Closing Temperatures, Annealing Correction Methods, Track Seasoning.

6) **The Use of Dielectric Track Recorders in Particle Identification**

Calibration, Charge Assignment, Low-energy Particles, charge and Mass Resolution, Some Applications of Particle Identification Techniques, The Ancient Cosmic Rays.

7) **Radiation Dosimetry and SSNTD Instrumentation**

Neutron Dosimetry, Alpha Particle Dosimetry and Radon Measurements, Charged Particle other than alphas, SSNTD Instrumentation Automatic Evaluation and Methods.

8) **Fission Track Dating**

Radioactive Dating, The Fission Track Age Equation, Practical Steps in obtaining a Fission Track Age, The Interpretation of Fission Track Ages, Neutron Dosimetry, Fission Decay Constant of ^{238}U, and Age Standards, Annealing Corrections, Fission Track Dating of Lunar Samples and Meteorites, Fission Track Dating in Archaeology, Errors in Fission Track Dating.

9) **Further Applications of Track Detectors and Some Directions for the Future**

Applications to Nuclear Physics, Elemental Distributions and Biological Applications, Extraterrestrial Samples, Particles in Stopping media.

TEXT BOOK

1. Solid State Nuclear Track Detection S.A. Durani and R.K. Bull, Pergamon Press (1987).
2. Nuclear Tracks in Solids Fleischer Robert L., Price P. Buford, walker Robert M., University of California Press (1975).

Paper E-III Radiation Detection & Measurement Laboratory (3 Cr. Hours)

The students will perform experiments on applied Health Physics and radiation detection. The use of the following equipment will be demonstrated during these experiments. Pocket Dosimeters, Beta-Gamma and Neutron Survey Meters, G.M. Detectors, Scintillation Detectors, Solid State Detectors and Neutron Detectors.

E-IV Project (3 Cr. Hours)

E-V Thesis (6 Cr. Hours)

OPTION-F (MATERIALS SCIENCE) (9 Cr. Hours)

Paper F-I Thermodynamics and Thermal Properties (3 Cr. Hours)

1) **THERMODYNAMICS OF CRYSTALS**

introduction, The Effect of Temperature on Metal Crystals, Heat Content, Entropy and Free Energy, The Variation of Free Energy with Temperature, Thermodynamics of Lattice Defects, The Phase Rule, The Lever Rule, The Free Energy-Composition Diagrams, The Binary Phase Diagram, Iron-Carbon Phase Diagram, Constituents of Iron and Steel, Microstructural changes During Colling.

2) **DIFFUSION IN SOLIDS**

Fick's Laws of Diffusion, Solution of Fiek's Second Law Applications Based on Second Law Solution, The Atomic Model of Diffusion, Other Diffusion Processes.

3) **PHASE TRANSFORMATIONS**

nucleation and Growth: The Nucleation Kinetics, The Growth and over all Transformation Kinetics, Martensitic Transformation, Applications; Transformations in Iron and Steel and Time-Temperature-Transformation Diagram, Precipitation Processes, Solidification and Crystallization, Recovery, Recrystallization and Grain Growth.

4) **THERMAL PROPERTIES**

Introduction, Heat Capacity, Thermal Conductivity, Thermal Expansion, Thermoelectricity; Thermoelectric Power, Seebeck Effect, Thomson Effect, Peltier Effect, Thermal Radiation, Thermal Stresses, Thermal Shock Resistance.

5) **THERMAL ENERGY**

Introduction, Activation Energy, Maxwell-Boltzmann Law, Arrhenius Rate Law, Chemical Reactions, Thermionic Emission.

6) **HEAT TREATMENTS OF IRON AND STEEL**

Introduction, Purpose of Heat Treatment, Annealing, Normalizing, Spheroidizing, Hardening, Tempering, Austempering and Martempering, Case Hardening: Carburizing, Nitriding, Flame Hardening, Induction Hardening, Cyaniding, and Quenching.

Text books;

1. Physical Properties of Materials, by M.C. Lovell, A.J. Avery and M.W. Vernon, Van Nostrand Reinhold (UK) Co. Ltd. 1984
2. Science of Engineering Materials, Vol.3, by Manas Chanda, The Macmillan Press Ltd. 1980.
3. Materials Science & Engineering by V.Raghavan, 2nd Edition, 1984.
4. Modern Physical Metallurgy by R.E. Smallman, 3rd Edition, Butterworth and Co.Ltd. 1980.
5. Refreshers Materials Science by R.B. Gupta and B.K. Gupta, 4th Edition, Satya Prakashan, New Dehli, 1992.
6. An Introduction to Metallurgy, by Alan Cottrell, 2nd Edition, Edward Aarnold (Pub.) Ltd. London, 1975.

Paper F-II Ceramics, Polymers & Composite Materials (3 Cr. Hours)

1) **POTTERY**

Clays, Primary Minerals, Secondary minerals, Characteristics of the Raw Materials Employed for the Manufacture of Whitewares. The Processing of Whitewares (Slip Casting, Plastic Forming, Powder Pressing and Firing).

2) **CERAMICS**

Performance and Properties of Materials for High Temperature, Refractories Such as Silica, Alumino – Silicates, Magnesia, Dolomite etc. Fabrication and Properties of Oxides, Carbide and Nitride Ceramics.

3) **GLASSES**

Crystals and Glasses, the process of Glass Formation, Nature of Glass Transition, The Glass Transition Temperature.

4) **POLYMERS**

Glassification of Polymers, Plymer Structure, Molecular Weight, Chemical Structure and Thermal Transitions, The Synthesis of High Polymers, Polymerization Techniques. The Solid State Properties of Polymers: The Amorphous & Crystalline State, Thermal Transitions and Properties, Electrical & Mechanical Properties.

5) **COMPOSITES**

Classification and Definition of Composite Materials, The Properties of Fibers, Matrices and the Interfaces, Structural Geometry of Reinforcing Materials Formation and Testing of Composites, Properties and Analysis of Composite Materials.

Tex Book

1. Chemistry and Physics of Clays by R.W. Grimshaw, 4th Edition John Wiley & Cons, New York, 1980.
2. Science of Engineering Materials by ManasChanda, Vol.2, Mc Millan Ltd. India, 1979.
3. The Physics Properties of Glasses by D.G. Holloway, Wykeham Publishing Ltd. London, 1973
4. Polymer Science and Technology by Joel R. Fried, Prentice – Hall of India Pvt. Ltd. New Dehli (2000).
5. Polymer Science by V.R. Gowarikar, N.V. Vishwanathan, J. Screedhar, Wiley Eastern Ltd. 1986.
6. Text Book of Polymer Science by F.W. Billmeyer Jr., 2nd Edition Wiley Interscience, New York, 1971.
7. Composite Materials by L. Holliday, Elsevier Publishing Co., New York, 1966.
8. Fiber Composite Hybrid Materials N.L. Hancox, Mc Millan, 1981.

Paper F-III Mechanical Properties and Strength of Materials-I (3 Cr. Hours)

General Different Tests to Evaluate the Mechanical Behavior of Materials, Hardness and its Measurements, Tensile, Compressive and Shear Tests, Sheet Metal Tests, Notch Impact Tests, The Structure-Dependent Properties of Materials, Atomic Model of Elastic Behavior, Resolved Shear Stress, The Law of Critical Resolved Shear Stress, The Relation Between Work-Hardening and Slip, Effect of Alloying on Elastic and Plastic Behavior, Point Defects, Line Defects, Dislocations, Types of Dislocations, Energy of Dislocations, Interaction Between Dislocations, Planar Defects: Stacking Faults, Twinning, Grain Boundaries, Grain Size, Tilt Boundaries.

Recommended books:

1. Modern Physical Metallurgy, By R.E. Smallman, 3rd Edition,
   Published By Butterworths and Co. Ltd. London, (1980).
2. Materials Science and Engineering, By V. Raghavan, 2nd Edition,
   Prentice-Hall International Inc., (1984).
2. Testing of Materials, By Vernon John
   Published By The Macmillan Press Ltd., Hong Kong, (1992).
4. The Structure and Properties of Materials, Vol III. Mechanical Behaviou, 4th Edition
   By H. W. Hayden and T. Wulff, John Wiley & Sons Inc. London, (1984).
5. The Science of Engineering Materials Vol 1: Structure of Matter, By Manas Chanda, Published By The Macmillan Press Ltd., (1979).

6. Engineering Materials and Their Applications, By R. A. Flinn. 2nd Edition, Houghton Mifflin Company, U.S.A. (1981).

Paper F-IV Mechanical Properties and Strength of Materials-II (3 Cr. Hours)

1. STRENGTHENING MECHANISMS

Introduction, Cold Working and Annealing, Solute Hardening, Precipitation or Second Phase Hardening, Strengthening Mechanisms, Diffusion Hardening etc.

2. PLASTIC DEFORMATION OF MATERIALS

Introduction, Stress-Strain Curves, Work-Hardening, Three Stages of Work Hardening, Work-Hardening in Polycrystals, Ideal Plastic Behavior, Strain-Hardening, Stain Ageing, Strain Rate and Temperature.

3. FRACTURE, CREEP AND FATIGUE

Introduction, Concept of Fracture Mechanics, Ductile Fracture, Brittle Fracture, Temperature Effects and the Ductile-Brittle Transition, Fracture Toughness and its determination, Crack Opening Displacement Testing, Creep, Creep Mechanisms, Creep Resistance Materials, Stress-Rupture Testing, Relaxation Testing, Fatigue, Factors Affecting Fatigue, Fatigue Testing, Fatigue Fracture.

Recommended books:

1. Modern Physical Metallurgy, By R.E. Smallman, 3rd Edition, Published By Butterworths and Co. Ltd. London, (1980).
2. Materials Science and Engineering, By V. Raghavan, 2nd Edition, Prentice-Hall International Inc., (1984).
3. Testing of Materials, By Vernon John Published By The Macmillan Press Ltd., Hong Kong, (1992).
4. The Structure and Properties of Materials, Vol III. Mechanical Behaviou, 4th Edition By H. W. Hayden and T. Wulff, John Wiley & Sons Inc. London, (1984).
5. The Science of Engineering Materials Vol 1: Structure of Matter, By Manas Chanda, Published By The Macmillan Press Ltd., (1979).
6. Engineering Materials and Their Applications, By R. A. Flinn. 2nd Edition, Houghton Mifflin Company, U.S.A. (1981).

Paper F-V Solid State Reactions and Materials Technology (3 Cr. Hours)

1. Preparation and Characterization of an Oxide Material.
2. Preparation and Characterization of a Binary Alloy.
3. Preparation and Characterization of a Ferromagnetic Material.
4. Preparation and Characterization of a Metallic Magnetic Alloy.
5. Determination of Crystal Orientation by Laue Method.
6. Determination of Crystal Symmetry with the Help of Weissenberg Method.
7. X-Ray Diffraction study of a Powder Sample using Debye-Sherrer/Diffractometer and Guinier Techniques.
8. Revealing of Magnetic Domains of Magnetic Materials by Bitter and Kerr Effects.
9. Preparation and Receptivity Measurements of a Flat Oxide Sample in the Temperature Range of $4 \leq to \leq 80K$.
10. Measurement of Magnetic Properties of Oxide and Metallic Magnetic Materials.
11. Constitution of a Binary Metallic System.
12. Constitution of Quasi-Binary Oxide System.

Text Book

1. X-ray Crystallography, by Buerger.

Reference Books

1. Practical X-ray Spectrometry, by R. Jenkins and L. Deny.

Paper F-VI Material Science Laboratory (3 Cr. Hours)

1. Preparation and Characterization of an Oxide Material.
2. Preparation and Characterization of a Binary Alloy.
3. Preparation and Characterization of a Ferromagnetic Material.
4. Preparation and Characterization of a Metallic Magnetic Alloy.
5. Determination of Crystal Orientation by Laue Method.
6. Determination of Crystal Symmetry with the Help of Weissenberg Method.
7. X-Ray Diffraction study of a Powder Sample using Debye-Sherrer/Diffractometer and Guinier Techniques.
8. Revealing of Magnetic Domains of Magnetic Materials by Bitter and Kerr Effects.
9. Preparation and Receptivity Measurements of a Flat Oxide Sample in the Temperature Range of $4 \leq$ to ≤ 80K.
10. Measurement of Magnetic Properties of Oxide and Metallic Magnetic Materials.
11. Constitution of a Binary Metallic System.
12. Constitution of Quasi-Binary Oxide System.

Text Book

1. X-ray Crystallography, by Buerger.

Reference Books

1. Practical X-ray Spectrometry, by R. Jenkins and L. Deny.

Paper F-VII Project (3 Cr. Hours)

Paper F-VIII Thesis (6 Cr. Hours)

Paper F-IX **AMORPHOUS AND POLYCRYSTALLINE MATERIALS** **(3 Cr. Hours)**

1. Preparation Of Materials

Introduction, Definition, Preparation of Amorphous Materials, Thermal Evaporation, Sputtering, Glow Discharge Decomposition, Chemical Vapour Deposition, Melt Quenching, Electrolytic Deposition, Cheimcal Reaction.

2. Structure Of Materials

Microscopic Structure, Experimental Techniques and Short-Range Order Scattering, Extended X-ray Absorption Fine Structure, Macroscopic Sturucture: Experimental Techniques Microscopy, Small Angle.

3. Opto Electronic Properties Of Materials

Introduction, The Kubo-Greenwood Formula, Anderson Localization, Photon Activated Hopping, Hopping and Variable Range Hopping, The Anderson Transition, Mobility Edges, Semimetals and Pseudogapes, Thermopower.Optical Properties

Recommended Books

1. Physics of Amorphous Materials By S.R. Elliot
2. Electronic Processes in Non-Crystalline Solids, by N.F.Mott And E.A.Davis.
3. Polycrystalline And Amorphous Thin Films And Devices, by L.L. Kazmerski.
4. Fundamental of thin films by K.L Chopra

Paper F-X PHYSICS OF MAGNETIC OXIDES (3 Cr. Hours)

1. Introduction

Crystal structure of ferrites, Types of spinels, Spinel solid solutions, Distorted spinels, magnetite and maghemite, Garnets, The garnet structure, Cation substitutions, Hexagonal ferrites,Crystal structure and Cation substitutions in Hexagonal ferrites, Microstructure of ferrites.

2. Fabrication Techniques

Introduction, Powder preparation, Co-precipitation, Precursor methods, Sol-gel methods, Spray drying, Combustion Synthesis, Green body forming, Compaction, Pressing, Casting, Solid state reactions, Densification, Hot pressing, Microwave sintering, Preparation of ferrite thin films, Liquid phase epitaxy, Sputtering techniques, Preparation of single crystals.

3. Magnetic Properties Of Ferrites

Origin of magnetic moments, Electronic structure, Bonding, Magnetic order, Diamagnetism and Paramagnetism, Exchange, Molecular Field Theory, Ferrimagnets, Anisotropy and magnetostriction, Domains and domain walls, Domain Structure, Magnetization processes and hysteresis.

4. Soft And Hard Ferrites

Soft ferrites, Initial permeability, Disaccomodation and magnetic annealing, Hard ferrites, Magnetization rotation, The BH-product, Magnetization dynamics, Domain wall dynamics, Ferromagnetic resonance.

Recommended Books

1. Raul Valenzuela" **Magnetic Ceramics**" Cambridge University Press, 1994.
2. J.Smit and H.P.J. Wijn "**Ferrites"** N.V. Gloeilampenfabrieken Eindhoven (Holland) 1959.
3. Allan H. Morrish " **The Physical Principles of Magnetism**" John Wiley & Sons Inc.1965.
4. Alex Goldman, "**Modern Ferrite Technology**" Van Nosttrand Reinhold New York 1990.
5. R.W. Cahn, P. Haasen, E.J Kramer,"**Materials Science and Technology**" Vol. 3B,VCH publishers Inc., New York, NY (USA) & Verlagsgesellschaft mbH, Weinheim (Federal Republic of Germany), (1994).

Option-G (Medical Physics) **(12 Cr. Hours)**

Paper G-I (Medical Physics-I) **(3 Cr. Hours)**

Radiation Physics:

- Atomic & Nuclear Structure
- Binding Energies, Potential Well and Nuclear Stability
- Electromagnetic Radiation
- Natural and Artificial Radioactivity
- Isotopes & Radiation Sources
- Nuclear Reactions and Modes of Decay
- Photoelectric Effect, Coherent & Compton Scattering, Pair Production

Radiation Dosimetry

- Interactions of Radiation with Matter (Attenuation, Absorption & HVL etc.)
- Principle of Radiation Detection
- Radiation Measuring Instruments (GM/ Proportional Counter, Ion Chambers & Phantoms etc.)
- Practical Ion Chambers (Calorimeters, Thimble & Parallel Plate)
- Dosimetric Quantities & Units (Exposure, Dose, Absorbed Dose, Kerma) and their Conversion
- The Bragg-Gray Cavity theory
- Calibration of Radiation Beams in terms of Absorbed Dose & Kerma
- Methods of Calorimeter, Chemical, Photographic Film and Thermoluminescene Dosimetry
- Patient Dosimetry

Radiology/ Medical Imaging

- Production and Properties of Diagnostic X-Ray Beam
- X-ray Tubes and Generator
- Beam Modification and Quality
- Diagnostic Radiology
- Mammography
- Fluoroscopy
- Digital Radiography
- Computed Tomography (CT)
- Magnetic Resonance Imaging (MRI)
- Diagnostic Ultrasound (Ultrasound imaging, Doppler techniques)
- Radiographic Image Processing and Quality Assurance

Nuclear Medicine

- Introduction to Nuclear Medicine
- Diagnostic Uses of Radioisotopes
- Radioisotope (Tc-99m) Generator & Radiation Dose Calibrator
- Radiopharmaceuticals (Labeling & Administration)
- Gamma Cameras (Construction and Working)
- Principal of Radionuclide Imaging (Planar & SPECT)
- Performance Parameters (Quality Assurance & Maintenance)
- Principles of Position Emission Tomography (PET) Imaging
- Radionuclide (I-131) Therapy
- Rectilinear Scanner & Thyroid Up Take System
- Radioimmunoassay

Paper G-II (Medical Physics-II) (3 Cr. Hours)

Radiotherapy

- Introduction to External Beam Radiation Therapy
- X-ray Beam Therapy (Superficial & Deep X-ray Therapy Units)
- Gamma-rays Beam Therapy (Cobalt-60 Teletherapy Machine)
- Photon & Electron Beam Therapy (Linear Accelerators)
- Radiation Beam Description (Profiles & Central Axis Specification)
- Beam Modification (Collimation, Wedges, Shielding, Bolus and Filters)
- Radiation Therapy Simulation (Patient Setup& Tumor Localization, Contouring)
- Radiation Treatment Techniques (Source-Axis Distance, Source-Skin Distance)
- Radiation Treatment Planning (Point Dose, 2D, 3D, Conformal & IMRT Planning)
- Brachytherapy (Intracavitary, Interstitial etc.)
- Brachytherapy Sources (Gamma & Beta Irradiator) their Properties
- Remote After Loading Systems (HDR, MDR, LDR and PDR)
- Brachytherapy Dose Distribution
- Total Body Irradiation
- Quality Assurance in Radiation Therapy

Radiation Protection:

- Radiation Exposures (Occupational, Medical & Public)
- Radiation Hazard and Biological Effects (Stochastic and Non-Stochastic)
- Cardinal Principles of Radiation Protection (Time, Distance and Shielding) and ALARA
- Physical Quantities (Activity, Exposure, Absorbed Dose, Dose Equivalents & Effective Dose etc.)
- Radiation Monitoring Instruments
- Personnel & Area Monitoring
- Radiation Contamination & Decontamination Procedures
- Sealed Radioactive Source Storage & Radioactive Waste Managements
- Intervention Levels (Maximum Permissible Dose, Intake Limit)
- Radiation Protection Protocols, Safety Regulation & Licensing
- Radiation Accidents & Emergency Management Procedures

Surface Anatomy & Radiation Biology

- Basic Anatomy & Physiology
- Biological Systems (Circulatory, Lymphatic, Respiratory, Reproduction etc.)
- Cell Structure and Tissues
- Cell Cycle and Cell Death
- Irradiation of Cells & Type of Damage
- Dose Response & Cell Survival Curves
- Oxygen Effect & Relative Biological Effectiveness
- Dose Rate and Fractionation
- Radioprotectors and Radiosensitizers

Paper G-III Bio Physics (3 Cr. Hours)

Basic Physical & Chemical Laws

- The electronic Structure of Atoms
- Molecular Orbitals and Covalent bonds
- Molecular interactions (strong& weak)
- Stereochemistry and Chirality
- Thermodynamics (Entropy, Enthalpy, Chemical Potential)
- Radioactivity
- Biological effects and applications of Radioisotopes

Separation Techniques

- Introduction
- Chromatography (thin layer, paper, partition, gas liquid & ion exchange)
- Electrophoresis (Zone, Low voltage, High voltage, Gel & Iso electric)

Physico-Chemical Techniques to study Biomolecules

- Introduction
- Hydration macromolecules
- Diffusion
- Viscosity
- Light scattering
- Small angle X-ray scattering

Spectroscopy

- Introduction
- Ultraviolet/visible spectroscopy
- Fluorescence spectroscopy
- Infrared spectroscopy
- Raman spectroscopy
- Electron Spin resonance

X-ray Crystallography

- Introduction
- Growth of Crystals of Biological Molecules
- X-ray Diffraction & Data Collection
- Structure Solution
- Refinement of the structure

Electron Microscopy

- Introduction
- Electron optics
- The Transmission Electron Microscope
- The Scanning Electron Microscope
- Preparation of the specimen for electron microscopy
- Image Reconstruction
- Electron Diffraction

NMR Spectroscopy

- Introduction & Basic Principles
- NMR Theory & Experiment
- NMR Parameters (Chemical Shift, Intensity, Line width, Spin-spin Coupling)
- NMR Applications in Biophysics & Medicine

Neurobiophysics

- Introduction
- The nervous system
- Physics of Membrane potentials
- Sensory mechanisms
- Signal Transduction

Recommended Books

1. Vasantha Pattabhi, Biophysics, Narosa Publishing House, 2005.
2. Rodney Cotterill, Biophysics, An Introduction, John Wiley & Sons 2004.
3. Elements of X-Ray Diffraction B.D. Cullity John Wiley & Sons 2002.

Paper G-IV (Medical Physics Laboratory) (3 Cr. Hours)

1. Measurement of X-ray beam quality in terms potential, current & exposure.
2. Measurement of radiation beam attenuation with various filters/ shielding materials.
3. Gamma spectroscopy using NaI scintillation detector.
4. Determination of concentration of activity for various volumes of radiopharmaceuticals.
5. Determination of quality parameters (Resolution, Uniformity & Linearity) of radionuclide scanning.
6. Determination of film density with exposure to phantom at different kVp and mAs values.
7. Calculation of absorbed dose form air Kerma Rate of sealed radioactive source.
8. Verification of beam profile and central axis depth dose data for Co-60 teletherapy machine.
9. Calibration of Cobalt-60 radiation beam in water phantom using thimble ionization chamber.
10. Verification of optical and mechanical alignments of radiotherapy machine.
11. Treatment planning for delivery of prescribed radiation doses to simulated tumor volumes.
12. Decontamination of I-131 contaminated area after measurement of exposure/ dose equivalent.

Paper G-V Project (3 Cr. Hours)

Recommended Books:

1. F M Khan, **The Physics of Radiation Therapy**, Williams and Wilkens, 1994.
2. J. R.Williams, D. I. Thwaits, **Radiotherapy Physics**, Oxford University Press New York, 1993.
3. JR Williams & DI Thwaites **Radiotherapy Physics in Practice**, Oxford Publications, 1994.
4. H E Johns, J R Cunningham, **The Physics of Radiology**, Fourth Edition, Charles C Thomas Publisher, 1984
5. S C Bushhong, **Radiologic Science for Technologists: Physics, Biology and Protection**, Mosby, 1997.
6. W J Meredith and J B Massey, **Fundamental Physics of Radiology**, Wright and Sons, Bristol, 1972
7. J T Bushberg, JA Seibert, EM Leidholdt, JM Boone, **The Essential Physics of Medical Imaging**, Second Edition, Lippincott Williams and Wilkens 2002.
8. P Armstrong and M L.Waste, **Diagnostic Imaging**, Blackwell Science Ltd, Oxford, 1998
9. R P Parker, P H S Smith, D M Taylor **Basic Science of Nuclear Medicine,** Second Edition. Churchill Livingstone 1984
10. J.A. Sorenson, M.E. Phelps et all **Physics in Nuclear Medicine**, Second Edition, 1987
11. IAEA Tecdoc 602, **Quality Control of Nuclear Medicine Instruments**, 1991
12. Performance Measurements of Scintillation Cameras. **NEMA Standards** Publication NU1-2001
13. H N Wagner **Principle of Nuclear Medicine,** 2nd edition WB Saunders, 1995,
14. G F Knoll, **Radiation Detection and Measurements**.
15. H Cember, **Introduction to Health Physics**
16. Evans, **The Atomic Nucleus**
17. E B Paul, **Nuclear and Particle Physics**
18. H Cember, **Introduction to Health Physics**, 3rd Ed., McGraw Hill, New York, 1996.
19. **ICRU Report 33**, Radiation Quantities and Units (1980)
20. Young M.E.J., **Radiological Physics**, Lewis, 1983
21. A Protocol for the Determination of Absorbed Dose from High-Energy Photon and Electron Beams, **Report of AAPM Task Group 21**, Med. Phys.,10(6),741, Nov/Dec. 1983
22. Kathren R.L., **Medical Physics Handbooks** 16, Adam Hilger Ltd., 1985.
23. IAEA **Technical Reports Series No. 277**, Absorbed Dose Determination in Photon and Electron Beams. An International Code of Practice, 1997., Second Edition
24. IAEA **Technical Reports Series No. 381,** The use of plane parallel ionisation chambers in high energy electron and photon beam. . An International Code of Practice, 1997
25. **ICRP 33**, Protection against ionising radiation from external sources used in medicine, 1982
26. **BJR Supplement 17**, Central Axis Depth Dose data for use in Radiotherapy, 1983

Paper G-VI Thesis (6 Cr. Hours)

COURSE OUTLINE

OF

ADDITIONAL ELECTIVE COURSES

FOR

BS – 4 YEARS PROGRAM

IN PHYSICS

Plasma Physics **(3 Cr. Hours)**

Pre-requisite:

Electrodynamics, Waves and Oscillations

Objectives:

1. To learn about the importance of the plasma alongwith the basic concept of plasma.
2. To know fluid description of the plasma.

Introduction, Occurance of plasma. Concept of temperature. Debye shielding. The plasma parameter. Criteria for plasma. Applications of plasma physics. Single particle motion in electromegnatic field. Unifrom 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. Introduction to controlled fusion, Basic nucler fusion reactions. Reaction rates and power density, radiation losses from plasma, operational conditions.

Recommended Books:

4. F.F. Chen, Introduction to plasma Physics, 2nd ed. (plenum).
5. N.A. Krall and A.W. Trivelpiece, Principles of Plasma Physics, 1973 (McGraw Hill)
6. S. Glasstone and R.H. Lovberg, Controller Thermonuclear Reactions, 1960 (D.Van Nestrand).

Surface Physics **(3 Cr. Hours)**

Pre-requisite:

Solid State Physics

Objectives:

1. To know about the surface physics and its applications.
2. Learn about the interaction of surface with the ions, electrons etc.

An Introduction to Surfaces

What is a surface? The energetics and thermodynamics of creting a surface. An introduction to surface Physics. Surface energies and the Wulff Theorem.

Studying **Surfaces**

What is UHV? Do we need UGV to study surfaces? The kinetic theory of gases, concept of vacuum and standard vacuum hardware components. Comparison of different types of pumps with measurement of vacuum pressure. Preparing a clean surface.

Surface Structures and Reconstructions:

Lattice concept. 3 D crystal structures, 2D surface structures. Specific types of surface, fcc, hecp, bcc and stepped surfaces and a discussion of their relative energies. More complex ceconstruction, stability, growth mechanisms, adsorption, Desorption and experimental probes of surface structure such a LEED and RHEED. The structure of semi-conductor surfaces. The surface structures of very small metal particles.

Adsorption, Desorption Bonding, Catalysis and Growth Process:

Adsorption mechanisms and kinetics chemisorption vs. physiorption, the kinetics of adsorption, potential energy curves and adsorption energetics Adsorption mechanisms and knetics for low coverages Langmuir Isotherms, derivation, adsorbate phase diagrams and phase transitions.

The Structure of Adsorbate Layers:
Experimental probes of surface structure such as LEED and RHEED. Growth processes, vibrational spectroscopy, catalysis, Desorption.

The Electronics and Magnetic Structure of Surfaces:
Band theory, Free electron theories and the work function, The electronic structure of semiconductor surfaces, Electron emission processes, Magnetic processes at surfaces.

Electron-Surface Interactions:
Electron diffraction and quasi – elastic scattering, comparison of particle scattering techniques, Electron spectroscopes, Discussion of the merits of different types of electron energy analysers and electron deterctors. Signal processing and spectral analysis. Theory and practice of Auger electron Spectroscopy, Quantification of Auger spectra, Auger depth Profiling.

Atom/ion surface interactions:
Comparison of particle scattering techniques, An Introduction to the theory and practice of SIMS, SIMS imaging and depth profiling, Auger depth profiling, theory and practice of Rutherford. Back scattering.

Surface Microscopy:
Classification of microscopy techniques, Basic concepts in surface imaging and localized spectroscopy, Imaging XPS, Optical microscopy, STEM. SEM. SPM. An introduction to the theory and practice of scanning Tunneling Microscopy, Scanning probe microscopy techniques, Atomic Force Microscopy.

Recommended Books:

3. John A. Venables, Introduction to Surface and Thin Film Processes Cambridge University Press (2000).

Fluid Dynamics **(3 Cr. Hours)**

Pre-requisite
Classical Mechanics, Electrodynamics

Objectives:

1. to know the fundamentals of Fluid Mechanic and its applications.
2. To learn about the computational aspect for solving diffusion equation.

Basic Fluid Mechanics:
Fundamentals of Continuum mechanics, Kinematics of the flow field, the continuity equation, governing equations of fluid motion, Incompressible flows, Compressible flows, Thin aerofoil.

Boundary Layer Theory:
Laminar Boundary layer, Turbulent Boundary layer. Reynold's number.

Computational Fluid Dynamics-I:

Introduction to numerical computation, Introduction to numerical solution of Ordinary Differential equation's using multi-step methods, Boundary value problems, Introduction to solution of Partial Differential Equation's using finite difference methods Advanced Techniques.

Computational Fluid Dynamics-II

Governing equations in integral and differential form, Reduced forms of governing equations, The finite volume methods, Incompressible and compressible flow & their methods, Discrete methods for the steady state and time dependent adection diffusion equation, The pressure correction method on staggered and unstaggered grids, Time marching schemes, Incorporation of turbulence models, Schemes for solving large algebraic systems, Use of a commercial code for the predication off complex flows.

Experimental Methods:

Introduction to laboratory techniques, Laboratory sessions (preceded by lectures): water waves, air flow past a cylinder aero foils, hydraulic jumps, vortex shedding and vibrations, turbulent jets and plumes.

Recommended Books:

1. H. Lamb, Hydrodynamics, Doer, 6th edition 1993.
2. White, F.M. Viscous fluid flow (2nd edition), McGraw Hill, 1991.
3. P.J. Roache, "Computational Fluid Dynamics", Albuquerque, N.M.,Hemosa Publishers.
4. Patankar, S.V., Numerical Heat Transfer and Fluid Flow, Hemisphere, 1980.
5. K.A. Hoffmann and S.T. Chiang. Computational Fluid Dynamics for Engineers, Vol.1 &11, 1993.

Methods of Experimental Physics (3 Cr. Hours)

Pre-requisites

Experimental labs and techniques used in these labs.

Objectives:

1. To learn about the vacuum techniques.
2. To learn the detection techniques about radiation, temperature.
3. to learn about the measuring techniques along with data analysis.

Vacuum Techniques:

Gas Transport: Throughout, Pumping Speed, Pump down time Ultimate pressure. Fore-Vacuum Pumps: Rotary Oil Pumps; sorption pumps, Diffusion pumps, sorption pumps (High Vacuum), Production of ultrahigh vacuum; Fundamental concepts; guttering pumps; Ion pumps; Cryogenic pumps, turbo molecular pumps. Measurement of total pressure in vacuums systems; Units pressure ranges; Manometers; Perini gauges; The McLoad gauges; Mass spectrometer for partial measurement of pressure. Design of high Vacuum system; Surface to Volume ratio; Pump Choice; pumping system design. Vacuum Components; Vacuum valves; vacuum Flanges; Liquid Nitrogen trap; Mechanical feed throughs & Electrical feed throughs Leak detection; Basic consideration; leak detection equipment; Special Techniques and problems; Repair Techniques.

Radiation Detection and Measurement:

GM tubes, scintillation detector, channeltron, photo multipliers, neutron detectors, alpha/beta detectors, x-rays/gamma detectors, cosmic rays detectors, Spectrographs and interferometers.

Sensor Technology:

Sensors for temperature, pressure displacement, rotation, flow, level, speed, rotation position, phase, current voltage, power magnetic field, tilt, metal, explosive and heat.

Electronics and Electronic Instruments:
Operational amplifiers, summing amplifiers, difference amplifiers, Differentiators, Integrators, Logarithmic amplifiers, current to voltage converter, Spectroscopy amplifiers, charge sensitive pre-amplifiers, Coincidence circuits, Isolators, Ramp Generators, and single channel analyzer. Power supplies, signal Generators, Counters, Multichannel analyzer, Lock in Amplifiers, Boxcar averages.

Computer Introduction:
Introduction to computers, GPIB Interface, RS 232. Interfacing, DA/AD conversion, Visual c/visual Basic.

Data Analysis:
Evaluation of measurement; Systematric Errors, Accuracy; Accidental Errors, Precision, Statistical Methods; Mean Value and Variance; statistical Control of Measurements; Errors of Direct measurements, Rejection of dta; Significance of results; Propahgation of errors; preliminary Estimation; Errors of Computation; Least squares fit to a polynomial. Nonlinear functions. Data manipulation, smoothing interpolation and extrapolation, linear and parabolic interpolation.

Environmental Physics (3 Cr. Hours)

Pre-requisite: Physics (F.Sc)
Objective:

- To become familiar with the essentials of environment and Global climate
- To learn to use spectroscopy for environments

Introduction to the Essentials of Environmental Physics:
The economic system, living in green house, enjoying the sun, Transport of matter, Energy and momentum, the social and political context
Basic Environmental Spectroscopy:
Black body radiation, The emission spectrum of sun, The transition electric dipole moment, The Einstein Coefficients, Lambert – Beer's law, The spectroscopy of bi-molecules, Solar UV and life, The ozone filter.
The Global Climate:
The energy Balance, (Zero-dimensional Greenhouse Model), elements of weather and climate, climate variations and modeling
Transport of Pollutants:
Diffusion, flow in reverse, ground water. Flow equations of fluid Dynamics, Turbulence, Turbulence Diffusion, Gaussian plumes in air, Turbulent jets and planes.
Noise:
Basic Acoustics, Human Perceptions and noise criteria, reducing the transmission of sound, active control of sound
Radiation:
General laws of Radiation, Natural radiation, interaction of electromagnetic radiation and plants, utilization of photo synthetically active radiation
Atmosphere and Climate:
Structure of the atmosphere, vertical profiles in the lower layers of the atmosphere, Lateral movement in the atmosphere, Atmospheric Circulation, cloud and Precipitation, The atmospheric greenhouse effect
Topo Climates and Micro Climates:
Effects of surface elements in flat and widely un-dulling areas, Dynamic action of Selig, Thermal action of selief

Climatology and Measurements of Climate Factor:
Data collection and organization, statistical analysis of climatic data, climatic indices, General characteristics of measuring equipments. Measurement of temperature, air humidity, surface wind velocity, Radiation balance, precipitation, Atmospheric Pressure, automatic weather stations.

Books Recommended:

1. Egbert Booker and Rienk Van Gron Belle, Environmental Physics, 2nd ed. John Wiley and sons. 1999.
2. Physics of Environmental and Climate, Guyot Praxis Publication. 1998.

Introduction to Quantum Computing **(3 Cr. Hours)**

Pre-requisite:
Quantum Mechanics and Computation Physics

Objectives

1. To be familiar with the quantum computing.
2. To learn about the Quantum circuits and cryptography.

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 inquality; 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. Chuange, Cambridge University Press, Cambridge 2000.
2. Exploration in Quantum Computation by C.P. Williams and S.H. Clearwater, Springer Verlag (997).
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 (2000).

Particle Physics **(3 Cr. Hours)**

Pre-requisite
Quantum Physics

Objectives

1. To know the particles and their classification.
2. To learn about the interaction of these particles.
3. To learn about the Quark models.

Particle Classification:
Quantum numbers, leptons, hadrons, baryons, mesons, quarks.

The Fundamental Interactions:
The elecrtromagnetic 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 and 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).

COMPUTER SIMULATION (3 Cr. Hours)

Pre-requisites
Mathematical Physics

Objectives;

1. Learn techniques to understand and develop computer simulations.
2. To use numerical techniques to sove the differential equations.
3. To understand the simulation in classical physics and Quantum Physics.

Introduction:

Importance of computers in physics, nature of computer simulation, computer graphics and programming languages, Techniques and class of computer simulation, Accuracy and stability of numerical techniques, External points and strings, principles of vector computing in Cartesian, spherical and cylindrical coordinates.

Numerical Approaches:

Solution of Ordinary Differential Equations, initial (boundary) and eigen value problems, numerical integrations, special functions and Gaussian quadrarure, matrix operation, partial differential equations (elliptic and parabolic types)

Simulation in Classical Physics:

Motion of Falling Objects, One Dimensional Dynamics (Accelerating cars and objects on springs), Energy and Center of Mass, Electric Fields and Potentials, LRC Circuits, Driven LRC

Circuits (Time varying), Wave phenomena (Fourier analysis, Coupled oscillator), Interference, Diffraction and Polarization, Geometrical Optics (Ray Tracing and Principle of Least Time), Electric Currents and Magnetic Fields, Electromagnetic Waves.

Random Precess and Quantum Physics:

Random Number and their uses, Random-walk problem, percolation theory, radio-activity and radioactive decay series, Noise and Signal, Guassian Distribution, Distribution Functions in Statistical Physics, Molecular Dynamics and Solids, Approaches to Equilibruim, Monte-Carlo Simulation, Canonical and Micro-Cononical Ensembles, Numerical Solution of time-independent), Schrodinger Wave Equation, Particle in Bound and Free States.

Computational Methods for Continuous Medium:

Fluid equations, Governing equation in integral and differential forms, Reduce forms of the governing equation, finite volume method, compressible and incompressible flow and their methods, discrete methods for the steady state and time dependent diffusion equation. The pressure-corection method on staggered and unstaggered grids. Time marching schems, incorporation of furbulence model, schemes for solving large algebraic system, use of commercial code for kprediction of off complex flow, Raynold averaging and its applications to Navier stokes equations. Mean and Turbulant kinetic energy equation, Magnetohydrodynamics, Modelling ideal (MHD), resistive and viseus flow of plasmas, thermal conduction and heat transport.

Books Recommended:

1. Hillar, Johnston and Styer, Quantum Mechanics Simulation. (A Series of the Consortium for upper level Physics software). John Wiley & Sons, Inc. New York. 1995.
2. P.J. Roache, Computational Fluid Dynamics, Albyuquerque, N.M. Hemosa Pulishers. 1993.
3. Marvin L. De Jong, Introduction to Computational Physics, Addison Weslay Publishing Company, Inc. New York, 1991.
4. Computer Simultation and Computer Algebra (Lectures for Beginers), Springer-Verlage Berlin, New York, 1988.
5. Simulation Methods" Part-I & II, Addision Wesley Publishing Company, Inc., New York. 1988.

EXPERIMENTAL NUCLEAR PHYSICS (3 Cr. Hours)

Pre-requisite

Nuclear Physics

Objective

1. To learn the nuclear detection system and techniques from their measurements.
2. To learn about the charged particles accelerator and nuclear reactor.
3. To develop understanding of neutrons physics.

Nuclear Radiation Detection and Measurements:

Interaction of nuclear radiation with matter; photographic emulsions; Gas-filled detectors; Scintillation counters and solid-state detectors; Cloud chambers; Bubble chambers.

Charged Particle Accelerators:

Linear and orbital accelarators Van de Graaff, Cyclotron; Betatron; Synchrocyclotron; Electron-Synchrotron; Alternating-gradient Synchrotron.

Neutron Physics:

Neutron Sources, Radioactive sources, Photo neutron sources Charged particle sources, Reactor as a neutron source, slow neutron detectors, fast neutron detectors, Measurement of neutron cross-sections as a function of energy, slowing down of neutrons, Nuclear fission, Description of fission reaction, Mass distribution of fission energy, Average number of neutrons released, Theory of fission and spontaneous fission, Nuclear chain reaction and applications.

Elementary Reactor Physic:

Controlled fission reactions, Types of nuclear reactors (Power and Research), Detailed study of PWR and CANDU type reactors.

Books Recommended:

1. Glenn. F. Knoll, Radiation Detection and Measurement, John Wiley, 1989.
2. William, R. Leo, Techniques for Nuclear and Particle Physics, Spinger, 1994.
3. Philips Berington and D. Keith, Data Detection and Error analysis for kphysical sciences, 2002.
4. Segre, Nuclei and Practicles, Bejamin, 1977.
5. Kenneth S. Krane, Introducing Nuclear Physics, 1995.
6. B. Povh, K. Rith. C. Scholtz, F. Zetsche, Particle and Nuclei, 1999.

RELATIVITY AND COSMOLOGY (3 Cr. Hours)

Pre-requisites

Mechanics, F.Sc Physics

Objective

1. To learn about the Special theory of relativity
2. To learn the basics of relativistic mechanics and develop understanding about the General theory

Special Relativity:

Galilean relativity, concept of ether, Michelson-Morley experiment, Einstein's postulates of special relativity, Lorentz transformations, structure of space-time, Minkowski space time ensors, the light-cone, line element, four-vectors, relativity of simultaneity, time dilation, proper time, length contraction time paradox, velocity transformation and velocity addition.

Relativistic Mechanics:

Force equation in relativity, rest mass, kinetic and total energy, conservation of energy and momentum.

Elements of Tensoer Calculus:

Manifolds and coordinates, curves and surgaces, tensor fields, Lie derivative geodesics, Riemann tensor, metric tnsor.

General Relativity:

Principles of general relativity, eqation of geodesics deviation, Einstien's field equations.

Cosmology:

Newtonian cosmology, cosmological re-shift, Hubble's law, microwave background, the Big Bang expansion rate, matter and radiation domination, history of the universe.

Books Recommended:

1. W.D.McComb, Dynamics and Relativity, Oxford University Press, 1999.
2. J.V.Narlikar, Introduction to Cosmology, Cambridge University Press, 1989.
3. R.D. D'Inverno, Introducing Einstein's Relativity, Oxford University Press, 1992.