UNIVERSITY OF SARGODHA
OFFICE OF THE REGISTRAR
(ACAD BRANCH)

NOTIFICATION

The Academic Council in its 19th (4/2023) meeting held on 13.09.2023, has recommended the curricula of the following academic programs for implementation on provisional basis w.e.f Fall 2023 subject to approval by the Syndicate:-

1.	BS in Urdu	(Annex-'A')
2.	BS in Islamic Studies	(Annex-'B')
3.	BS in English (Linguistics)	(Annex-'C')
4.	BS in English (Language & Literature)	(Annex-'D')
5.	BS in Media and Communication Studies	(Annex-'E')
6.	BS in Physical Education	(Annex-'F')
7.	BS in Fine Arts	(Annex-'G')
8.	BS in Textile Design	(Annex-'H')
9.	BS in Graphic Design	(Annex-'I')
10.	BS in Chemistry	(Annex-'J')
11.	BS in Physics	(Annex-'K')
12.	BS in Statistics	(Annex-'L')
13.	BS in Botany	(Annex-'M')
14.	BS in Mathematics	(Annex-'N')
15.	BS in Geology	(Annex-'O')
16.	BS in Geography	(Annex-'P')
17.	BS in Zoology	(Annex-'Q')
18.	BS in History	(Annex-'R')
19.	BS in Pakistan Studies	(Annex-'S')
20.	BS in Education	(Annex-'T')
21.	BS in Sociology	(Annex-'U')
22.	BS in Social Work	(Annex-'V')
23.	BS in Economics	(Annex-'W')
24.	BS in Psychology	(Annex-'X')
25.	BS in International Relations	(Annex-'Y')
26.	BS in Political Science	(Annex-'Z')

(WAQAR AHMAD)
Additional Registrar (General)

No. SU/Acad/23/1015

Dated: 01.11.2023

Distribution:

- Controller of Examinations (with the request to upload on University Website for affiliated Colleges)

C.C:

- Director Academics
- Director, QEC
- Additional Registrar (Affiliation & Registration)
- Secretary to the Vice-Chancellor
- PA to Registrar
- Notification File

1. **Title of Degree Program:** BS in Physics

2. **Program Learning Objectives:** This program provides students a comprehensive understanding of fundamental principles in physics, including conceptual comprehension of natural laws, their interpretation, and mathematical representations of physical phenomena. The core objective is to develop in students the inclination towards independent thinking, thorough inquiry, and intrinsic drive for self-directed learning. The program aims to enhance the scientific communication skills of our students towards the concepts of physics and other disciplines using a concise scientific language. It intends to provide students an opportunity to experience the collaborative dynamics of working in interactive groups while emphasizing the need of upholding scientific and professional ethical standards. It would also help provide students with the necessary competencies for pursuing careers in physics education, research, and other sectors of the public and commercial industries.

3. **Program Structure:**

Duration	Minimum 4-Years (8-Semesters), Maximum 6-Years (12-Semesters)
Admission Requirements:	45% marks in HSSC (Part-I/Part-II) of the following I. Pre-Engineering or II. ICS (Math, Physics) or III. Pre-Medical with Mathematics as Additional Subject. IV. A Level (with Physics and Math)
Degree Completion Requirements:	131 Credit Hours

4. **General Education (Gen Ed) Requirements:(Mandatory/Core Curses):**

The minimum requirement for Gen Ed is 30 credits hours and will be offered in first four semesters only.

Sr. No.	Semester	Course Code	Course Title	Credit Hours	Prerequisite
1.	2	URCG-5112	Fables, Wisdom and EPICS	2(2-0)	Nil
2.	4	URCG-5114	Basic Science	3(2-1)	Nil
3.	2	URCG-5116	Science of Society-I	2(2-0)	Nil
4.	1	URCG-5118	Functional English	3(3-0)	Nil
5.	3	URCG-5119	Expository Writing	3(3-0)	Nil
6.	2	URCG-5120	Exploring Quantitative Skills	3(3-0)	Nil
7.	3	URCG-5121	Tools for Quantitative Reasoning	3(3-0)	Nil
8.	1	URCG-5105 URCG-5126	Islamic Studies (OR) Religious Education/Ethics*	2(2-0)	Nil
9.	3	URCG-5122	Ideology and Constitution of Pakistan	2(2-0)	Nil
10.	1	URCG-5123	Applications of Information and Communication Technologies (ICT)	3(2-1)	Nil
11.	4	URCG-5124	Entrepreneurship	2(2-0)	Nil
12.	4	URCG-5125	Civics and Community Engagement	2(2-0)	Nil
13.	1-8	URCG-5111	Translation of Holy Quran	NC	Nil
14.	2	URCG-5127	Seerat of the Holy Prophet (SAW)	1(1-0)	Nil
			GE Courses Credit Hours Total	31	

5. **Single Major Courses:**

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite
1	PHYS-5101	Mechanics	3(3-0)	Nil
2	PHYS-5102	Waves and Oscillations	3(3-0)	Nil
3	PHYS-5103	Introduction to Electromagnetism	4(3-1)	Nil

4	PHYS-5104	Modern Physics	3(0-3)	Nil
5	PHYS-5105	Physics Lab-I	3(3-0)	Nil
6	PHYS-5106	Theory of Thermodynamics	3(3-0)	Nil
7	PHYS-5107	Physics Lab-II	3(0-3)	Nil
8	PHYS-6109	Methods of Mathematical Physics-I	3(3-0)	Nil
9	PHYS-6110	Classical Mechanics-I	3(3-0)	PHYS-5101
10	PHYS-6111	Electromagnetism-I	3(3-0)	PHYS-5103
11	PHYS-6112	Electronics	3(3-0)	Nil
12	PHYS-6113	Electronics Lab	3(0-3)	Nil
13	PHYS-6114	Methods of Mathematical Physics-II	3(3-0)	PHYS-6109
14	PHYS-6115	Classical Mechanics–II	3(3-0)	PHYS-6110
15	PHYS-6116	Electromagnetism-II	3(3-0)	PHYS-6111
16	PHYS-6117	Quantum Mechanics-I	3(3-0)	Nil
17	PHYS-6118	Solid State Physics-I	3(3-0)	Nil
18	PHYS-6119	Modern Physics Lab	3(0-3)	Nil
19	PHYS-6120	Statistical Mechanics	3(3-0)	Nil
20	PHYS-6121	Atomic and Molecular Physics	3(3-0)	Nil
21	PHYS-6122	Plasma Physics	3(3-0)	Nil
22	PHYS-6123	Quantum Mechanics-II	3(3-0)	PHYS-6117
23	PHYS-6124	Solid State Physics-II	3(3-0)	PHYS-6118
24	PHYS-6126	Computational Physics	3(3-0)	Nil
25	PHYS-6127	Laser Physics	3(3-0)	Nil
26	PHYS-6128	Relativity and Cosmology	3(3-0)	Nil
27	PHYS-6129	Nuclear and Elementary Particle Physics	3(3-0)	Nil
Major Courses Credit Hours Total			87	

Interdisciplinary/Allied courses: minimum 12 credit hours:

Interdisciplinary/Allied courses will be offered up till 4th semester

1.	MATH-5101	Calculus-I	3(3-0)	Nil
2.	MATH-5104	Calculus-II	3(3-0)	MATH-5101
3.	MATH-5105	Linear Algebra	3(3-0)	Nil
4.	MATH-5109	Ordinary Differential Equations	3(3-0)	Nil
Interdisciplinary Courses Credit Hours Total			12	

6. Field experience/internship: Minimum 03 credit hours:

Lasting 6-8 weeks and ideally scheduled during summer breaks after 4th semester.

1.	PHYS-6108	Field Experience/Internship	3(3-0)	Nil

7. Capstone Project: Minimum 03 credit hours:

This project, after the sixth semester, requires faculty supervision and evaluation following department guidelines

1.	PHYS-6125	**Capstone project**	**3(3-0)**	Nil

Scheme of Studies
BS in *Physics*

Semester-I

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-1	URCG-5118	Functional English	3(3-0)	Nil
GE-2	URCG-5105 URCG-5126	Islamic Studies (OR) Religious Education/Ethics*	2(2-0)	Nil
GE-3	URCG-5123	Applications of Information and Communication Technologies (ICT)	3(2-1)	Nil
ID-1	MATH-5101	Calculus-I	3(3-0)	Nil
Major-1	PHYS-5101	Mechanics	3(3-0)	Nil
Major-2	PHYS-5102	Waves and Oscillations	3(3-0)	Nil
GE-4(i)	URCG-5111	Translation of Holy Quran***	NC	Nil

Semester Total Credit Hours: **17**

Semester-II

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-5	URCG-5112	Fables, Wisdom and EPICS	2(2-0)	Nil
GE-6	URCG-5116	Science of Society-I	2(2-0)	Nil
GE-7	URCG-5120	Exploring Quantitative Skills	3(3-0)	Nil
GE-8	URCG-5127	Seerat of the Holy Prophet (SAW)	1(1-0)	Nil
ID-2	MATH-5104	Calculus-II	3(3-0)	MATH-5101
Major-3	PHYS-5103	Introduction to Electromagnetism	4(3-1)	Nil

Semester Total Credit Hours: **15**

Semester-III

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-9	URCG-5119	Expository Writing	3(3-0)	Nil
GE-10	URCG-5121	Tools for Quantitative Reasoning	3(3-0)	Nil
GE-11	URCG-5122	Ideology and Constitution of Pakistan	2(2-0)	Nil
ID-3	MATH-5105	Linear Algebra	3(3-0)	Nil
Major-4	PHYS-5104	Modern Physics	3(3-0)	Nil
Major-5	PHYS-5105	Physics Lab-I	3(0-3)	Nil
GE-4(ii)	URCG-5111	Translation of Holy Quran***	NC	Nil

Semester Total Credit Hours: **17**

Semester-IV

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-11	URCG-5114	Basic Science	3(2-1)	Nil
GE-12	URCG-5124	Entrepreneurship	2(2-0)	Nil
GE-13	URCG-5125	Civics and Community Engagement	2(2-0)	Nil
ID-4	MATH-5109	Ordinary Differential Equations	3(3-0)	Nil
Major-6	PHYS-5106	Theory of Thermodynamics	3(3-0)	Nil
Major-7	PHYS-5107	Physics Lab-II	3(0-3)	Nil

Semester Total Credit Hours: **16**

Semester-V

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Major-8	PHYS-6109	Methods of Mathematical Physics-I	3(3-0)	Nil
Major-9	PHYS-6110	Classical Mechanics-I	3(3-0)	PHYS-5101
Major-10	PHYS-6111	Electromagnetism-I	3(3-0)	PHYS-5103
Major-11	PHYS-6112	Electronics	3(3-0)	Nil
Major-12	PHYS-6113	Electronics Lab	3(0-3)	Nil
GE-4(iii)	URCG-5111	Translation of Holy Quran***	NC	Nil

Semester Total Credit Hours: **15**

Semester-VI

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Major-13	PHYS-6114	Methods of Mathematical Physics-II	3(3-0)	PHYS-6109
Major-14	PHYS-6115	Classical Mechanics–II	3(3-0)	PHYS-6110
Major-15	PHYS-6116	Electromagnetism-II	3(3-0)	PHYS-6111
Major-16	PHYS-6117	Quantum Mechanics-I	3(3-0)	Nil
Major-17	PHYS-6118	Solid State Physics-I	3(3-0)	Nil
Major-18	PHYS-6119	Modern Physics Lab	3(0-3)	Nil

Semester Total Credit Hours: **18**

Semester-VII

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Major-19	PHYS-6120	Statistical Mechanics	3(3-0)	Nil
Major-20	PHYS-6121	Atomic and Molecular Physics	3(3-0)	Nil
Major-21	PHYS-6122	Plasma Physics	3(3-0)	Nil
Major-22	PHYS-6123	Quantum Mechanics-II	3(3-0)	PHYS-6117
Major-23	PHYS-6124	Solid State Physics-II	3(3-0)	PHYS-6118
Compulsory	PHYS-6125	Capstone Project	3(3-0)	Nil
GE-4(iv)	URCG-5111	Translation of Holy Quran***	NC	Nil

Semester Total Credit Hours: **18**

Semester-VIII

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Major-24	PHYS-6126	Computational Physics	3(3-0)	Nil
Major-25	PHYS-6127	Laser Physics	3(3-0)	Nil
Major-26	PHYS-6128	Relativity and Cosmology	3(3-0)	Nil
Major-27	PHYS-6129	Nuclear and Elementary Particle Physics	3(3-0)	Nil
Major-29	PHYS-61xx	Optional Course	3(3-0)	Nil

Semester Total Credit Hours: **15**

Degree Program Total: **131**

Optional Courses**

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Opt-1	PHYS-6129	Advanced Electronics	3(3-0)	Nil
Opt-2	PHYS-6130	Physical and Geometrical Optics	3(3-0)	Nil
Opt-3	PHYS-6131	Physics of Nanotechnologies	3(3-0)	Nil
Opt-4	PHYS-6132	Methods of Experimental Physics	3(3-0)	Nil
Opt-5	PHYS-6133	Introduction to Quantum Computing	3(3-0)	Nil
Opt-6	PHYS-6134	Particle Physics	3(3-0)	Nil

(a) * Ethics course is offered to Non-Muslim students, in Semester-I.
(b) **Student can take one optional course in semester VIII from courses offered at the department.
(c) *** Translation of Holy Quran and Seerat of the Holy Prophet (SAW) only for Muslim Students.

Semester-I

URCE-5118 **Functional English** **Cr.H-3(3-0)**

Thecourseaimsatprovidingunderstandingofawriter'sgoalofwriting(i.e.clear,organizedandeffectivecontentandtousethatunderstandingandawarenessforacademicreadingandwriting.Theobjectivesofthecoursearetomakethestudentsacquireandmasterthegrammaticalacademicwritingskills.Thecoursewouldenablethestudentstodevelopargumentativewritingtechniques.Thestudentswouldbeabletologically addspecificdetailsonthetopicssuchasfacts,examplesandstatisticalornumericalvalues.Thecoursewillalsoprovideinsighttoconveytheknowledgeandideasinanobjectiveandpersuasivemanner.Furthermore,thecoursewillalsoenhancethestudents'understanding ofethicalconsiderationsinwritingacademicassignmentsandtopicsincludingcitation,plagiarism,formatting and referencing the sources as well as the technical aspects involved in referencing.

Contents:

1. DevelopingAnalyticalSkills
2. Transitionaldevices(word,phraseandexpressions)
3. Developmentofideasinwriting
4. ReadingComprehension
5. PreciseWriting
6. Developingargument
7. Sentencestructure:Accuracy,variation,appropriateness,andconciseness
8. Appropriateuseofactiveandpassivevoice
9. OrganizationandStructureof aParagraph
10. OrganizationandstructureofEssay
11. TypesofEssays.

Recommended Books:

1. Bailey,S.(2011).Academicwriting:Ahandbookforinternationalstudents(3rded.).NewYork:Routledge.
2. Eastwood,J.(2011).ABasicEnglishgrammar.Oxford: OxfordUniversityPress.
3. Swales,J.M.,&Feak,C.B.(2012).*Academicwritingforgraduatestudents:Essentialtasksandskills* (3rded.).AnnArbor:The Universityof MichiganPress.
4. Swan,M.(2018).*PracticalEnglish usage*(8thed.). Oxford:Oxford UniversityPress.

SuggestedBooks:

1. Biber, D., Johansson, S., Leech, G., Conrad, S., Finegan, E., & Quirk, R. (1999). *Longman grammarof spoken and written English*. HarlowEssex:MIT Press.
2. Cresswell,G.(2004).*Writing foracademicsuccess*.London:SAGE.
3. Johnson-Sheehan,R.(2019). *Writingtoday*.DonMills:Pearson.
4. Silvia,P.J.(2019).*Howtowritealot:Apracticalguidetoproductiveacademicwriting*.Washington:American PsychologicalAssociation.
5. Thomson,A.J.,&Martinet,A.V.(1986).*APracticalEnglishGrammar*.Oxford:OxfordUniversityPress

URCI-5105 **Islamic Studies** **2(2-0)**

Islamic Studies engages in the study of Islam as a textual tradition inscribed in the fundamental sources ofIslam;Qur'anandHadith,historyandparticularculturalcontexts.Theareaseekstoprovideanintroductiontoandaspecializationin Islamthroughalargevarietyofexpressions(literary,poetic,social,andpolitical)and through a variety of methods (literary criticism, hermeneutics, history, sociology, and anthropology).It offers opportunities to get fully introductory foundational bases of Islam in fields that include Qur'anicstudies, Hadith and Seerah of Prophet Muhammad (PBUH), Islamic philosophy, and Islamic law, cultureandtheologythrough thetextualstudyof Qir'an andSunnah..

Contents

IntroductiontoQur'anicStudies

1) BasicConceptsofQur'an
2) HistoryofQuran
3) Uloom-ul-Quran

مطالعہ قرآن (تعارف قرآن، منتخب آیات کا ترجمہ و تفسیر: سورۃ البقرہ آیات 1-5، 482-482؛ سورۃ الحجرات آیات 1-18؛ سورۃ

الفرقان آیات 26-77؛ سورۃ المومنون آیات 1-11؛ سورۃ الاحزاب آیات 2، 41-6466؛ 24، -5255؛ سورۃ الانعام آیات 151-

156؛ سورۃ الصف آیات 112-؛ الحشر آیات 1844-؛ العمران آیات 154154-؛ النحل آیات 12-14؛ لقمٰن آیت 44، حم السجدہ
آیت 56)

Introduction to Sunnah

1) Introduction of Hadith
2) Legal Status of Hadith
3) History of the compilation of Hadith
4) Kinds of Hadith

حدیث کا تعارف، حدیث کی دینی حیثیت، حفاظت و تدوین حدیث، حدیث کی اقسام

متن حدیث: 1 درج ذیل موضوعات پر احادیث کا مطالعہ

1. اعمال کا اجر نیت پر منحصر ہے۔ 4. بہترین انسان قرآن کا طالب علم اور اس کا معلم ہے۔ 6. کتاب و سنت کو مضبوطی سے پکڑنے کا ذریعہ ہیں 2. ارکان اسلام 5. اسلام، ایمان، احسان اور قیامت کی نشانیاں، 2. بچوں کو نماز کی تلقین 7. دین کا مقصد اللہ کی خالص عبادت ہے 8. حصول علم، تلاوت قرآن اور عمل کی اہمیت و فضیلت، 5 روز محشر کا محاسبہ، 14 حقوق اللہ کے ساتھ انسانی حقوق

العباد کا لحاظ رکھنا بھی لازم ہے 11 حسن خلق کی عظمت اور فحش گوئی کی مذمت 14۔
دنیا و آخرت کی بھلائی کے ضامن چار چیزیں، 16۔ ہلاک کر دینے والی سات چیزیں، 12 بے عمل مبلغ کا عبرتناک انجام 15 ہر شخص نگران ہے اور ہر شخص
مسئول

1) Sirah of the Prohet
2) Importance of the Study of Sirah
3) Character building method of the Prophet

سیرت النبی ﷺ (مطالعہ سیرت کی ضرورت و اہمیت، تعمیر سیرت و شخصیت کا نبوی منہاج اور عملی نمونے، اقامت دین کا

نبوی طریق کار، اقدام تدوین عہد خلفائے راشدہ، میثاق مدینہ، خطبہ حجۃ الوداع، اخلاقی تعلیمات، تشکیل اجتماعیت اور اسوہ حسنہ

، قرآن مجید میں سیرت سرور عالم کا بیان، غزوات نبوی ﷺ کے مقاصد و حکمتیں)

Islamic Culture & Civilization

1) BasicConceptsofIslamicCulture&Civilization
2) HistoricalDevelopmentofIslamicCulture&Civilization
3) CharacteristicsofIslamicCulture&Civilization
4) IslamicCulture&CivilizationandContemporaryIssues

2. اسلامی تہذیب و تمدن (اسلامی تہذیب کا مفہوم، اسلامی کے عوامل و عناصر، اسلامی تہذیب کی خصوصیات، ، اسلامی تہذیب
، علمی، معاشرتی اور سماجی اثرات، تہذیبوں کے تصادم کے نظریے کا تنقیدی جائزہ، تہذیبی تصادم کے اثرات و نتائج، طبعی،
حیاتیاتی اور معاشرتی علوم میں مسلمانوں کا کردار، نامور مسلمان سائنسدان

Recommended Books

1) HameedullahMuhammad,—EmergenceofIslaml,IRI,Islamabad
2) HameedullahMuhammad,—MuslimConductofState
3) HameedullahMuhammad,_IntroductiontoIslam
4) AhmadHasan,—PrinciplesofIslamicJurisprudenceIslamicResearch,Institute,InternationalIsl amicUniversity, Islamabad (1993)
5) Dr.MuhammadZia-ul-Haq,—IntroductiontoAlShariaAlIslamialAllamaIqbalOpenUniversity,Islamabad(2001)
6) Dr.Muhammad ShahbazManj,Teleeemat-e-Islam.

UQCE-5126 ETHICS* 2(2-0)

This course is designed for the non-Muslim students.

Contents:

1. MeaningandScopeofEthics.
2. RelationofEthicswith:
   (a) Religion
   (b) Science
   (c) Law
3. HistoricalDevelopmentofMorality
   :(a).InstinctiveMoralLife.
   (b). Customary Morality.(c).Reflectiv eMorality.
4. MoralTheories:
   (a). Hedonism (Mill)(b).Intuitionism (Butler)
   (c).Kant'sMoralTheory.
5. MoralEthicsandSociety.
   (a). Freedom and Responsibility.(b).Tolerance
   (c). Justice
   (d). Punishment(TheoriesofPunishment)
6. MoralTeachingsofMajorReligions:
   a).Judaism
   b). Christianityc). Islam
7. ProfessionalEthics:
   a).MedicalEthicsb).Ethicsof Students
   c). Ethics of Teachers.
   d).BusinessEthics

RecommendedBooks:

1 WilliamLille.AnIntroductiontoEthics,LondonMethuen&Co.latest edition.
2 Titus,H.H.EthicsforToday.NewYork: AmericanBook,latest edition.
3 Hill,Thomas.EthicsinTheoryandPractice.N.Y.ThomasY.Crowel,latest edition
4 AmeerAli,S.TheEthicsofIslam.Culcutta:NoorLibraryPublishers,latestedition
5 Donaldson, D.M. Studies in Muslim Ethics. London: latest edition.
6 Sayeed, S.M.A.(Tr.) Ta'aruf-e-Akhlaqiat.Karachi:BCC&T,KarachiUniversity.

URCI-5123 Applications of Information Communication Technologies (ICT) 3 (2+1)

The course introduces students to information and communication technologies and their application inthe workplace. Objectives include basic understanding of computer software, hardware, and associatedtechnologies. How computers can be used in the workplace, how communications systems can help boostproductivity, and how the Internet technologies can influence the workplace. Students will get basicunderstanding of computer software, hardware, and associated technologies. They will also learn howcomputers are used in the workplace, how communications systems can help to boost productivity, andhowthe Internettechnologies can influence theworkplace.

Contents:

1. Introduction,OverviewofInformationTechnology.
2. Hardware:ComputerSystems&Components,StorageDevices.
3. Software:OperatingSystems,ProgrammingandApplicationSoftware.
4. DatabasesandInformationSystemsNetworks.
5. FileProcessingVersusDatabaseManagementSystems.
6. DataCommunicationandNetworks.
7. PhysicalTransmissionMedia&WirelessTransmissionMedia.
8. Applicationsofsmart phoneandusage.
9. TheInternet, BrowsersandSearch Engines.
10. Websitesandtheirtypes.
11. EmailCollaborativeComputingandSocialNetworking.
12. E-Commerce.
13. IT Securityandotherissues.
14. Cyber LawsandEthics ofusingSocialmedia.
15. UseofMicrosoftOfficetools(Word,PowerPoint,Excel)orothersimilartoolsdependingontheoperatingsystem.
16. Other ITtools/software specifictofieldofstudyofthestudentsif any.

RecommendedBook:

1. DiscoveringComputers2022:DigitalTechnology,Dataand DevicesbyMistyE.Vermaat,Susan L.sebok;17th edition.

Suggested Books:

1. ComputingEssentials2021byTimothyJ.O'LearyandLindaI.O'Leary,McGrawHillHigherEducation; 26th edition.
2. Computers:UnderstandingTechnologybyFuller,Floyd; Larson,Brian:edition2018.

MATH-5101 Calculus-I 3
(3-0)

Calculus is the mathematical study of continuous change. If quantities are continually changing, we need calculus to study what is going on. Calculus is concerned with comparing quantities which vary in a non-linear way. It is used extensively in science & engineering, since many of the things we are studying (like velocity, acceleration, current in a circuit) do not behave in a simple, linear fashion. Calculus has two major branches, differential calculus (Calculus-I) & integral calculus (Calculus-II); the former concerns instantaneous rates of change, & the slopes of curves, while integral calculus concerns accumulation of quantities, & areas under or between curves. This is the first course of the sequence, Calculus-I, II & III, serving as the foundation of advanced subjects in all areas of mathematics. The sequence, equally, emphasizes basic concepts & skills needed for mathematical manipulation. It focuses on the study of functions of a single variable. Calculus-I is an introduction to differential & integral calculus: the study of change.

Contents

1 Functions & their graphs, Rates of change & tangents to curves

2 Limit of a function & limit laws, the precise definition of a limit
3 One-sided limits, continuity, Limits involving infinity; asymptotes of graphs
4 Differentiation: tangents & derivative at a point, the derivative as a function
5 Differentiation rules, the derivative as a rate of change
6 Derivatives of trigonometric functions, Chain rule, implicit differentiation
7 Related rates, linearization & differentials, higher derivatives
8 Applications of derivatives: extreme values of functions
9 Rolls' theorem, the mean value theorem, Monotonic functions & the first derivative test
10 Convexity, point of inflection & second derivative test, Concavity & curve sketching
11 Applied optimization, Antiderivatives, integration: area & estimating with finite sums
12 Sigma notation & limits of finite sums, definite integral, the fundamental theorem of calculus
13 Indefinite integrals & the substitution method, Substitution & area between curves
14 Applications of definite integrals: volumes using cross-sections
15 Volumes using cylindrical shells, arc length, Areas of surfaces of revolution
16 Transcendental functions: inverse functions & their derivatives
17 Natural logarithms, exponential functions, Indeterminate forms & L'Hôpital's rule
18 Inverse trigonometric functions, hyperbolic functions

Recommended Texts

1. Thomas, G.B., Weir, M. D.,& Hass J. R. (2014).*Thomas' calculus: single variable*(13th ed./Latest). London: Pearson.
2. Stewart, J. (2015).*Calculus* (8th ed. /Latest). Boston: Cengage Learning.

Suggested Readings

1. Anton, H., Bivens I. C.,& Davis, S. (2016).*Calculus* (11th ed. /Latest). New York: Wiley.
2. Goldstein, L. J., Lay, D. C., Schneider, D. I.,& Asmar, N. H. (2017).*Calculus & its applications*(14th ed.). London: Pearson.
3. Larson, R.,& Edwards, B. H. (2013).*Calculus* (10th ed. /Latest).New York: Brooks Cole.

PHYS-5101 Mechanics Cr.H-3(3-0)

Course Brief:

Mechanics is all about motion of a body. It deals with forces, motion and further to the laws of motion in inertial frames specifically. This course provides the students a broad understanding of the physical principles of the mechanics, to describe mechanical events that involve forces acting on macroscopic objects. The main objective of this course is to create quantitative skills in the students and to motivate them to think creatively and critically about scientific problems and experiments. Students are encouraged to share their thinking with teacher and the other students to examine different problem-solving strategies.

Course Learning Objectives:

After completion of the course, students will be able

1- To understand the basic concepts of mechanics, kinematics and dynamics.

2- To understand the specific knowledge in mechanics particularly Newton's Laws and applications, dynamics of the object and conservation theorem.

3- To develop problem solving approach to answer problems in applied physics.

4- To recognize and distinguish the various types of motion like rotational motion, planetary motion and their relevant concepts.

Course Contents:

1 Motion in one/two/three dimensions.
2 Newtonian mechanics, Friction, Drag force, Work and kinetic/potential energy.
3 Linear momentum, Conservation of momentum/energy, Power, System of particles, Collisions in one/two dimensions.
4 Rotational dynamics, Moment of inertia, Principles of parallel and perpendicular axis theorem.
5 Determination of moment of inertia of various shapes.
6 Rotational dynamics of rigid bodies and its effect on the application of torque.
7 Angular momentum and its conservation, Effect of torque on the angular momentum.
8 The motion of planets and Kepler laws in detail, Motion of satellite and its energy consideration in planetary and satellite motion.
9 Fluid statics, Fluid dynamics.

Recommended Books:

1. Halliday, D., Resnick, R. & Walker, J. (2014). *Fundamentals of physics* (10th Ed.). New York: Wiley.
2. Halliday, D., Resnick, R. & Krane, K. S. (2003). *Physics* (5th Ed.). New York: Wiley.

Suggested Books:

1. Young, H. D., Freedman, R. A. & Ford, A. L. (2019). *University physics* (15th Ed.). New York: Pearson.
2. Serway, R. A. & Jewelt, J. W. (2014). *Physics for scientist and engineers* (9th Ed.). New York: Brooks/Cole.
3. Melissinos, A.C. (2008). *Experiments in modern physics.* New York: Academic press.

PHYS-5103 Waves and Oscillations 3(3-0)

Course Brief:

This course includes the very necessary and fundamental concepts of oscillations in start to develop a logical foundation for the generation of waves in a medium and even in the absence of a medium i.e electromagnetic waves. Damped oscillations in connection with resonance are elaborated followed by types of waves in terms of their respective media for propagation. Characteristic features of mechanical waves including waves in a stretched string and sound waves are learnt to students that include speed of waves, superposition, resonances, harmonics and Doppler Effect, to mention a few. Later in case of electromagnetic waves, their generation, propagation in various media, diffraction, reflection and refraction like properties are also elaborated.

Course Learning Objectives:

This course provides students an insight of the principles of waves as carriers of energy including sound and optical waves mainly. A student studying this course will understand classical as well modern physics and will also acquire the skills to apply principles to new and unfamiliar problems. Students are encouraged to share their thinking with teachers and peers and to examine different problem-solving strategies, in the said field.Students will learn that waves come from many interconnected (coupled) objects when they are vibrating together. We will discuss many of these phenomena, along with related topics, including mechanical vibrations and waves, sound waves, electromagnetic waves and optics.
S

Course Contents:

1 S.H.M and its application, energy consideration in S.H.M
2 S.H.M and uniform circular motion combination of harmonic oscillations
3 Damped harmonic oscillation, Forced oscillation, driven harmonic oscillation and resonance
4 Mechanical waves, traveling waves, linear wave equation, power & intensity in wave motion

5 Principle of superposition, standing waves, interference of waves, beats
6 Doppler effect & its applications, supersonic and shock waves
7 Measurement of speed of light by Roemer's and Fizeau's methods, reflection, refraction
8 Huygens's principle and its applications to reflection and refraction
9 Fermat's principle, conditions for interference
10 Young's double slit experiment, intensity distribution in double slit interference pattern, phasors
11 Interference from thin film
12 Introduction to diffraction pattern, single slit diffraction pattern
13 Intensity in single slit diffraction pattern using phasor, diffraction grating
14 X-ray diffraction
15 Polarization by selective absorption
16 Reflection.

Recommended Texts:

1 Resnick, R., Halliday, D. &Krane, K. S. (2002). *Physics (*5th ed.) New York: Wiley.
2 Halliday, D., Resnick, R. & Walker, J. (2014). *Fundamental of physics* (10th ed.) New York: Wiley.

Suggested Readings:

1. Sears, F. W., Zemansky, M. W. & Young, H. D. (2000). *University physics* (8th ed.) Massachusetts: Addison-Wesley.
2. Alonso, M. & Finn, E. J. (1999). *Physics* MA: Addison-Wesley.
3. Serway, R. A. &Jewelt, J. W. (2004). *Physics for scientists and engineers* (6th ed.). New York: Thomson Brooks.

4. URCQ-5111 Translation of the Holy Quran –I 1(1—0)NC

6. تیسواں پارہ۔ناظرہ مع تجوید
7. بنیادی عربی گرامر
8. اسم اور اس کے مختلف: اسماء عل، مفعول، تفضیل، مبالغہ افعال اور اس کی اقسام: ماضی، مضارع، امر، نہی
9. حروف تہجی، حروف جارہ، مشبہ بلیس: حرف اور اس کی اقسام
10. Memorization: تیسویں پارے کی آخری بیس سورتیں (حفظ مع ترجمہ)

Semester-II

URCG-5112 Fables, Wisdom Literature, and Epic 2(2-0)

The course will enable students to explore human experiences, cultivate an appreciation of the past, enrich their capacity to participate in the life of their times, and enable an engagement with other cultures and civilizations, both ancient and modern. But independently of any specific application, the study of these subjects teaches understanding and delight in the highest achievements of humanity. The three components of the course, including fables, wisdom literature and epic, will enable the learners to explore and understand the classic tradition in literature. Development of personal virtue, a deep Sufi ethic and an unwavering concern for the permanent over the fleeting and the ephemeral are some of the key themes explored in the contents that will develop an intimate connection between literature and life.

Contents

1. Fables
   The Fables of Bidpai
   The Lion and the Bull
   The Ring-dove
   The Owls and the Crows

   Selected poem from Bang-i-Dara

2. Gulistan-e- Sa'di
   Ten ḥikāyāt from John T. Platts, The Gulistan
3. Epic
   THE SHĀHNĀMA OF FIRDAUSI

Recommended Texts

1. John T. P. (1876). The Gulistan; or, Rose Garden of Shaikh Muslihu'd- Dīn Sa'dī of Shīrāz. London: Wm. II. Allen.
2. Chishti, Y.S. (1991). Sharaḥ-i bāng-i darā. Lāhaur: Maktaba-i ta'mīr-i insāniyat

Suggested Readings

1. Thackston, W. (2000). A Millennium of Classical Persian Poetry. Maryland: Ibex Publishers.
2. Wood, R. (2013). Kalila and Dimna: Fables of Conflict and Intrigue. United Kingdom: Medina Publishing, Limited.

URCG-5116 **Science of Society-I** **2 (2-0)**

Course Description:

This course will introduce students with the subject matter of social science, its scope, nature and ways of looking at social phenomenon. It will make the participants acquaintance with the foundations of modern society, state, law, knowledge and selfhood. While retaining a focus on Pakistani state and society, students will encounter theoretical concepts and methods from numerous social science disciplines, including sociology, politics, economics anthropology and psychology and make them learn to think theoretically by drawing on examples and case studies from our own social context. Students will be introduced to the works of prominent social theorists from both western and non-western contexts. Instruction will include the use of written texts, audio-visual aids and field visits.

Learning Outcomes:

The course has following outcomes:

It will

- Introduce student with the nature of human social behavior and foundations of human group life
- Analyze the reciprocal relationship between individuals and society.
- Make student aware with the nature of societies existing in modern world
- Make students familiar with the philosophy of knowledge of social sciences
- Introduce students with the works of prominent theories explain human group behavior
- Help students to understand the foundations of society including culture, socialization, politics and economy
- Introduce students with various dimensions of social inequalities with reference to gender, race, ethnicity and religion
- Make them aware about the understanding of various themes pertains to social science in local context
- Help them recognize the difference between objective identification of empirical facts, and subjective formulation of opinionated arguments

Course Outlines:

1. **Introduction to Social Sciences**
   - Social world, Human Social behavior, Foundations of society
   - Evolution of Social sciences
   - Philosophy of Science
   - Scope and nature of social sciences
   - Modernity and social sciences
   - Branches of social science: Sociology, Anthropology, Political Science, Economics

Society and Community, Historical evolution of Society

   - Types of Societies
   - Foraging society, Horticultural society, Pastoralist society
   - Agrarian societies, Industrial society, Postindustrial society

2. **Philosophy of Knowledge in social Science and social inquiry**
   - Understanding social phenomenon
   - Alternative ways of knowing
   - Science as a source to explore social reality
   - Objectivity, Value-Free research
   - Positivism vs Interpretivism
   - Qualitative vs Quantitative

3. **Culture and Society**
   - Idea of Culture, Assumptions of Culture
   - Types, Components, Civilization and culture
   - Individual and culture. Cultural Ethnocentrism, Cultural Relativism
   - Outlook of Pakistani culture
   - Global Flows of culture, Homogeneity, Heterogeneity
4. **Social Stratification and Social inequality**
   - Dimensions of inequality, Social class
   - Gender, Race, Religion, Ethnicity, Caste
   - Patterns of social stratification in Pakistan
   - Class, caste system in agrarian society
   - Ascription vs Achievement, Meritocracy
   - Global stratification in modern world, Global patterns of inequality
5. **Personality, Self and Socialization**
   - Concept of self, Personality
   - Nature vs Nurture, Biological vs Social
   - Development of Personality
   - Socialization as a process, Agents of socialization
   - Socialization and self/group identity
6. **Gender and Power**
   - Understanding Gender
   - Social construction of Patriarchy
   - Feminism in Historical context, Gender Debates
   - Gender and Development
   - Gender issues in Pakistani society, Women Participation in politics, economy and education
   - Toward a gender sensitive society, Gender mainstreaming

Pakistan: State, Society, Economy and Polity

   - Colonialism, colonial legacy, National identity
   - Transformation in Pakistani society: Traditionalism vs Modernism
   - Economy, Informality of Economy, Modern economy and Pakistan
   - Political Economy, Sociology of Economy

Recommended Textbooks and Reading Materials:

1. Giddens, A. (2018). Sociology (11th ed.). UK: Polity Press.
2. Henslin, J. M. (2018). Essentials of Sociology: A Down-to-Earth Approach.(18th Edition) Pearson Publisher.
3. Macionis, J. J. (2016). Sociology (16th ed.). New Jersey: Prentice-Hall.
4. Qadeer, M. (2006) Pakistan - Social and Cultural Transformation in a Muslim Nation.
5. Smelser, N.J. and Swedburg, R., The Handbook of Economic Sociology, Chapter 1 'Introducing Economic Sociology', Princeton University Press, Princeton.
6. Systems of Stratification | Boundless Sociology (no date). Available at: https://courses.lumenlearning.com/boundless-sociology/chapter/systems-of-stratification/
7. Jalal, A. (ed.) (1995) 'The colonial legacy in India and Pakistan', in Democracy and Authoritarianism in South Asia: A Comparative and Historical Perspective. Cambridge: Cambridge University Press (Contemporary South Asia)
8. Zaidi, S. A. (2015) Issues in Pakistan's Economy: A Political Economy Perspective. Oxford University Press. Chapter 26
9. Akhtar, A. S. (2017) The Politics of Common Sense: State, Society and Culture in Pakistan. Cambridge: Cambridge University Press.

Smelser, N.J. and Swedburg, R., The Handbook of Economic Sociology, Chapter 1 'Introducing Economic Sociology', Princeton University Press, Princeton.

URCQ-5120 Exploring Quantitative Skills 3(3-0)

Since ancient times, numbers, quantification, and mathematics has played a central role in scientific and technological development. In the 21st century Quantitative Reasoning (QR) skills are essential for life as they help to better understand socio-economic, political, health, education, and many other issues an individual now faces in daily life. The skills acquired by taking this course will help the students to apply QR methods in their daily life and professional activities. This course will also change student's attitude about mathematics. It will not only polish their QR skills, but also enhance their abilities to apply these skills.

Contents:

1. What is quantitative reasoning?
2. Overview of history of mathematics and contributions of Muslim scholars.
3. Different types of standard numbers and their role in practical life scenarios.
4. Understanding relationship between parts and whole.
5. Practical life scenarios involving parts & whole.
6. Practical life scenarios involving units and rate.
7. Unit analysis as a problem solving tool
8. Understanding our World through numbers.
9. Dealing with very big and small numbers & their applications.
10. Understanding uncertainty and its applications.
11. Stock exchange and economy.
12. Money management (profit, loss, discount, zakat, simple interest, compound interest and taxation).
13. Money management in practical life scenarios like investments and federal budget.
14. Practical scenarios involving expressions.
15. Equating two expressions in one variable & using it to solve practical problems.
16. Social and economic problems involving expressions.
17. Introduce geometrical objects through architecture and landscape.
18. Dealing with social and economic issues involving geometrical objects
19. Practical scenarios involving sets and Venn diagrams.
20. Ven diagrams and their applications in different disciplines.

Recommended Books:

1 Using and understanding mathematics, 6th edition by Jeffrey Bennet and William Briggs, published by Pearson USA.
2 Mathematical thinking and reasoning 2008 by Aufmann, Lockwood, Nation & Clegg published by Houghton Mifflin Company USA.
3 Pre-calculus by Robert Blitzer 5th edition published by Pearson USA.
4 Pre-calculus Graphical, Numerical, Algebraic 8th edition by Franklin D. Demana, Bert K. Waits, Gregory D. Foley & Daniel Kennedy published by Addison Wesley USA.
5 Pre-calculus Mathematics for Calculus, 6th edition by James Stewart, Lothar Redlin and Saleem Watson published by Brooks/Cole Cengage Learning USA.
6 GRE Math Review https://www.ets.org/s/gre/pdf/gre_math_review.pdf
7 OpenAlgebra.com A free math study guide with notes and YouTube video tutorials

Additional Resources:

1 Beauty and power of mathematics: https://youtu.be/VIbjHIGMjQM
2 Types of numbers: https://youtu.be/6YytojexiOg
3 Mathematics in daily life: https://youtu.be/VIbjHIGMjQM
4 Geometry through architecture: https://youtu.be/z2Fb0R2EYo4
5 Trigonometric ratios: https://youtu.be/Jsiy4TxgIME
6 Inverse trigonometric functions: https://youtu.be/JGU74wbZMLg
7 Solving word problems involving linear equations: https://youtu.be/DfbQjiSooOo
8 GRE Preparation Materials: https://ScholarDen.com

URCG-5127 Seerat of the Holy Prophet مطالعہ سیرت النبی صلی اللہ علیہ وسلم 1(1-0)

Title	Description
Semester	
Nature of Course	
Total Teaching weeks	18
Objectives of the Course	۱۔طلباء کو مطالعہ سیرۃ طیبہ کی ضرورت و اہمیت سے آگاہ کرنا ۲۔ تعمیر شخصیت میں مطالعہ سیرۃ طیبہ کے کردار کو واضح کرنا ۳۔بعثت نبوی کے موقع پر اقوام عالم کی عمومی صورت حال سے آگاہ کرنا ۴۔رسول اکرم صلی اللہ علیہ وسلم کی مکی اور مدنی زندگی کا اس طرح مطالعہ کروانا کہ طلباء ان واقعات سے نتائج کا استنباط کر سکیں ۵۔ طلباء کوعہد نبوی کی معاشرت ، سیاست ، معیشت سے آگاہ کرنا

Course Description

S.No.	Title	Description
1	حضور صلی اللہ علیہ وسلم کے ابتدائی حالات زندگی	۱۔ حضور صلی اللہ علیہ وسلم کا خاندانی حسب و نسب ۲۔ پیدائش اور ابتدائی تربیت ۳۔ لڑکپن اور جوانی کے حالات زندگی
2	بعثت نبوی کے وقت دنیا کے حالات(۱)	۱۔ بعثت نبوی کے وقت اہم تہذیبیں ۲۔ عرب، مصر، حبشہ، بازنطینی، ساسانی
3	بعثت نبوی	۱۔ مکی عہد میں دعوت اسلام
4	بعثت نبوی	۱۔ مدنی عہد میں دعوت اسلام
5	خصائص النبیؐ	آپ ؐ بطور پیغامبر امن
6	خصائص النبیؐ	بحثیت استاد و معلم
7	خصائص النبیؐ	بحثیت تاجر
8	خصائص النبیؐ	بحثیت سربراہ ریاست
9	خصائص النبیؐ	ذاتی محاسن اور عالمگیر اثرات
10	خصائص النبیؐ	ناموس رسالتؐ

غیر مسلموں سے تعلقات	اسوہ حسنہ اور عصر حاضر	11
اسوہ حسنہ کی روشنی میں گھریلو زندگی	اسوہ حسنہ اور عصر حاضر	12
مستشرقین اور مطالعہ سیرت	اسوہ حسنہ اور عصر حاضر	13
وطن سے محبت اور سیرت	اسوہ حسنہ اور عصر حاضر	15
مستشرقین کے اعتراضات اور ان کے جوابات	اسوہ حسنہ اور عصر حاضر	16

نصابی کتب

نمبر شمار	نام مؤلف	نام کتاب
1	ابن ہشام	السیرۃ النبویۃ
2	مولاناشبلی نعمانی ، سید سلمان ندوی	سیرۃ النبی صلی اللہ علیہ وسلم
3	قاضی محمد سلیمان سلمان منصور پوری	ر حمۃ اللعالمین
4	مولانا سیدابو الحسن علی ندوی	نبی رحمت صلی اللہ علیہ وسلم
5	ڈاکٹر یسین مظہر صدیقی	عہد نبوی کا نظام حکومت
6	ڈاکٹر خالد علوی	انسان کامل

حوالہ جاتی کتب

نمبر شمار	نام مؤلف	نام کتاب
1	سید ابوالاعلیٰ مودودی	سیرت سرور عالم صلی اللہ علیہ وسلم
2	مولانا صفی الرحمن مبارکپوری	الرحیق المختوم
3	پیر محمد کرم شاہ الازہری	ضیاء النبی صلی اللہ علیہ وسلم
4	ڈاکٹر اکرم الضیاء العمری	السیرۃ النبویۃ الصحیحۃ
5	مولاناعبدالرؤف دانا پوری	اصح السیر

MATH-5104 **Calculus-II** **3(3-0)**

This is the second course of the basic sequence Calculus serving as the foundation of advanced subjects in all areas of mathematics. The sequence, equally, emphasizes basic concepts & skills needed for mathematical manipulation. As continuation of Calculus-I, it focuses on the study of functions of a single variable. This Core Curriculum course is designed to meet the following four learning goals: Students will construct and evaluate logical arguments. Students will apply and adapt a variety of appropriate strategies to solve mathematical problems. Students will recognize and apply mathematics in contexts outside of mathematics. Students will organize and consolidate mathematical thinking through written and oral communication. Students will integrate transcendental functions, including logarithms, exponential, trigonometry and inverse trigonometric, hyperbolic and inverse hyperbolic functions, apply methods of integration, such as algebraic substitution, trigonometric substitution, partial fractions, integration by parts, and use a table of integrals, solve limit problems involving indeterminate forms with La'Hopital's Rule and convert parametric representation of curves to rectangular coordinates, represent a curve using polar coordinates, and integrate functions expressed in polar coordinates.

Contents

1 Techniques of integration: Using Basic Integration Formulas, Integration by Parts
2 Trigonometric Integrals, Trigonometric Substitutions
3 Integration of Rational Functions by Partial Fractions
4 Integral Tables & Computer Algebra Systems, Numerical Integration, Improper Integrals
5 Sequences & Infinite Series, The Integral Test, Comparison Tests
6 Absolute Convergence, The Ratio & Root Tests
7 Alternating Series & Conditional Convergence
8 Power Series, Taylor & Maclaurin Series, Convergence of Taylor Series
9 The Binomial Series & Applications of Taylor Series

10 Parametrizations of Plane Curves
11 Calculus with Parametric Curves, Polar Coordinates
12 Graphing Polar Coordinate Equations
13 Areas & Lengths in Polar Coordinates, Conic Sections, Conics in Polar Coordinates

Pre-requisite: **Calculus-I**

Recommended Texts

1 Thomas, G. B., Weir, M. D.,& Hass, J. R. (2014). *Thomas' calculus: single variable* (13th ed. /Latest).London: Pearson.
2 Stewart, J. (2012). *Calculus*, (8th ed. /Latest). New York: Cengage Learning.

Suggested Readings

1 Anton, H., Bivens, I. C.,& Davis, S. (2016). *Calculus*, (11th ed. /Latest). New York: Wiley.
2 Goldstein, L. J., Lay, D. C., Schneider, D. I., & Asmar, N. H. (2017). *Calculus &its applications* (14th ed.). London: Pearson.
3 Larson, R., & Edwards, B. H. (2013). *Calculus* (10th ed. /Latest). New York: Brooks Cole.

PHYS-5103 **Introduction to Electromagnetism** **3(3-0)**

Course Brief:
PHYS-5103 gives an introduction in electromagnetism with emphasis on the following topics: Electric fields and currents, magnetic fields and induction, simple electrical circuits and electromagnetic oscillations.

Course Learning Objectives:
The objectives of this course are to tease out the laws of electromagnetism from our everyday experience by specific examples of how electromagnetic phenomena manifest themselves. The students would be able to describe, in words, the ways in which various concepts in electromagnetism come into play in particular situationand to predict outcomes in other similar situations.The overall goal is to use the scientific method to come to understand the enormous variety of electromagnetic phenomena in terms of a few relatively simple laws.

Course Contents:
1. Coulomb's law in vacuum, Electric field due to discrete/continuous charges distributions, Electric dipole, Electric flux, Gauss's law and its applications.
2. Electric potential due to discrete/continuous charges distributions.
3. Work and Electric potential energy.
4. Capacitors and capacitance, Capacitance for various geometries, Capacitance with Dielectrics, Energy transfer in electric circuit.
5. Power in electric circuits, Calculating current in a single loop and multiple loop by using Kirchhoff laws, Circuit analysis.
6. Growth and decay of current in RC-circuits and its analytical treatment. Magnetic field, Magnetic forces on a single point charge/current carrying conductor.
7. Torque on a current carrying loop and magnetic dipole, Biot & Savart Law and its analytical treatment and application.
8. Ampere's law and its applications, Electromagnetic induction and its laws.
9. Inductance,Inductance for various configurations, LR circuits, Growth and decay of current in RL circuits.

10. Electromagnetic Oscillation (Qualitative and Quantitative analysis using differential equations), Forced electromagnetic oscillations and resonance.
11. Alternating current circuits, Single loop RLC circuits (series and parallel), Power in AC circuits and phase angles
12. Measurement of resistance using a Neon flash bulb and condenser
13. Conversion of a galvanometer into Voltmeter & an Ammeter
14. To determine the self inductance of given coil.
15. To determine the mutual inductance b/w two coils.
16. To determine frequency of AC supply by electromagnetic sonsmeter/ Melde's experiment.
17. Measurement of low resistance coil by a Carey Foster Bridge.

Recommended Texts:

1. Halliday, D., Resnick, R. & Walker, J. (2014). *Fundamental of Physics* (10th ed.). New York: Wiley.
2. Halliday, D., Resnick, R. & Krane, K. S. (2003). *Physics* (5th ed.). New York: Wiley.

Suggested Readings:

1. Young, H. D., Freedman, R. A. & Ford, A. L. (2019). *University physics* (15th ed.). New York: Pearson.
2. Ohanian, H. C. & Markert, J. T. (2006).*Physics for engineers and scientists* (3rd ed.). New York: W. W. Norton.
3. Serway, R. A. & Jewelt, J. W. (2014). *Physics for scientist and engineers* (9th ed.). New York: Brooks/Cole.

Semester-III

URCE- 5119 Expository Writing 3 (3-0)

Thiscourse preparesundergraduatestobecomesuccessfulwritersandreadersofEnglish.Thecoursehelpsstudents develop their fundamental language skills with a focus on writing so that they can gain theconfidence to communicate in oral and written English outside the classroom. The course is divided intofiveunitsandtakesaProject-basedLearningapproach.Unitthemestargetthedevelopmentof21st centuryskills and focus on self-reflection and active community engagement. The course completion will enablethe students to develop communication skills as reflective and self-directed learners. They will be able tointellectually engage with different stages of writing process, and develop analytical and problem-solvingskillstoaddress various community-specificchallenges.

Contents

1. Self-Reflection
   - Introductiontothebasicsofthewritingprocess
   - Introductiontothestepsofessaywriting
   - Prewritingactivities:Brainstorming,listing,clusteringandfree writing
   - PracticingOutliningoftheessay
2. PersonalizedLearning
   - LearningProcess, LearningStyles, Goal Settingand LearningPlan
3. OralPresentation
   - StructureandSignificance,ContentSelectionandSlidePresentation,Peer Review
4. CriticalReadingSkills
   - IntroducingAuthenticReading(Dawnandnon-specialistacademicbooks/texts)
   - Reading Strategies and Practice: Skimming, scanning, SQW3R, Annotating, Detailed readingand note-taking, Standard Test Practice: TOEFL and IELTS, Model Review Reports andAnnotatedBibliographies
5. CommunityEngagement
   - Student-ledbrainstormingonlocalversusglobalissues,Identifyingresearchproblems
   - Draftingresearchquestions,Draftinginterview/surveyquestionsforcommunityresearch(inEng

lishor L1)

- EngagingstudentsinCritical reading,Presentinginterview/surveyinformation,Fieldwork
- WritingCommunityEngagement Project

6. Lettertothe Editor
    - Typesofletters, Format andpurposeoflettertotheeditor,Stepsinwritingletter-to-editor

Recommeded bookss

1. Bailey,S.(2011).Academicwriting:Ahandbookforinternationalstudents(3rded.).NewYork:Routledge.
2. Swales,J.M.,&Feak,C.B.(2012).*Academicwritingforgraduatestudents:Essentialtasksandskills* (3rded.).Ann Arbor:The Universityof MichiganPress.

SuggestedReadings

1. Cresswell,G.(2004).*Writingforacademicsuccess*.London:SAGE.
2. Johnson-Sheehan,R.(2019). *Writingtoday*.DonMills: Pearson.
3. Silvia,P.J.(2019).*Howtowritealot:Apracticalguidetoproductiveacademicwriting*.Washington: American PsychologicalAssociation.

URCQ-5121 Tools for Quantitative Reasoning 3(3-0)

This course is based on the course exploring quantitative skills offered in semester-III. Students will be introduced to more tools necessary for quantitative reasoning skills to live in the fast paced 21st century. Students will be introduced to importance of mathematical skills in different professional settings, social and natural sciences. These quantitative reasoning skills will help students to better participate in national and international issues like political and health issues. This course will prepare the students to apply quantitative reasoning tools more efficiently in their professional and daily life activities. This course will help them to better understand the information in form of numeric, graphs, tables, and functions.

Contents:

1. Investigating relationships between variables.
2. Exploring tools to find relationship between variables.
3. Resources and population growth.
4. Dealing with Economical, environmental and social issues.
5. Graphical and analytical approaches to solve a problem.
6. Applications of graphical & analytical approaches in social & economic problems.
7. Understanding inequalities around us.
8. Dealing with practical problems involving inequalities in different disciplines.
9. Golden ratio in sculptures.
10. Comparison of statements and their use in social and economic problems.
11. Number patterns and their applications.
12. Survival in the modern World.
13. Propositions and truth values.
14. Applications of logic.
15. Exploring and summarizing data, misleading graphs.
16. Finding a representative value in a data.
17. Measure and spread of a data, measuring degree of relationship among variables.
18. Counting the odds.

Suggested readings:

1 Bennett, J. & Briggs, W. (2015). Using and understanding mathematics (6th Edition). Pearson Education, Limited. http://xn--webducation-dbb.com/wp-content/uploads/2019/09/Jeffrey-Bennett-WilliamBriggs-Using-Understanding-Mathematics_-A-Quantitative-Reasoning-Approach-Pearson-2015.pdf

2 Blitzer, R. (2014). Precalculus. (5th Edition). Pearson Education, Limited. https://www.ilearnacademy.net/uploads/3/9/2/2/3922443/precalculus__edition_5f.pdf

Further readings:

1 Using and understanding mathematics, 6th edition by Jeffrey Bennet and William Briggs, published by Pearson USA.
2 Mathematical thinking and reasoning 2008 by Aufmann, Lockwood, Nation & Clegg published by Houghton Mifflin company USA.
3 Pre-calculus by Robert Blitzer 5th edition published by Pearson USA.
4 Pre-calculus Graphical, Numerical, Algebraic 8th edition by Franklin D. Demana, Bert K. Waits, Gregory D. Foley & Daniel Kennedy published by Addison Wesley USA.
5 Pre-calculus Mathematics for Calculus, 6th edition by James Stewart, Lothar Redlin and Saleem Watson published by Brooks/Cole Cengage Learning USA.
6 https://www.ets.org/s/gre/pdf/gre_math_review.pdf
7 OpenAlgebra.com A free math study guide with notes and YouTube video tutorials.
8 https://www.ScholarDen.com

Additional Resources (Optional):

1 Direct proportion: https://youtu.be/kuvdMCDqmKg
2 Inverse proportion: https://youtu.be/xEFyfL9YdHA
3 Identifying a linear function: https://youtu.be/AZroE4fJqtQ
4 Functions: https://youtu.be/GY6Q2f2kvY0
5 Linear functions: https://youtu.be/MXV65i9g1Xg
6 Applications of linear equations: https://youtu.be/UAYCkFMU-YM
7 Solving system of linear equations: https://youtu.be/2DzmE3_QS-E
8 Scatter Plot and correlation: https://youtu.be/qscgK78No70
9 Mean Median and Mode: https://youtu.be/B1HEzNTGeZ4
10 Pearson's correlation coefficient: https://youtu.be/jBQz2RGxCek

URCP-5122 Ideology and Constitution of Pakistan Cr.H-2(2-0)

Thiscoursefocusesonideologicalbackgroundof Pakistan.Thecourseisdesignedtogiveacomprehensiveinsight aboutthe constitutional development sof Pakistan.Starting from the Government of India Act, 1935 till to date, all important events leading to constitutional developments in Pakistan will be the focus ofcourse. Failure of the constitutional machinery and leading constitutional cases on the subject. Moreover,students will study the process of governance, national development, issues arising in the modern age andposing challenges to Pakistan. It will also cover the entire Constitution of Pakistan 1973. However,emphasis would be on the fundamental rights, the nature of federalism under the constitution, distributionofpowers,therightsandvariousremedies,thesupremacyofparliamentandtheindependenceofjudiciary.

Contents:

1 **Ideology ofPakistan**
IdeologicalrationalewithspecialreferencetoSirSyedAhmedKhan,AllamaMuhammadIqbalandQuaid-e-AzamMuhammad AliJinnah.
TwoNationTheoryandFactorsleadingtoMuslimseparatism.

2 **ConstitutionalDevelopments**
Salient Feature of the Government of India Act
1935Salient Feature of Indian Independence Act
1947ObjectivesResolution
SalientFeature ofthe1956Constitution
DevelopmentsleadingtotheabrogationofConstitutionof1956Salientfeaturesofthe 1962Constitution
CausesoffailureoftheConstitutionof1962
ComparativestudyofsignificantfeaturesoftheConstitutionof1956,1962and1973

3 **Fundamentalrights**
a. Principlesofpolicy
b. Federation of PakistanPresidentParliament

TheFederalGovernment

c. **Provinces**
   Governors
   ProvincialAssemblies
   TheProvincial Government

4 **TheJudicature**
   Supreme
   CourtHighC
   ourts
   Federal Shariat
   CourtsSupremeJudicial
   Council
   AdministrativeCourtsandtribunals

5 **IslamicProvisionsinConstitution**

6 **SignificantAmendmentsofConstitutionofPakistan1973.**

RecommendedBooks:

1. ConstitutionalandPoliticalHistoryofPakistanbyHamidKhan
2. Mahmood,ShaukatandShaukat,Nadeem.ConstitutionoftheIslamicRepublicofPakistan,3rdreedn. Lahore:LegalResearchCentre,1996.
3. Munir,Muhammad.ConstitutionoftheIslamicRepublicofPakistan:BeingaCommentaryon theConstitution ofPakistan, 1973. Lahore,Law Pub.,1975.
4. Rizvi,SyedShabbarRaza.ConstitutionalLawofPakistan:Text,CaseLawandAnalytical Commentary. 2nd re edn. Lahore:Vanguard, 2005.
5. TheTextoftheConstitutionoftheIslamicRepublicofPakistan,1973(asamended).
6. FundamentalLawsofPakistanbyA.K.Brohi.

MATH-5105 **Linear Algebra** **3(3-0)**

Linear algebra is the study of linear systems of equations, vector spaces, and linear transformations. Solving systems of linear equations is a basic tool of many mathematical procedures used for solving problems in science and engineering. Linear Algebra plays a significant role in many areas of mathematics, statistics, engineering, the natural sciences, and the computer sciences. It provides a foundation of important mathematical ideas that will help students be successful in future coursework. The main objective of this course is to help students to learn in rigorous manner, the tools & methods essential for studying the solution spaces of problems in mathematics and in other fields& develop mathematical skills needed to apply these to the problems arising within their field of study and to various real-world problems. The student will become competent in solving linear equations, performing matrix algebra, calculating determinants, finding eigenvalues & eigenvectors and the student will come to understand a matrix as a linear transformation relative to a basis of a vector space.

Contents

1 Representation of linear equations in matrix form
2 Solution of linear system, Gauss-Jordan & Gaussian elimination method
3 Vector space, definition, examples & properties
4 Subspaces, Linear combination & spanning set
5 Linearly Dependent & Linearly Independent sets
6 Bases & dimension of a vector space
7 Intersections, sums & direct sums of subspaces, Quotient Spaces, Change of basis
8 Linear transformation, Rank & Nullity of linear transformation
9 Matrix of linear transformations

10 Eigen values & eigen vectors, Dual spaces
11 Inner product Spaces with properties, Projection
12 Cauchy inequality
13 Orthogonal & orthonormal basis
14 Gram Schmidt process & diagonalization

Recommended Texts

1. Dar, K.H. (2007). *Linear algebra* (1st ed.). Karachi: The Carwan Book House.
2. Kolman, B.,& Hill, D. R. (2005). *Introductory linear algebra* (8th ed.). London: Pearson/Prentice Hall.

Suggested Readings

1. Cherney, D., Denton, T., Thomas, R.,& Waldron, A. (2013). *Linear algebra* (1st ed.). California: Davis.
2. Anton, H., & Rorres, C. (2014). *Elementary linear algebra: applications version* (11th ed.). New York: John Wiley & Sons.
3. Grossman, S. I. (2004). *Elementary linear algebra* (5th ed.). New York: Cengage Learning.

PHYS-5104 Modern Physics 3(3-0)

The modern physics also termed as post-Newtonian concepts in physics deals with the major advances made in the twentieth century. To get the correct understanding of the natural world, we still use these ideas as given in the course contents.

Course Learning Objectives:

The purpose of this course is to provide students with a foundation in the concepts, fundamental principles and analytic techniques needed to solve problems arising in the context of contemporary physics.

Course Contents:

1. Black Body Radiation.
2. Plank's Radiation Law and Quantum of Energy, Derivation of Stefan's Law and Wien's Displacement Law from Planck's Radiation Law.
3. Quantization of Energy, Light Quantization and Photoelectric Effect. The Compton Effect.
4. Wave Nature of Matter and de-Broglie Hypothesis and its Experimental Verification, Wave Packet and its Localizations in Space and Time.
5. Hydrogen Spectrum, Bohr Theory of Atomic Structure, Deficiencies of the Bohr Model,
6. Bohr Correspondence Principle, Experimental Evidence for Quantization and Determination of Critical Potential (Frank-Hertz Experiment).
7. Nuclear Structure and the Basic Properties of the Nucleus (Nuclear Size, Binding Energy, Angular Momentum of the Nucleus.
8. Magnetic Moment and parity) Meson Theory of Nuclear Force.
9. Radioactivity and Laws of Radioactive Decay, Conservation Laws in Radioactive Decays. Radioactive Isotopes and Carbon Dating.
10. Nuclear Reactions and Q-values, The Compound Nucleus, Nuclear Fission and Fusion Applications of Nuclear Physics.

Recommended Texts:

1. Halliday, D. Resnick, R. & Walker, J. (2014). Fundamentals of physics (10th ed.). New York: Wiley.

2. Halliday, D. Resnick, R. & Krane, K. S. (2003). Physics (5th ed.). New York: Wiley.
3. Young, H. D., Freedman, R. A. & Ford, A. L. (2019). University physics (15th ed.). New York: Pearson.

Suggested Readings:

1. Beiser, A. (2003). Concepts of modern physics (6th ed.). New York: McGraw Hill.

2. Serway, R. A. & Jewelt, J. W.(2019). Physics for scientist and engineers (10th ed). New York: Cengage Learning.

PHYS-5105 Physics Lab - I 3(0-3)

The main emphasizes of this course is on graphical analysis, error calculation, and on system of S.I. units in the beginning of session. This course will help the student develop a broad array of basic skills and tools of experimental physics and data analysis.The purpose of this course is to prepare students with the latest development in this course and its associated technologies.

Course Learning objectives:

- The students will be to design and develop a strong background in the fundamentals of physics such as mechanics, optics, magnetism and electricity, modern physics and electronics.
- The students will be able to use the different components and equipment in physics practical.
- The students will also be able to work effectively and safely in the laboratory environment independently and as well as in teams
- The students will be able to enhance their expertise in setting up experiments, collecting and analyzing data
- The purpose of this home-grown laboratory for basic experimental training is to enhance research driven culture among the students.
- It helps students to develop critical and scientific thinking skills needed for the understanding of fundamental concepts in physics.

Course Contents:

1. Modulus of Rigidity by Static & Dynamic method (Maxwell's needle, Barton's Apparatus).
2. To determine the value of "g" by compound pendulum/Kater's Pendulum.
3. To study the conservation of energy (Hook's law).
4. To determine elastic constants by spiral springs.
5. To study the laws of vibration of stretched string using sonometer.
6. To determine Horizontal/Vertical distance by Sextant.
7. To determine the stopping potential by photo cell.

Recommended Texts:

1. Melissinos, A. C. & Napolitano, J. (2003). *Experiments in modern physics.* New York: Gulf Professional Publishing.
2. Shamos, M. H. (2012). *Great experiments in physics: firsthand accounts from Galileo to Einstein.* New York: Courier Corporation.

Suggested Readings:

2. Mark, H. &Olsono, H. T. (2004). *Experiments in modern physics*. New York: McGraw-Hill
3. Young, H. D., Freedman, R. A. & Ford, A. L. (2019). *University physics* (15th ed.). New York: Pearson.

4. Musaddiq, M. H. (2008). *Experimental physics.* Lahore: Allied Book Center.
5. Serway, R. A. &Jewelt, J. W. (2014). *Physics for scientist and engineers* (9th ed.). New York: Brooks/Cole.

6. URCQ-5111 Translation of Holy Quran-II 1(1-0) NC

7. o ایمانیات اور عبادات
8. اللہ پر ایمان ،فرشتوں پر ایمان،رسولوں پر ایمان،آسمانی کتابوں پر ایمان
9. یوم آخرت پر ایمان ،تقدیر پر ایمان،نماز ،روزہ،زکوۃ،حج،جہاد
10. oمعاشرے کے حقوق
11. خاندان کی تکوین
12. حق مہر
13. رضاعت و حمل
14. اولاد کو قتل کرنے کی ممانعت
15. شوہر کی نافرمانی
16. طلاق
17. بیوی کی عدت کے احکام
18. نکاح کا پیغام بھیجنا
19. عورت کی وراثت (اس کے شوہر کی طرف سے)
20. والدین کے حقوق
21. بیویوں اور اولاد کے بیچ عداوت
22. oخاندان کے حقوق
23. مہمان کی عزت
24. اجازت طلب کرنے کے اصول
25. مجلس کے آداب
26. تعاون اور بھائی چارہ
27. گروہ بندی
28. محبت
29. لوگوں کے درمیان صلح
30. عفو و درگزر ،غصہ پر قابو اور معاف کرنا
31. شعوب و قبائل
32. لوگوں کے بیچ اختلاف
33. حمایت و رنگ بازی

Grammar: 34.

35. قرآنی عربی گرامر کے اصول اور ان کے اطلاقات (متن قرآن پر اطلاق سے
36. توضیحات)

37. Details ofChapters andverseNumbers:

38.

39. منتخب آیات مع ترجمہ و تجوید
40. البقرہ)) ۱۱۷، ۱۷۷،۲۷۸،۱۱۸،۴۵،۲۳۸، ۴۵، ۴۲۸،۷۱۸،۱۵۸،۳۴۷، ۴۲۸،۵۳،
41. ۳۲۷،۵۲۷،۱۱۸،۲۲۷،۲۳۷،۱۱۷،۲۴۸،۴۲۸،۲۸۷،۸۲،۲۲،۳۴۸،۲۸۷،۴۷،
42. ۱۳۸،۴۳۸،۱۳۸،۷۳۸،۲۸۸،۲۸۸،۱۳۸،۲۸۸،۱۸۸،۲۲۷،۷۵۸،۲۴۷،۲۷۸،
43. ۳۲،۱۲۷،۸۲۷،۳۳۸،۵۲۷،۸۲(
44. النساء)۲۸۷،۴۳،۸۷،۲۱۷،۲۳،۱۲،۲۲،۲۲،۳۷،۱۲،۲۲،۲۳۷،۲۴،۸۲،۴۲،
45. ۷،۱۸،۷،۲،۷۲۷،۴۳،۱۸،۴۳،۷۲۷،۲۸۷،۷۷،۷۷،۴۸،۵۸،۲۱۷،۵،۷۷،۵۳،
46. ۷۲،۲۸۷،۵۴،۲۵۷،۲۷(
47. االنعام)۵۴،۲۵،۷۴۷،۸۲،۵۷،۱۳۷،۸۸(
48. العمران)۷،۲۷،۵۵۷،۵۲،۴۸۷،۴۲،۲۳،۱۲(
49. المائدہ)۴،۸،۸۲،۲۷،۲۳،۸۲،۸،۵۴(
50. االعراف)۲۲۷،۲۲۷،۴۳(
51. لتوبہ)۱۸، ۲۷،۷۱(
52. ہود)۸۷(
53. الزمر)۲(
54. النور)۲۸،۱۲،۱۸،۸۴،۲۸،۵۴(
55. محمد)۳۳(
56. ارذل)۸۲، ۱۸(

57. □الرعد)٣(
58. □الطالق)٥(
59. □الحج)٤(
60. □ابراہیم))٥٥،٣٨(
61. □االسراء)٥٨،٣٨(
62. □االحقاف)٤٧(
63. □المومنون)١٨(
64. □ العنکبوت)٢٥،٤٨، ٢(
65. □النحل)٨٨(
66. □لقمان)٥،٤٧، ٥٧(
67. □ االحزاب))٢٥،٢٣،١٤،٤٣(
68. □الشعراء)١(
69. □الروم)٧٨(
70. □مریم)٢٨،٥٧(

71. □المجادلہ)٧٧،٨٧(

Semester-IV

URCG-5114 **Basic Science** **Cr. Hrs 3 (2-1)**

Life, its characteristics, natural science, biology and its branches; Importance of Flora & Fauna in biodiversity; Importance of Natural Compounds in daily life, medicine and human health; Latest developments in natural sciences (Biotechnology); Ecosystem and its components; Environment and its components; Pollutants and their effect on the environment (Greenhouse effect, global warming, acid rains, water pollution and ozone depletions etc); Introduction to micro-organism and its types (bacteria, fungi, viruses)

Practical:

1: Field Survey of Flora & Fauna and their identification
2: Study of herbarium
3: Study of Museum

Recommended Texts.

1. Keddy, P.A. (2017). Plant ecology origins, processes, consequences. Cambridge, University Press.
2. Canadell, J.G., Diaz, S., Heldmaier, G., Jackson, R.B., Levia, D.F., Schulze, E.D. & Sommer, U. (20 19). Ecological studies. Springer.
3. Bhat, S.V., Nagasampagi, B.A. & Sirakumar, M. (2006). Chemistry of Natural Products. Springer Science
4. De, A.K. (2019). Environmental Chemistry. New Age International Press

Suggested Books

1. Fath, B. (2018). Encyclopedia of ecology. Elsevier.
2. Ajith, H .. Urmas. P., Pastur, G. M & Iversion L. R. (2018). Ecosystem services from forest landscpes: broadsclaes consideration. 1st Edition. Springer International Publishing AG.
3. Xu, R., Ye, Y. & Zhao, W. (2011). Introduction to Natural Product Chemistry. CRC Press
4. Tayler, D.J., Green, N.P.O. & Stout, G.W. (1997). Biological Science 1&2. Cambridge University Press
5. Tayler, M.R., Simon, E.J., Dickey, D.J. & Hogan, K.A. (2020). Campbell Biology: Concepts & Connections (10th Edition). Pearson

URCE-5124 Entrepreneurship 2(2-0)

Thiscourseaddressestheuniqueentrepreneurialexperienceofconceiving,evaluating,creating,managing,and potentiallysellingabusinessidea.Thegoalistoprovideasolidbackgroundwithpracticalapplicationofimportantconceptsapplicabletotheentrepreneurialenvironment.Entrepreneurialdiscussionsregardingthe key business areas of finance, accounting, marketing and management include the creative aspects ofentrepreneurship.Thecoursereliesonclassroomdiscussion,participation,thecreationofafeasibilityplan,and building a business plan to develop a comprehensive strategy for launching and managing a newventure.

Contents:

1. **Background:** What is an Organization, Organizational Resources, Management Functions, KindsofManagers,Mintzberg'sManagerialRoles.
2. **Formsof BusinessOwnership:**TheSoleproprietorship,Partnership,Joint StockCompany
3. **Entrepreneurship:** The World of the Entrepreneur, what is an entrepreneur? The Benefits ofEntrepreneurship, The Potential Drawbacks of Entrepreneurship, Behind the Boom: Feeding theEntrepreneurial Fire.
4. **TheChallengesofEntrepreneurship:**TheCulturalDiversityinEntrepreneurship,ThePowerof"Small"Business,PuttingFailureintoPerspective,TheTenDeadlyMistakesofEntrepreneurship,How to Avoid the Pitfalls, Idea Discussions & Selection of student Projects, Islamic Ethics ofEntrepreneurship.
5. **InsidetheEntrepreneurialMind:**FromIdeastoReality:Creativity,Innovation,andEntrepreneurship,Creativity–EssentialtoSurvival,CreativeThinking,BarrierstoCreativity,Howto Enhance Creativity, The Creative Process, Techniques for Improving the Creative Process,ProtectingYour Ideas,IdeaDiscussions &SelectionofstudentProjects.
6. **Productsandtechnology,identificationopportunities**
7. **Designing a Competitive Business Model and Building a Solid Strategic Plan:** Building astrategic plan, Building a Competitive Advantage, The Strategic Management Process, Formulatestrategic options and select the appropriate strategies, Discussion about execution of Students'Project.
8. **Conducting a Feasibility Analysis and Crafting a Winning Business Plan:**Conducting aFeasibilityAnalysis,Industryandmarketfeasibility,Porter'sfiveforcesmodel,Financialfeasibilityanalysis.WhyDevelopaBusinessPlan,TheElementsofaBusinessPlan,WhatLendersandInvestors LookforinaBusinessPlan,MakingtheBusinessPlan Presentation.
9. **Building a Powerful Marketing Plan:** Building a Guerrilla Marketing Plan, Pinpointing theTarget Market, Determining Customer Needs and Wants Through Market Research.Plotting aGuerrilla Marketing Strategy: How to Build a Competitive Edge, Feed Back & Suggestions onStudent Project, Islamic EthicsforEntrepreneurialMarketing
10. **E-Commerce and the Entrepreneur:** Factors to Consider before Launching into E-Commerce,TenMythsofE-Commerce,StrategiesforE-Success,DesigningaKillerWebSite,TrackingWebResults,EnsuringWebPrivacyandSecurity,Feed Back&SuggestionsonStudentProject.
11. **Pricing Strategies:** Three Potent Forces: Image, Competition, and Value, Pricing Strategies andTactics,PricingStrategiesandMethods forRetailers,TheImpact of Credit on Pricing
12. **AttractingVentureCapitalist:**ProjectedFinancialStatements,BasicFinancialStatements,RatioAnalysis, Interpreting Business Ratios, Breakeven Analysis, Feed Back &Suggestions on StudentProject,
13. **IdeaPitching:**Formal presentation,5-minutespitch,fundingnegotiationandlaunching.

RecommendedBooks:

1.Scarborough,N.M.(2011).*Essentialsofentrepreneurshipandsmallbusinessmanagement*.Publishingas Prentice Hall,One Lake Street,Upper Saddle River, NewJersey07458..

SuggestedBooks:

1.Burstiner,I.(1989). *Smallbusinesshandbook*.PrenticeHallPress.

URCC-5125 Civics and Community Engagement 2(2-0)

The Civics and Community Engagement course is designed to provide students with an understanding oftheimportanceofcivicparticipation,cultureandculturaldiversity, basicfoundationsofcitizenship,groupidentitiesandtheroleofindividualsincreatingpositivechangewithintheircommunities.Thecourseaimsatdevelopingstudents'knowledge,skillsandattitudesnecessaryforactiveandresponsiblecitizenship.

Content:

1 IntroductiontoCivics&CommunityEngagement

(i) Overviewofthecourse: Civics&CommunityEngagement
(ii) Definitionandimportanceofcivics
(iii) Keyconcepts incivics:citizenship,democracy, governance,andtherule oflaw
(iv) Rightsandresponsibilitiesofcitizens

2 CitizenshipandCommunityEngagement

(i) IntroductiontoActiveCitizenship:OverviewoftheIdeas,Concepts,PhilosophyandSkills
(ii) ApproachesandMethodologyforActiveCitizenship

3 Identity,Culture,andSocialHarmony

(i) ConceptandDevelopmentofIdentity,Groupidentities.
(ii) Components of Culture, Cultural pluralism, Multiculturalism, Cultural Ethnocentrism, Culturalrelativism,Understandingculturaldiversity,GlobalizationandCulture,Social Harmony,
(iii) ReligiousDiversity(Understandingandaffirmationofsimilarities&differences)
(iv) UnderstandingSocio-PoliticalPolarization.
(v) Minorities,SocialInclusion,Affirmativeactions

4 Multi-culturalsocietyandinter-culturaldialogue

(i) Inter-culturaldialogue(bridgingthedifferences,promotingharmony)
(ii) Promotingintergroupcontact/Dialogue
(iii) Significanceofdiversityanditsimpact
(iv) Importanceanddomains ofInter-cultural dialogue

5 ActiveCitizen:LocallyActive,GloballyConnected

(i) Importanceofactivecitizenshipatnational andgloballevel
(ii) Understandingcommunity
(iii) Identificationofresources(human,naturalandothers)
(iv) Utilizationofresourcesfordevelopment(communityparticipation)
(v) Strategicplanning,fordevelopment(communitylinkagesandmobilization)

6 Humanrights,constitutionalismandcitizens'responsibilities

(i) IntroductiontoHumanRights
(ii) HumanrightsinconstitutionofPakistan
(iii) Publicdutiesandresponsibilities
(iv) Constitutionalismanddemocraticprocess

7 Social Institutions,SocialGroups,FormalOrganizations andBureaucracy

(i) TypesofGroups,Groupidentities,Organizations
(ii) Bureaucracy,Weber'smodelofBureaucracy
(iii) Roleofpoliticalparties,interestgroups,andnon-governmental organizations

8 CivicEngagementStrategies

(i) Grassrootsorganizingandcommunitymobilization
(ii) Advocacyand lobbyingforpolicychange
(iii) Voluntecrismandservice-learningopportunities

9 Socialissues/ProblemsofPakistan

(i) OverviewofmajorsocialissuesofPakistani society

10 SocialActionProject

RecommendedBooks:

1. Kennedy. J. K., & Brunold, A. (2016). Regional context and Citizenship education in Asia andEurope.New Yourk:Routledge, Falmer.
2. Henslin, James M. (2018). Essentials of Sociology: A Down to Earth Approach (13th ed.). New York:Pearson Education

3. Macionis,J.J., &Gerber,M.L. (2020).Sociology. NewYork: Pearson Education
SuggestedBooks:
1. GlencoeMcGraw-Hill.(n.d.).CivicsToday:Citizenship,Economics,andYouth.
2. Magleby, D. B., Light, P. C., & Nemacheck, C. L. (2020). Government by the People (16th ed.).Pearson.
3. Sirianni, C., & Friedland, L. (2005). The Civic Renewal Movement: Community-Building andDemocracyin the United States. KetteringFoundationPress.
4. Bloemraad, I. (2006). Becoming a Citizen: Incorporating Immigrants and Refugees in the UnitedStatesand Canada. Universityof California Press.
5. Kuyek,J.(2007).CommunityOrganizing:TheoryandPractice.FernwoodPublishing.
6. DeKieffer,D.E.(2010).TheCitizen'sGuidetoLobbyingCongress.TheCapitol.Net.
7. Rybacki, K. C., & Rybacki, D. J. (2021). Advocacy and Opposition: An Introduction toArgumentation(8thed.). Routledge.
8. Kretzmann,J. P.,&McKnight,J.L.(1993). BuildingCommunitiesfromthe InsideOut:APathTowardsFindingandMobilizinga Community'sAssets. ACTAPublications.
9. Patterson,T.E.(2005).EngagingthePublic:HowGovernment andtheMediaCanReinvigorateAmericanDemocracy. Oxford UniversityPress.
10. Love, N. S., & Mattern, M. (2005). Doing Democracy: Activist Art and Cultural Politics. SUNYPress.

MATH-5109 Ordinary Differential Equations 3(3-0)

This course introduces the theory, solution, & application of ordinary differential equations. Topics discussed in the course include methods of solving first-order differential equations, existence & uniqueness theorems, second-order linear equations, power series solutions, higher-order linear equations, systems of equations, non-linear equations, Sturm-Liouville theory, & applications. The relationship between differential equations & linear algebra is emphasized in this course. An introduction to numerical solutions is also provided. Applications of differential equations in physics, engineering, biology, & economics are presented. The goal of this course is to provide the student with an understanding of the solutions & applications of ordinary differential equations. The course serves as an introduction to both nonlinear differential equations & provides a prerequisite for further study in those areas.

Contents

1 Introduction to differential equations: Preliminaries & classification of differential equations
2 Verification of solution, existence of unique solutions, introduction to initial value problems
3 Basic concepts, formation & solution of first order ordinary differential equations
4 Separable equations, linear equations, integrating factors, Exact Equations
5 Solution of nonlinear first order differential equations by substitution, Homogeneous Equations,
6 Bernoulli equation, Ricaati's equation & Clairaut equation
7 Modeling with first-order ODEs: Linear models, Nonlinear models
8 Higher order differential equations: Initial value & boundary value problems
9 Homogeneous & non-homogeneous linear higher order ODEs & their solutions, Wronskian,
10 Reduction of order, homogeneous equations with constant coefficients,
11 Nonhomogeneous equations, undetermined coefficients method, Superposition principle
12 Annihilator approach, variation of parameters, Cauchy-Euler equation,
13 Solving system of linear differential equations by elimination
14 Solution of nonlinear differential equations
15 Power series, ordinary & singular points & their types, existence of power series solutions
16 Frobenius theorem, existence of Frobenius series solutions
17 The Bessel, Modified Bessel, Legendre & Hermite equations & their solutions

18 Sturm-Liouville problems: Introduction to eigen value problem, adjoint & self-adjoint operators,
19 Self-adjoint differential equations, eigen values & eigen functions
20 Sturm-Liouville (S-L) boundary value problems, regular & singular S-L problems

Recommended Texts

1 Boyce, W. E., & Diprima, R. C. (2012). *Elementary differential equations & boundary value problems* (10th ed.) USA: John Wiley & Sons.
2 Zill, D.G., & Michael, R. (2009) *Differential equations with boundary-value problems* (5th ed.) New York: Brooks/Cole.

Suggested Readings

1 Arnold, V. I. (1991). *Ordinary differential equations* (3rd ed.). New York: Springer.
2 Apostol, T. (1969). *Multi variable calculus &linear algebra* (2nd ed.). New York: John Wiley & sons.

PHYS-5106 Theory of Thermodynamics 3(3-0)

Thermodynamics literally means heat in motion.The subject of thermodynamics deals with transformation of heat energy in to mechanical energy and vice versa. It describes processes that involve changes in temperature, transformation of energy, relationships between heat and work. To get a deeper inside and understanding in to the laws of thermodynamics, the molecular concept of matter is incorporated into the study of thermodynamics by means of statistical mechanics. Objectives of this course are to enable students to be conversant with the terminology associated with thermodynamics. They can understand the origin of heat and temperature, the basic laws of thermodynamics, the applications of these laws for analyzing and controlling the thermodynamic system.

Course Learning Objectives:

At the end of this course students will have basic knowledge of climate changes as a result of global warming around the globe, flow of energy in the form of heat in different substances, composition of atmosphere around the earth, laws of thermodynamics, working principle of heat engine, refrigerator, air condition and heat pumps. They will also be able to understand the Time flow in everyday life.

Contents:

1 Kinetic theory of gases, derivation of fundamental equation of kinetic theory of gases. Phase transition and phase diagram.
2 Maxwell distribution of molecular speeds and energies, modification of kinetic theory for real gas, the Van der Waal's equation, Zeroth law of thermodynamics and thermodynamic equilibrium.
3 Thermodynamic processes and types of thermodynamic systems. First law of thermodynamics, Its Consequences, applications on different types of systems and work-energy calculations.
4 Second law of thermodynamics and the concept of entropy, entropy measurements for reversible and irreversible process.
5 Combined first and second law of thermodynamics, entropy changes in the ideal gases.
6 Carnot cycle and efficiency measurements.
7 The Joule-Thomson experiment.
8 The third law of thermodynamics and its consequences. Free energy.
9 Thermodynamic Potentials and Maxwell relations.
10 Transfer of heat and its distribution, Mean free path and microscopic calculations of mean free path.
11 Thermoelectricity

Recommended Books:

1. Halliday, D., Resnick, R. & Krane, K. S. (2016). *Physics* (5th ed.). New York: Wiley.
2. Young, H. D., Freedman R. A., Ford, A. L., Seers, F. W. & Zemansky, P. (2008). *University physics* (13th ed.). San Francisco: Addison Wesley.

Suggested Books:

1. Serway, R. A. & Jewelt, J. W.(2019). *Physics for scientist and engineers* (10th ed). New York: Cengage Learning.
2. Halliday, D., Resnick, R. & Walker, J. (2014). *Fundamental of physics* (10th ed.). New York: Wiley.
3. Garg, S. C., Bansal, R.M. & Ghosh, C.K. (2012). *Thermal physics* (2nd ed.). India: McGraw Hill Education.

PHYS-5107 Physics Lab- II 3(0-3)

Physics is an experimental science. This lab helps the students in improvising their approach towards the subject. This physics lab aids a student in establishing the relevance of the theory. It brings clarity in the mind of the students regarding the basic concept of the subject. Experiments carried out in this lab work helps students in learning how to be patient and careful while taking observation and hitherto. In order to enhance scientific and critical thinking for the understanding of basic concepts in this course, they are encouraged to share their knowledge and results with their teachers.

Course Learning objectives:

- The students will be to design and develop a strong background in the fundamentals of physics and basic electronics.
- The students will have a good foundation in the fundamentals related to the experiments included in this course and their advanced applications.
- The students will be able to learn practically aboutaccepter and rejector circuits, diode, logic gates,and amplifiers.
- The students will get motivated to develop small experiments related to these techniques and develop their physical understanding.
- The students will also be able to work effectively and safely in the laboratory environment independently and as well as in teams.
- After completion of this course students will be able to design and carry out scientific experiments.
- Students will be able to learn how to present their results in the form of a report.

Course Contents:

1. Resonance frequency of an acceptor circuit
2. Resonance frequency of a Rejecter Circuit.
3. Determination of ionization potential of mercury.
4. Characteristics of a semiconductor diode (Compare Si with Ge diode)
5. Setting up of half & full wave rectifier & study of filtration factors
6. To set up and study various logic gates (AND, OR, NAND etc) using diode and to develop their truth tables.
7. To determine static characteristics of a transistor.
8. To determine wavelength of light by diffraction grating.

Recommended Texts:

1. Melissinos, A. C. & Napolitano, J. (2003). *Experiments in modern physics.* New York: Gulf Professional Publishing.

Shamos, M. H. (2012). *Great experiments in physics: firsthand accounts from Galileo to Einstein.* New York: Courier Corporation.

Suggested Readings:

72. Mark, H. & Olsono, H. T. (2004). *Experiments in modern physics*. New York: McGraw-Hill
73. Young, H. D., Freedman, R. A. & Ford, A. L. (2019). *University physics* (15th ed.). New York: Pearson.
74. Musaddiq, M. H. (2008). *Experimental physics*. Lahore: Allied Book Center.
75. Arora, C.L. (2010). *B.Sc practical physics.* New Delhi: Chand & Company.
1. Singh, H. & Hemne, P.S. (2000). *B.Sc practical physics.* New Delhi: Chand & Company

URCE-5124 Internship/Field Experience
3(3-0)

Semester-V

PHYS-6109 Methods of Mathematical Physics-I 3(3-0)

Course Brief:

This course provides a wide range of analytical mathematical techniques essential to the solution ofadvanced problems in physics. The main objective is to have an in-depth understanding of the basics of complex analysis, the residue theorem, and its applications to integral solving techniques. This course enables the student to solve orthogonal functions, Beta functions, Factorial functions, Gamma functions digamma and poly-gamma functions. It also enables the student to solve and apply Bessel functions, their kinds, and recurrence relations used in physics problems. This course will further extend the learning to solve second order differential equations using the concepts of Sturm-Liouville theory, Green's functions, and eigen valued problems.

Course Learning Objectives:

The course learning objectives are to understand the techniques of complex analysis, such as contour integral and analytic continuation and to develop an ability in students for solving problems related to special functions like Gamma, digamma, poly-gamma,Beta functions, Factorial functions andGreen's functions.

Course Contents:

1 Function of complex variables and basic review
2 Analytical functions, harmonic functions
3 Cauchy Riemann equations
4 Differentiation of complex variables and Greens theorem
5 Integration of complex variables, Cauchy's theorem, and Cauchy's integral formula
6 Sequence and series in complex numbers (Taylor and Laurent expansions)
7 Calculus of residues and its basic concept
8 Evaluation of different integral types in residues
9 Dispersion relations
10 The gamma function (definition, types, and properties)
11 Factorial notations
12 Digamma and poly-gamma functions
13 Legendre duplication formula
14 Beta functions and its mathematical notations (Forms of Beta functions)
15 Incomplete beta functions
16 Stirling's series
17 Eigen functions and orthogonal functions

18 Strum-Liouville theory
19 Green's functions and properties
20 Bessel functions of first kind and orthogonality
21 Generating function, recurrence relations, integral form, and Jacobi series of Bessel functions
22 Modified and spherical forms of Bessel functions
23 Neumann and Hankel functions

Recommended Texts:

1. Arfken, G. B., Weber, H. J. & Harris, F. E. (2011). *Mathematical methods for physicists* (7th ed.). New York : Elsevier Science.
2. Kreyszig, E. (2011). *Advanced engineering mathematics* (10th ed.). New York: Wiley.

Suggested Readings:

1. Spiegel, M. R., Lipschutz, S., Schiller, J. J. & Spellman, D. (2009). *Schaum's outline of complex variables* (2nd ed.). New York: McGraw Hill Professional.
2. Wong, C. W. (2013). *Introduction to mathematical physics* (2nd ed.). Oxford: Oxford University Press.
3. Kakani, S. L. &Hemrajani, C. (2010). *Mathematical physics* (2nd ed.). New Delhi: CBS Publishers.

PHYS-6110 Classical Mechanics –I 3(3-0)

The fundamental goal of this course is to create understanding in students to classical mechanics and its applications. The focus in this course will be given to develop knowledge of the physical concepts and mathematical methods of classical mechanics to improve skills in formulating and solving physics problems. Students will learn the use of Newton's laws of motion, conservation theorems to solve advanced problems involving the dynamic motion of classical mechanical systems. This course provides the up-to-date treatment of classical mechanical systems so that students face least difficulty in understanding the advance topics covered in classical Mechanics II course.

Course Learning Objectives:

Upon successful completion of this course, the student will be able:

1- Understand the basic concepts of classical mechanics and analyze the world around them from a physics point of view;
2- Apply knowledge of classical mechanics to different everyday situations and apply classical mechanics formulism to solve various practical problems.
3- Validate a basic knowledge of Newton's Laws and equations of motion. Apply Newtonian mechanics to complex motion problems.
4- Understand the oscillatory motion and various types of oscillators.
5- To determine the gravitational potential, gravitation fled and hence gravitational force in the vicinity of various objects of different size and shapes.

Course Contents:

1 Historical background of classical mechanics
2 Concept of scalars vectors and coordinates transformations
3 Properties of orthogonal matrix
4 Vector products and proof of various identities of vectors
5 Velocity and acceleration in various coordinates
6 Gauss's divergence theorem and stokes theorem
7 The Newtonian formulation of mechanics and kinematics of particle motion
8 Force and types of force, problems about constant force acting upon the body and motion on inclined plane

9 Motion of the body in resistive medium solving the problem free falling object and motion of projectile and Atwood's machine
10 Conservation theorems: linear momentum, angular momentum and conservation of energy equilibrium and its type
11 Motion in electromagnetic field, equilibrium and nature of equilibrium
12 Oscillatory motion, free oscillator in one and two dimension
13 Damped oscillator and its types, under-damped, critically damper and over damped oscillator
14 forced oscillator
15 Physical oscillatory systems and electrical oscillation
16 Nonlinear oscillations.
17 Gravitation: gravitation and gravitational potential
18 Poisson's equations, Lines of force and equi-potential surfaces
19 Ocean Tides

Recommended Texts:

1. Thornton, S. T. & Marion, J. B. (2012). *Classical dynamics of particles and systems* (5th ed.). New York: Thomson Brooks/Cole
2. Tai L. Chow. (2010). *Classical mechanics.* (2nd ed). Taylor and Francis. California USA
3. Goldstein, H., Charles, P. P. & Safko J. L. (2001). *Classical mechanics* (3rd ed). Massachusetts: Addison Wesley Reading.

Suggested Readings:

1. Taylor, J. R. (2005). *Classical mechanics*. California: University Science Books.
2. Tom, W. B. K. (2005). *Classical dynamics* (5th ed). London: Imperial College Press.
1. Finn, J. M. (2010). *Classical dynamics.* Boston: Jones and Bartlett Publishers.

PHYS-6111 Electromagnetism-I 3(3-0)

Course Brief:

PHYS-6110 gives an insight of electromagnetism with emphasis on the following topics: Orthogonal coordinate systems, fundamental theorems, Electrostatics in free space, boundary-value problems, electrostatics inside matter and currents.

Course Learning Objectives:

The learning objectives for the students are to understand the laws of electrostatics, their mathematical forms, ideas contained in them, the logical steps of the arguments which leads to these equations and the ability to solve problems involving them.

Course Contents:

1. Differential calculus: gradient, divergence, curl
2. Integral calculus: gradient theorem,Green's theorem,Stokes' theorem
3. Orthogonal coordinate systems: cartesian, cylindrical and spherical coordinate systems
4. Electrostatics in free space: Coulomb's law for electric force, electric field and electric potential due to a single point charge, discrete charge distribution and continuous charge distributions
5. Gauss's law,divergence and curl of static electric field, electrostatic boundary conditions, electrostatic energy for discrete and continuous charge distributions, conductors
6. Capacitors: parallel-plate, cylindrical and spherical capacitors
7. Boundary-value problems: solutions of Laplace's equation in cartesian, cylindrical and spherical coordinates, method of images; other image problems
8. Electric field and electric potential of an electric dipole, multipole expansion of electric potential

9. Electrostatics inside matter: polarization; electric field and electric potential of a polarized object; bound charges, Gauss's law in the presence of dielectrics; boundary conditions on electric displacement; electrostatic energy in dielectrics, Electric susceptibility, permittivity, relative permittivity
10. Electric line, surface and volume currents, equation of continuity, magnetic force on line, surface and volume currents.

Recommended Texts:

1. Griffiths, D. J. (2007). *Introduction to electrodynamics* (4th ed.). New York: Prentice Hall.
2. Cheng, D. K. (2013). *Field and wave electromagnetics* (2nd ed.). New York: Pearson.

Suggested Readings:

1. Vanderlinde, J. (2005). *Classical electromagnetic theory* (2nd ed.). New York: Springer.
2. Zahn, M. (2003). *Electromagnetic field theory: a problem solving approach* (1st ed.). Florida: Krieger Publishing Co.

Fleisch, D. (2008). *A student's guide to Maxwell's equations* (1st ed.). Cambridge: Cambridge University Press.

PHYS-6112 Electronics 3(3-0)

Electronics is the application of devices controlling the flow of electrons. The nonlinear behavior of active components and their ability to control electron flows makes amplification of weak signals possible.

Course Learning Objectives:

Electronics is widely used in information processing, telecommunication, and signal processing. The ability of electronic devices to act as switches makes digital information processing possible. This course covers the basic concepts of Electronics which helps students to learn and understand.

Course Contents:

1 Semiconductor diode and application, semiconductor diode, characteristics curves
2 Dc & ac resistance, diode equivalent circuit, series and parallel diode configuration with dc load
3 Rectification, half and full wave rectifier circuit with and without filter, zener diode, led
4 bjt's: transistor and transistor operation, transistor configurations (cb, ce, cc)
5 Current amplification factors, load line and operating conditions
6 Dc biasing (voltage divider bias c-e amplifier), design of voltage divider bias c-e amplifier
7 negative feedback amplifiers, general characteristics of negative feedback amplifiers
8 Classification of negative feedback amplifiers, voltage series feedback amplifier. Integrated amplifier: the differential amplifier (modes of operation, common mode rejection ratio)
9 Operational amplifier and its parameters, op-amp configuration with negative feedback, op-amp applications (voltage summing, voltage buffer, voltage comparators)
10 Op-amp as differentiator and integrator oscillators: oscillator principles and conditions for oscillation, oscillator with lc feedback circuits
11 Transistor rc phase shift oscillator, crystal oscillators, ujt relaxation oscillator, multi vibrators, schmitt trigger
12 Field effect transistors: introduction of fets
13 Construction and basic operation jfet, characteristics and parameter of jfets, jfets biasing (voltage divider bias)
14 The metal oxide semiconductor fet (mosfet), mosfet parameters and characteristics, low and high frequency response of fet amplifiers.

15 Negative Feedback Amplifiers: Negative feedback amplifiers,General characteristics of Negative feedback amplifiers, Classification of negative feedback amplifiers, voltage series feedback amplifier.
16 Integrated amplifier: The Differential amplifier (modes of operation, common mode rejection ratio), Operational Amplifier and its parameters, Op-amp configuration with negative feedback ,Op-amp applications (voltage summing, voltage buffer, voltage comparators), Op- amp as differentiator and integrator.
17 Oscillators: Oscillator Principles and conditions for oscillation, Oscillator with LC feedback circuits, Transistor RC phase shift oscillator, Crystal oscillators, UJT relaxation oscillator, Multivibrators, Schmitt trigger.

Recommended Texts:

1. . Boylestad, R. & Nashelsky, L. (2002). *Electronic devices and circuit theory*. New Jersey: Pearson Prentice Hall.
2. Floyd, T. L. (2007). *Principles of electric circuits*. New Jersey: Pearson Prentice Hall.

Suggested Readings:

1. . Halliday, D., Resnick, R. & Walker, J. (2014). *Fundamental of physics* (10th ed.). New York: Wiely.
2. Young, H. D., Freedman, R. A. & Ford, A. L. (2019). *University physics* (15th ed.). New York: Pearson.
1. Beiser, A. (2003). *Concepts of modern physics* (6th ed.). New York: McGraw-Hill Education.

PHYS-6113 Electronics Lab 3(0-3)

This course introduces the students to basic of electric circuits through a series of experiments. This includes the working principles of resistors, capacitors and inductors. Students learn different experimental techniques to determine the values of combination of different circuits. The course introduces students to the basic components of electronics: diodes, transistors, and operational amplifiers

Course Learning Objectives:

It covers the basic operation and some common applications. This laboratory course will help the students in getting familiarized with basic electrical measurement techniques, enhancing ability to apply electrical theory to practical problems, practice in recording and reporting technical information, familiarization with electrical safety requirement and also verification of some basic electric circuit theorems.

Course Contents:

1 . To construct from discrete components or, and, not circuits and verify their truth tables
2 To construct from discrete components nand, nor, exclusive or circuits and verify their truth tables
3 Design a fixed and self-bias and voltage divider bias transistor
4 To construct a single stage ce transistor voltage amplifier and study gain, input impedance, output impedance, and half power points by sine/square wave testing and effect of bias on the output and measurement of distortion
5 To construct and study the wave forms at the base and collector of the transistors of a free running a multivibrators
6 To construct and study of the height, duration and time period of the output pulses in a monostable and bistabale multivibrators with reference to the input trigger
7 To study of rc integrators and differentiators
8 Design an inverting and non-investing d.c. Amplifier, measurement of parameters of a given ic operational amplifier
9 Design and study the application of operational amplifier (current to voltage converter, instrumentation amplifier, buffer, voltage clamp, integrator and differentiator. low and high pass filters and half-wave

rectifier)

10 To construct a phase shift or wein bridge oscillator and measure its frequency by 741,555 timer

Recommended Texts:

1. . Robert, L. B. & Nashelsky, L. (2005). *Electronic devices and circuit theory* (9th ed.). New Jersey: Prentice Hall.
2. Higgins, R. J. (1974). *Experimental electronics* (4th ed.). New York: McGraw-Hill Education.

Suggested Readings:

1. . Mitchel, E. S. (2003). *Grob's basic electronics* (13th ed.). New York: McGraw-Hill Education.
1. Thomas, L. F. (1981). *Principles of electric circuits* (31st ed.). OH: Charles E. Merrill Publishing Co

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o اخلاق)ت عارف،ضرورت و اہمیت،اقسام،مغزورت(

اخلاق حسنہ:

- برائی کو نیکی سے ہٹانا
- نیکی کے کاموں میں مسابقت
- لوگوں کے درمیان صلح
- عدل و انصاف
- سچائی
- ایثار
- ملنساری
- مہمانوازی
- لغویات سے اعراض
- عاجزی و انکساری
- نگاہ اور آواز کو پست رکھنا
- چال میں میانہ روی
- شرمگاہوں کی حفاظت
- صبر
- شکر
- امور میں میانہ روی

اخلاق رذیلہ:

- ظلم اور زیادتی
- غرور و تکبر
- نفسانی خواہشات کی پیروی
- بدگمانی
- جھوٹ
- چغلی اور نمیمت
- تمسخر اور شیخی خوری
- لہو و لعب
- برے کاموں سے بچنا
- احسان جتانا اور تکلیف دینا
- فضول خرچی اور حد سے بڑھنا
- حسد اور تنگ دلی
- بے پروائی

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Semester-VI

PHYS-6114 Methods of Mathematical Physics-II 3(3-0)

Course Brief:

This course provides a wide range of analytical mathematical techniques essential to the solution of advanced problems in physics. The main objective is to develop intuition towards formulating physical phenomena in mathematical languagethat are most commonly used to solve problems in physics. This course has an in-depth understanding of the basics of special functions and their applications to problem solving techniques.

Course Learning Objectives:

The course learning objectives areto develop mathematical skills in students to solve problems (ordinary differential equations and partial differential equations) in quantum mechanics, solid state physics and other main course of physics by using Fourier series, Fourier integral, Fourier Transform and Laplace transform.

Course Contents:

1 Legendre equation Legendre Polynomials: Generating Functions, Recurrence Relations, Orthogonality, Associated Legendre equation, Associated Legendre Functions its orthogonality, Spherical Harmonics, Legendre Function of the second kind.
2 Hermite equation and Hermite polynomials (Generating function, orthogonality, recurrence relations)
3 Laguerre equation and Laguerre Functions (Generating function, orthogonality, recurrence relations)
4 Associated Laguerre Functions
5 Fourier Series: Definition and general properties of Fourier series, Uses and Applications of Fourier Series.
6 Fourier series of any period
7 Cosine and sine Fourier series
8 Complex form of Fourier series
9 Fourier integral
10 Gibbs phenomenon
11 Integral transforms
12 Fourier transforms and inversion theorem
13 Discrete Fourier transform
14 Fourier transforms of derivatives
15 Convolution theorem.
16 Laplace transform and its application.
17 Inverse Laplace transform.
18 Laplace transforms by derivatives
19 Solution of differential equation using Laplace transform (Initial valued problems)

Recommended Texts:

1. Arfken, G. B., Weber, H. J. & Harris, F. E. (2011). *Mathematical methods for physicists* (7th ed.). New York : Elsevier Science.
2. Kreyszig, E. (2011). *Advanced engineering mathematics* (10th ed.). New York: Wiley.

Suggested Readings:

1. Spiegel, M. R., Lipschutz, S., Schiller, J. J. & Spellman, D. (2009). *Schaum's outline of complex variables* (2nd ed.). New York: McGraw Hill Professional.
2. Wong, C. W. (2013). *Introduction to mathematical physics* (2nd ed.). Oxford: Oxford University Press.
Kakani, S. L. &Hemrajani, C. (2010). *Mathematical physics* (2nd ed.). New Delhi: CBS Publishers & Distributors.

PHYS-6115 Classical Mechanics- II 3(3-0)

The aim of this course is to continue, merge and extend the studies of Classical Mechanics I PHYS-302 in previous semester. Its ideas also link with other courses like quantum mechanics and condensed matter. The fundamental goal of this course is to create understanding in students to classical mechanics and its applications. This course provides the students the up-to-date treatment of classical mechanical systems and serves as basics and pre-requisite of Quantum Mechanics so that students face least difficulty in entering from classical Physics to Quantum mechanics. The purpose of the course is to make the students capable in formulating and solving physics problems.

Course Learning Objectives:

Upon successful completion of the course, the student will be able:

1- To develop a knowledge of the calculus of variations, central force motion and motion of planets.

2- To deal with the system of particles and related phenomenon.

3- To write the equations of motion for complicated mechanical systems using the Lagrange's and Hamilton's equations of motion.

4- To develop problem solving approach and critical thinking, Students will be able to solve problems in applied physics.

5- To study advance fields of Physics like quantum mechanics and field theory on the basis of Lagrangian and Hamiltonian technique.

Course Contents:

1 Some methods in the calculus of variations
2 Euler's equation, "first and second form" of Euler's equation
3 Kinematics of system of particles
4 Collision between particles, center of mass and lab co-ordinate system, elastic collision in lab and cm coordinate system
5 Scattering by central force field, Rutherford's scattering formula
6 Rocket motion
7 Limitations of Newtonian mechanics, generalized co-ordinates and constraints, virtual displacement and virtual work
8 D' Alembert's principle and Lagrange 's equation
9 Lagrange 's equation of motion and its applications
10 Hamilton's principle and Lagrange's equation
11 Hamiltonian of dynamical system, Hamilton's canonical equations
12 Poisson bracket and their properties
13 Central force motion, Two body problem and reduced mass
14 General solution of problems of motion in central force field
15 Inverse square law of force, Kepler's laws of planetary motion
16 Orbital dynamics, orbits in central field and stability of circular orbits
17 Dynamics of rigid body, Inertia tensor and principal axes of inertia, Moment of inertia for different body coordinate system,
18 Eulerian angles and Euler's equation of motion for a rigid body, Motion of a symmetric top.

Recommended Texts:

1. Thornton, S. T. & Marion, J. B. (2012). *Classical dynamics of particles and systems* (5th ed.). New York: Thomson Brooks/Cole
2. Tai L. Chow. (2010). *Classical mechanics.* (2nd ed). Taylor and Francis. California USA
3. Goldstein, H., Charles, P. P. & Safko J. L. (2001). *Classical mechanics.* (3rd ed). Massachusetts: Addison Wesley Reading.

Suggested Readings:

1. Taylor, J. R. (2005). *Classical mechanics*. California: University Science Books.
2. Tom W. B. K. (2005). *Classical dynamics* (5th Ed.). London: Imperial College Press.
1. Finn J. M. (2010). *Classical dynamics.* Boston: Jones and Bartlett Publishers..

PHYS-6116 Electromagnetism-II 3(3-0)

Course Brief:

PHYS-6115 gives an insight of electromagnetism with emphasis on the following topics: Magnetostatics in free space, classification of fields, magnetostatics inside matter, electromagnetic induction, Maxwell's equations in free space and inside matter, and electromagnetic waves in free space and inside matter.

Course Learning Objectives:

The learning objectives are to understand the laws of magnetostatics, their mathematical forms, ideas contained in them, the logical steps of the arguments which leads to these equations and the ability to solve problems involving them. For the students to be aware of deep physical meanings for the existence of electromagnetic waves as a consequence of Maxwell's equations is also of particular importance.

Course Contents:

1. Magnetostatics in free space: Biot-Savart law for magnetic force, magnetic field and magnetic vector potential due to line, surface and volume currents, divergence and curl of static magnetic field, classification of Fields
2. Solutions of Laplace's vector equation and poisson's vector equation, Ampere's law, magnetostatic boundary conditions
3. Magnetic field and magnetic vector potential of a magnetic dipole, multipole expansion of magnetic vector potential
4. Magnetostatics inside matter: magnetization, magnetic field and magnetic vector potential of a magnetized object, bound currents
5. Ampere's law inside matter; boundary conditions on magnetic displacement, paramagnetic, diamagnetic and ferromagnetic materials
6. Electrodynamics: ohm's law, electromotive force
7. Faraday's law, differential and integral forms and its uses/applications, Lenz's law
8. Inductors, mutual and self inductance, energy stored in magnetic field, magnetic energy for line, surface and volume currents
9. Maxwell's equations in free space for static and dynamic cases, displacement current, Maxwell's equations inside matter for static and dynamic cases, polarization current
10. Poynting's theorem, Electromagnetic waves in free space and inside matter

Recommended Texts:

1. Griffiths, D. J. (2007). *Introduction to electrodynamics* (4th ed.). New York: Prentice Hall.
2. Cheng, D. K. (2013). *Field and wave electromagnetics* (2nd ed.). New York: Pearson.

Suggested Readings:

1. Vanderlinde, J. (2005). *Classical electromagnetic theory* (2nd ed.). New York: Springer.
2. Zahn, M. (2003). *Electromagnetic field theory: a problem solving approach* (1st ed.). Florida: Krieger Publishing Co.
3. Fleisch, D. (2008). *A student's guide to Maxwell's equations* (1st ed.). Cambridge: Cambridge University Press.

PHYS-6117 Quantum Mechanics-I 3(3-0)

Quantum mechanics (QM) is important because it plays a fundamental role in explaining how the world works. Physicists often says QM governs the behavior of microscopic systems when in fact it governs the behavior of all physical systems, regardless of their size. It tells us a lot about the structure of reality. In this course, we review the fundamental ideas of QM, introduce the path integral for a non-relativistic point particle.

Course Learning Objectives:

The student will gain the knowledge about general experience with non-relativistic quantum mechanics that is useful for further studies in theoretical and experimental physics as well as nanotechnology for device

applications. Moreover, they will acquire the knowledge about fundamental quantum mechanical processes in nature and experience using mathematical tools to construct appropriate models for various practical purposes.

Course Contents:

1. Review of Concepts of Classical Mechanics and Historical Review (Experiments and Theories).
2. Wave Aspects of Particles, Hilbert Space, and Wave Functions.
3. The linear vector space, Hilbert space, Dimensions, and basis of a vector space.
4. Square integrable wave functions, Dirac notation, and Operators.
5. The state of a system and Observables, Measurement in Quantum Mechanics.
6. Time evolution operator, Stationary states, Time independent potentials.
7. Time evolution of expectation values, Symmetries, and Conservation Laws.
8. Symmetric potentials, parity, and Properties of one dimensional motion.
9. The free particle, step potential, and potential barrier and well.
10. The finite and infinite square well potential.

Recommended Texts:

1. Zettili, N. (2009). *Quantum mechanics: concepts and applications* (2nd ed.). New York: John Wiley & Sons.

2. Liboff, R. L. (2002). Introductory quantum mechanics (4th ed.). New York: Addison Wesley Publishing Company.

Suggested Readings:

1. Townsend, J. S. (2012). *A modern approach to quantum mechanics* (2nd ed.). New York: University Science Books.
2. Robinett, R. W. (2006). *Quantum mechanics, classical results, modern systems and visualized examples* (2nd ed.). Oxford: Oxford University Press.
3. Griffiths D. J. (2018). *Introduction to quantum mechanics* (3rd ed.). Cambridge: Cambridge University Press.

PHYS-6118 Solid State Physics-I 3(3-0)

This course offers an introductory exploration of the theoretical framework underlying solid state materials, with a particular emphasis on crystalline materials. The curriculum covers fundamental principles concerning crystal structure, interatomic bonding, x-ray diffraction, and lattice dynamics. Students will acquire the knowledge and skills necessary to effectively use these principles in order to fully understand the many characteristics shown by crystalline materials, including but not limited to their electrical, optical, and mechanical properties.

Course Learning Objectives:

Define "lattice", "unit cell", and "crystal system" in relation to crystal structure. Calculate crystal density from lattice structure and atomic composition. Explain the kinds of interatomic bonding (ionic, covalent, metallic, and van der Waals). Diatomic molecule bond energy calculation. Explain how interatomic bonding influences material characteristics. Explain the concepts of X-ray diffraction. Determine a material's crystal structure through x-ray diffraction. In lattice dynamics, define "phonon" and "lattice heat capacity". Calculate a material's lattice heat capacity using classical or quantum physics.

Course Contents:

1 Crystal structure, periodic arrays of atoms, fundamental types of lattices
2 Index system for crystal planes, simple crystal structures,

3 Direct imaging of atomic structure, non-ideal crystal structures,
4 Reciprocal lattice, methods of x-ray diffraction by the crystals, scattered wave amplitude,
5 Brillouin zones, Fourier analysis of the basis, quasi crystals,
6 Crystal binding and elastic constants, crystals of inert gases, ionic crystals,
7 Covalent crystals, metals, hydrogen bonds, analysis of elastic strains, elastic compliance and stiffness constants, elastic waves in cubic crystals,
8 Vibrations of crystals with monatomic basis, two atoms per primitive basis,
9 Quantization of elastic waves, phonon momentum, inelastic scattering by phonons, Classical and quantum theories of lattice heat capacity,
10 Free electron model, Free electron gas in one dimension,
11 Finite temperature: the Fermi-Dirac distribution , Free electron gas in three dimensions,
12 K-Space, Fermi energy, Fermi momentum, and Fermi temperature,
13 Density of states, heat capacity of the electron gas, qualitative and quantative solution to the problem of electronic
14 Heat capacity of free electron gas, Sommerfeld Modal

Recommended Texts

1. Kittle, C. (2005). *Introduction to solid state physics* (8th ed.). New Jersey: Wiley
2. Wahab, M. A. (2017). *Solid states physics: structure and properties of materials* (3rd ed.). Oxford: Alpha Science International.

Suggested Readings

1. Szwachi, N. G. & Szwacka, T. (2016). *Basic elements of crystallography* (2nd ed.). Singapore: Pan Stanford Publishing.
2. Simon, S. H. (2013). *The oxford solid state basics* (1st ed.). Oxford: Oxford University Press.
1. Blakemroe, J. S. (2012). *Solid state physics* (2nd ed.). Cambridge: Cambridge University Press. Kakani, S. L. & Hemrajani, C. (2010). *Mathematical physics* (2nd ed.). New Delhi: CBS Publishers.

Semester-VII

PHYS-6120 Statistical Mechanics 3(3-0)

The purpose of this course is to translate the microscopic (quantum) world where the laws of nature are written to the everyday macroscopic (classical) world that we're familiar with, covering both classical and quantum Statistical Mechanics. Statistical Mechanics is a probabilistic approach to equilibrium properties of large numbers of degrees of freedom. It demonstrates the firm physical and statistical basis of thermodynamics by showing how the properties of macroscopic systems are direct consequences of the behaviors of their elementary constituents.

Course Learning objectives:

After the successful completion of this course, student will be in apposition to apply classical and quantum mechanical rules to large assemblies of microscopic entities. Students will be able to describe the vibrational motions of ions, atoms and molecules within the crystals. They will be skilled in calculating the heat capacities and entropies changes within the systems.

Contents:

1 Review of thermodynamics: mathematical formulation of first and second law of thermodynamics
2 Maxwell's relation, reduction of derivatives, general conditions of equilibrium

3 Partition function: partition function, relations of partition function with thermodynamical variables, examples (collection of simple harmonic oscillators, half spin paramagnet)
4 Basic principles of statistical mechanics: microscopic and macroscopic states, phase space, ensembles, Liouvillie theorem
5 Formation of micro-canonical, canonical and grand canonical partition function, Maxwell distribution of molecular speed
6 Probability of the particle in quantum state, density of states in k-space, single particle density of states in energy
7 Maxwell-Boltzmann distribution function, validity of Maxwell-Boltzmann statistics, evaluation of constants α and β, Maxwell speed distribution function
8 Theory of ideal Fermi system: Fermi-Dirac distribution function, examples of the Fermi system (free electron theory of metals, electrons in stars, electrons in white dwarf stars)
9 Theory of Bose system: Bose-Einstein distribution function, black body radiation, the photon gas, ideal Bose gas model of liquid helium, Einstein's model of vibration in a solids, Debye's model of vibration in a solids, advanced topics: fluctuations, Bose-Einstein condensation
10 Introduction to density matrix approach.

Recommended Books:

1. Reif, F. (2009). *Fundamentals of statistical and thermal physics*. New York: McGraw Hill.
2. Garg, S. C., Bansal, R.M. & Ghosh, C.K. (2012). *Thermal physics* (2nd ed.). India: McGraw Hill.
3. Kersan Huang, Introduction to Statistical Physics,2nd Edition
4. Blundell, S.J; Blundell, K.M; Concepts in thermal Physics, 2nd edition, Oxford University press (2009).
5. Rief, F; Statistical Physics, Barkely Physics Course Vol. 5 Mcgraw-Hill Book Company1967.

Suggested Readings:

1. Agarwal, B. K. & Melvin, E. (2012). *Statistical mechanics* (3rd ed.). New Delhi: New Age International.
2. Pathria, R. K. (2011). *Statistical mechanics*.UK: Elsevier Ltd.
3. Sinha, S. K. (2007). *Introduction to statistical mechanics*. Oxford: Alpha Science International.

PHYS-6121 Atomic and Molecular Physics 3(3-0)

Atomic and Molecular Physics is a field of physics that involves investigation of the structures of atoms and molecules, their energy states, and their interactions with other particles and electromagnetic radiation. In this field of physics, atoms are studied as isolated systems made up of nuclei and electrons. Its primary concern is related to the arrangement of electrons around the nucleus and the processes by which these arrangements change. The aim of this course is to develop an understanding of the physics of atoms, atomic structure and molecular energy levels spectra.

Course Learning objectives:

After completion of this course, students should be able to elaborate basic concepts, interpret the fundamental principles of plasma physics based on experimental as well mathematical foundations. This course provides a platform for advance studies in the field of plasma physics.

Contents:

1 Atomic structure, the Thomson model, the Rutherford model, alpha-particle scattering, the Rutherford scattering formula.
2 The Thomson model, The Rutherford model, Alpha-Particle Scattering.
3 Electron orbits, Summerfeld model.
4 Atomic Spectra of hydrogen atom, Nuclear Motion and Reduced Mass.
5 The Correspondence principle.
6 The Frank-Hertz experiment.

7 Quantum Theory of the Hydrogen Atom, the Schrödinger equation, solution of the angular equation, solution of the radial equation, Quantum numbers, Total Quantum numbers, Orbital Quantum number, Magnetic Quantum Number.
8 Atoms in external fields, Space quantization, Magnetic moment, and Bohr Magneton
9 The Zeeman effect (normal and anomalous Zeeman effects).
10 Fine structure of hydrogen, parity, selection rules, transitions between fine-structure levels.
11 Stern-Gerlach Experiment
12 Spin-orbit interaction
13 Shells and sub shell's structure and the periodic table
14 Electron configuration in many electron-atoms, Exclusion principle,
15 Hund's rules, Coupling of angular momenta, LS-coupling, jj-coupling.
16 Origin of Spectral lines Two-electron Spectra, One electron Spectra, Selection Rules (LS-coupling)
17 Relative intensities in a multiplet, X-ray spectra.
18 Paschen-Back effect, Stark effect.
19 Introduction of Molecular Physics
20 Molecular formation
21 Theories of bonding
22 The H_2 Molecule
23 Molecular orbits
24 Molecular spectra (diatomic molecules)
25 Dissociation and Pre-disassociation energy

Recommended Books:

1. Foot, C. (2005). *Atomic physics* (1st ed.). New York: Oxford University Press.
2. Brandsen, B. H., Joachian, C. J. & Plivier, T. J. (2003). *Physics of atoms and molecules*(2nd ed.). England: Person Education.

Suggested Readings:

1. Krane, K. S. (2019). *Modern physics* (4th ed.). New York: John Wiley & Sons.
2. White, H. E. (2016). *Introduction to atomic spectra*(1st ed.). India: McGraw-Hill.
3. Haken, H. & Wolf, H. C. (2012). *The physics of atoms and quanta: Introduction to experiments and theory.* Germany: Springer.
4. Thorne, A. P. (2012). *Spectro physics.* New York: Chapman & Hall.

PHYS-6122 Plasma Physics 3(3-0)

This is a calculus-based introductory course on plasma physics with maximum emphasis on conceptual understanding, mathematical formulation, interpretation of the fundamental principles of plasma physics and application of the acquired knowledge for solving problems. In this course, students will learn about plasmas, the fourth state of matter. The aim of this course is to describe, in words, the ways in which various concepts in plasma physics come into play in particular situations and discusses the applications and properties of human-made and naturally occurring plasmas.

Course Learning objectives:

After completion of this course, students should be able to elaborate basic concepts, interpret the fundamental principles of plasma physics based on experimental as well mathematical foundations. This course provides a platform for advance studies in the field of plasma physics.

Contents:

1 Introduction to plasmas, how plasmas are produced, occurrence of plasma in nature, concept of temperature, Debye shielding, plasma frequency, plasma parameter, criteria for plasma, applications of plasma physics

2 Motion of a charged particle in a static uniform electric and magnetic fields and in the presence of perpendicular electric and magnetic fields, gravitational drift, charge particle motion in nonuniform electric and magnetic fields, gradient drift, curvature drift, magnetic mirror
3 Time varying electric field, polarization drift, time varying magnetic field, adiabatic invariants
4 Fluid description of plasma, continuity equation, momentum balance equation, equation of state, and two-fluid equations, fluid drift perpendicular to magnetic field, fluid drift parallel to magnetic field, the plasma approximation
5 Waves in cold plasma, Fourier representation of waves, group velocity, plasma oscillations, electron and ion plasma waves, sound waves, ion waves, validity of plasma approximation, comparison of electron and ion waves
6 Electrostatic electron waves perpendicular to magnetic field, upper-hybrid frequency, electrostatic ion waves perpendicular to magnetic field, lower-hybrid frequency.
7 Electromagnetic waves in un-magnetized and magnetized plasmas, cutoffs and resonances, experimental consequences, hydromagnetic waves, magnetosonic waves

Recommended Books:

1. Chen, F. F. (2016). *Introduction to plasma physics and controlled fusion* (3rd ed.). New York: Springer.
2. Bittencourt, J. A. (2004). *Fundamentals of plasma physics* (3rd ed.). New York: Springer.

Suggested Readings:

1. Bellan, P. M. (2006). *Fundamentals of plasma physics* (1st ed.). Cambridge: Cambridge University Press.
2. Goldston, R. J. (2019). *Introduction to plasma physics*. Bristol: IOP Publishing.
3. Dendy, R. O. (1993). *Plasma physics: an introductory course.* Cambridge: Cambridge University Press.

PHYS-6123 Quantum Mechanics-II 3(3-0)

Quantum physics is arguably the greatest intellectual triumph in the history of human civilization, but to most people it seems like it's too remote and abstract to matter. This is largely a self-inflicted wound on the part of physicists and pop-science writers: when we talk about quantum physics, we usually emphasize the weird and counter-intuitive phenomena but it can be hard to see any connection between these phenomena and everyday life. This course examines the fundamental concepts and techniques of quantum mechanics. Furthermore, it is used to derive time-dependent perturbation theory and the Born series for non-relativistic scattering.

Course Learning Objectives:

Students will develop a self-critical perspective on the theoretical techniques to solve the problems. Rather the task is to develop reflective and critical skills for thinking about creative solutions to for further higher studies and applications. Students will also gain the competence as they are able to apply non-relativistic quantum mechanics to microscopic fields such as solid state physics and nanotechnology.

Course Contents:

1. Orbital angular momentum, eigenvalues, and eigenfunctions of L^2 and L_z
2. Matrix representation of angular Momentum operators and Schrödinger Equation in Three Dimensions.
3. 3D problems in Cartesian and Spherical coordinates.
4. Time independent and dependent perturbation theory for non-degenerate and degenerate levels.
5. Variational method, WKB approximation, and Time dependent perturbation theory.
6. Identical Particles, Second Quantization, Many Particles Systems, and Systems of Identical Particles.
7. Pauli Exclusion Principle, Theory of Scattering, and the Interaction of quantum systems with radiation.
8. Classical Treatment of Incident Radiation and Quantization of the electromagnetic field.
9. Transition Rates for Absorption and Emission of Radiation.
10. Transition Rates within the Dipole and the Electric Dipole Selection Rules.

Recommended Texts:

1. Zettili, N. (2009). *Quantum mechanics: concepts and applications* (2nd ed.). New York: John Wiley & Sons.

2. Liboff, R. L. (2002). *Introductory quantum mechanics*(4th ed.). New York: Addison Wesley Publishing Company.

Suggested Readings:

1. Townsend, J. S. (2012). *A modern approach to quantum mechanics* (2nd ed.). New York: University Science Books.
2. Robinett, R. W. (2006). *Quantum mechanics, classical results, modern systems and visualized examples* (2nd ed.). Oxford: Oxford University Press.
3. Griffiths D. J. (2018). *Introduction to quantum mechanics* (3rd ed.). Cambridge: Cambridge University Press.

PHYS-6124 Solid State Physics-II 3(3-0)

This course introduces solid state physics fundamentals. Quantum mechanics, crystallography, and solid electrical structure will dominate this course. Crystal structure and lattice vibrations are the focus of this dispute. A solid's electrical band structure shows its electron energy levels. The belief is the foundation of condensed matter research due of its relevance. Semiconductors are electrically in between conductors and insulators. Certain materials attract or repel due to magnetism. Physics defines solids by their optical characteristics, which explain how they behave with light. Some materials exhibit superconductivity at low temperatures.

Course Learning Objectives:

Quantum theory, crystallography, and solids are good venues to begin. Investigate the complicated movement of charged particles within solids. Study the ideas behind the formation of electronic bands and the behavior of electrons at different energy levels. The effects of external fields on charge carriers must be explained. This essay aims to provide a justification for the unique characteristics and significance of semiconductors in the field of electronics. What is the historical background of the discovery of magnetism? The phenomenon of superconductivity has been studied both theoretically and experimentally.

Course Contents:

1 Effect of temperature on the Fermi-Dirac distribution, free electron gas in three dimensions, heat capacity of the electron gas,
2 Experimental electrical resistivity of metals, motion in magnetic fields, Hall effect, Magneto resistance, ratio of thermal to electrical conductivity.
3 Energy Bands: Nearly free electron model, origin of the energy gap, magnitude of the energy gap
4 Bloch functions, wave equation of an electron in a periodic potential
5 Periodic & extended zone schemes, motion of electrons in a periodic potential
6 Kronig-Penney model, calculation of band structure
7 Crystal momentum of an electron, solution of the central equation, empty lattice approximation,
8 Approximate solution near a zone boundary, number of orbital in a band, metals and insulators.
9 Homogeneous Semiconductors: Band gap, equation of motion, effective mass, physical
10 Interpretation of the effective mass, effective masses in semiconductors, silicon and germanium

11 Intrinsic carrier concentration, intrinsic mobility, impurity conductivity, donor states, acceptor states,
12 Thermal ionization of donors and acceptors.
13 Diffusion in semiconductors
14 Diamagnetic and paramagnetic solids, magnetic susceptibilities of diamagnetic and paramagnetic substances,
15 Quantum theory of paramagnetism, Pauli paramagnetism of conduction electrons,
16 Quantum theory of ferromagnetism, antiferromagnetism and Ferrimagnetism
17 Introduction to superconductivity and types of superconductors, BCS theory, magnetic field induced superconducting to normal state transitions, parameters evidencing the superconducting phase transitions
18 free energy change during superconducting transition, London relations and coherence length of superconductor,
19 Quantized flux due to cooper pairs flowing in a ring, calculation of the sustaining time of supercurrents,
20 Thermodynamics of superconductors, Superconductors projected to AC/DC fields
21 Fabrication of junctions for Josephson effects, principle and theory of SQUIDS,
22 Electric polarization, calculation of macroscopic electric field, dielectric constant and polarizability,
23 phase transitions in ferroelectric crystals, differentiation of anti-ferroelectric, piezoelectric and ferro-elastic materials.

Recommended Texts

1. Pillai, S.O. (2005). *Solid states physics* (6th ed.). New Delhi: New age international limited.
2. Wahab, M. A. (2017). *Solid states physics: structure and properties of materials* (3rd ed.). Oxford: Alpha Science International.

Suggested Readings

1. Ibach, H. & Lüth, H. (2009). *Solid states physics* (4th ed.). New York City: Springer.
2. Ashcroft, N. W. & Mermin, N. D. (2003). *Solid state physics* (1st ed.). Hong Kong: CBS Publishing Asia.

H. P. Myers. (2002). *Introductory solid states physics* (2nd ed.). Boca Raton: CRC Press.

PHYS-6125 **Capstone Project** **3(3-0)**

URCQ-5111 **Translation of the Holy Quran –IV** **1(1-0) NC**

- Tofamiliarizethestudentswithcommandmentsoftradeandinheritancementionedinthe Quranictext (withthehelpof Urdutranslation).
- Students
- Tointroducethestudentstoscientificfactsandmiraclesoftheholy QuranandQuranicstressondeepstu dyofAllah'sexploreduniverse.
- Tomotivatethestudentsforreadingandexploringthelast HolyBookrevealedbyAlmightyAllah.Thro

ughmemorizationstudentswilldeveloptheirrelationwithlastrevelation

تجارت اور وراثت:

- ملکیتقسیم
- نادانکامال
- عوامالناسکامال
- عورتونکامال
- یتیموں کامال
- کفارکامال
- جائزمال
- معاہدے
- ربن
- قرض

سائنسی حقائق:

- تخلیق کائنات
- اجرامِ فلکی
- شجروحجر
- زمین و آسمان کے اسرار
- ہوائیں اورطوفان، بہائم اور مویشی

منتخب آیاتمع ترجمہ وتجوید

- البقرہ(۴۱۸،۲۷،۴۲۸،۱۱۷،۴۲۸،۲۷،۴۱۸،۵۲۸،۲۷۸،۴۲۸،۴۷۸۸،۷۲۸، ۷۱۸،۵۱۸،۸۲۸،۸۲۸، ۴۷۸،۱۱۷،۳۲، ۲۷،۲۱۸،۲۱۸، ۴۴۸،۲۸،۳۸۸،۱۸، ۵۲۷، ۵۲۷،۲۲۸، ۱۴،۵۲۷،۱۲،۱۴،۵۲۷، ۳۲،۸۲،۷۱،۲۸،۲۷،۱۷۸)
- العمران(۲۴،۱۸،۱۲۷،۱۳۷،۵۳۷،۱۷۷)
- النساء(۷۲۷،۲۸،۸،۲۸)
- المائدہ(۱۲،۲۲،۴۱،۴۲،۲۲)
- لتوبہ (۲۲، ۵۸، ۵۸،۲۲، ۵۸، ۱۲، ۵)
- االعراف(۲۲۷،۲۱۷،۳۳۷،۱۵،۱۲۷،۳۲۷،۳۲۷،۲۴،۱۴،۴۲۷،۸۱۷)
- الرعد(۵،۱۷)
- الطور(۵۵)
- االنعام (۲۳،۲۵۷،۷۵۷،۳۲،۲۴)
- االزنل (۲۸، ۲۳، ۷۵)
- الکہف(۴۵،۱۷،۴۵،۸۳،۱۵،۲۱۷،۷۴)
- الجاثیہ (۴)
- فاطر(۱۸، ۸۷، ۳۷)
- العنکبوت (۱۸، ۳۲، ۷۵)
- الروم(۱۴)
- االسراء(۲۲،۱۱)
- الرعد(۸)
- السبا(۸۸،۳،۱۷)
- یونس (۲۲، ۷۱۷، ۵۸،۵۸، ۴، ۸۸)
- یوسف(۵۲، ۵۷)
- لفرقان(۸۲، ۳۴)
- لقمان(۲۸، ۲۷)
- طہ(۳۴،۵۷۷)
- النحل(۲،۲،۴۷۷،۲۲،۲۲،۲۱،۲۵،۷۲،۷۷،۴۱)
- النمل(۲۷،۱۷،۲۷،۸۲،۱۲،۲۲،۵۲،۵۲)
- السجدہ(۱۸)
- الحدید(۲)
- ہود(۲،۳۵)
- یسین(۱۳، ۷۵)
- الروم(۲۵،۵۸،۲۷،۱۴،۲۳،۲۳)
- فصلت (۲۳، ۲۳)
- الحج(۳۱،۸۸،۴۲،۷۲)

□الحجر)٨٨،٢٧(
□الانبياء)١٣،٧٣، ١٥(
□الزاريات)١٥(
□الزلزله)٧(
□القصص)٨٢،٧٢،١٢،٢١،٢١(
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Semester-VIII

PHYS-6126 **Computational Physics** **3(3-0)**

Computational Physics consists of techniques to approximate mathematical procedures. Approximations are needed because we either cannot solve the procedure analytically or because the analytical method is intractable. These techniques enable one to find the solutions of such problems by using computing technology. This course is designed to have an understanding of various computational and numerical techniques used in physics.

Course Learning Objectives:

On completion of this course, students should be able learn selected computational methods and can formulate a strategy to solve a given problem in physics using required computational methods along with their limitations. By using modern programming tools, they can independently use computers to program the problems in physics.

Course Contents:

1. A brief introduction to numerical analysis and different programming languages and packages.
2. A brief introduction to numerical analysis and different programming languages and packages
3. Basics of numerical computation
4. Principles of computer operations
5. Roots of equations (real roots by iterative method, Convergence Criterion of convergence, Newton Raphson method, Regula falsi method bisection method)
6. Numerical integration (Trapezoidal method, Truncation errors in Trapezoidal method, Simpson's method, Truncation errors in Simspson's method, and Gauss quadrature method)
7. Numerical solutions of ODEs (Euler's method, modified Euler's method, rk4 method)
8. Interpolation (Linear interpolation, interpolating polynomials, the Lagrange interpolating polynomial, finite differences, newton forward difference method, newton backward difference method, difference operators)
9. Numerical Differentiation (Finite Difference Approximations,)
10. Introduction to Python, Python basics
11. Variables and Basic Data Structures
12. Functions (Builtin and User defined)
13. Branching Statements (If-Else statements, Ternary Operators)
14. Iteration (For Loops, While Loops, List Comprehension)
15. Two and Three-Dimensional plots
16. Symbolic math using Sympy module
17. Implementation of numerical analysis using Python

Recommended Texts:

1. Peter, A. S. (1992). *Introduction to numerical methods* (2nd ed.). London: Macmillan Pub. Ltd.
2. Qingkai Kong, Timmy Siauw & Alexandre M. Bayen (2011). *Python Programming and Numerical Methods: A Guide for Engineers and Scientists*. London: Academic Press.

Suggested Readings:

1. Jaan Kiusalaas (2013). *Numerical Methods in Engineering with Python 3*. New York: Cambridge University Press .
2. Macheown, P. K. & Merman, D. J. (1987). *Computational techniques in physics* (4th ed.). Bristol: AdmHilger.
3. T. Pang (2010). *Introduction to computational Physics*. New York: Cambridge University Press.
   H. J. Gardner (2012), *Computational Physics*. Singapore: World Scientific.

PHYS-6127 **Laser Physics** **3(3-0)**

In this course the students will get a basic understanding of the laser Physics, which have potential applications in optical spectroscopy, material processing, 3D imaging, and various branches of science.The course provides the physical foundations for lasers, including light-matter interaction phenomena (absorption, emission and dispersion), propagation of laser beams, laser resonators, rate equations for lasers, transient laser phenomena, principles and characteristics of cw and pulsed lasers, and some topical laser applications as a case study. Moreover, the course will treat some common types of laser in more details, including continuous-wave (cw) and pulsed, gas and solid state lasers.

Contents:

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

Recommended Books:

1. Silfvast, W. T. (2008). *Laser fundamentals*. New York:Cambridge University Press.
2. Milonni, P. W. & Eberly, J. (2010). *Laser physics*. New Jersey: John Wiley & Sons, Inc.

Suggested Readings:

1. Hecht, J. (2018). *Understanding lasers*. New Jersey: Wiley-IEEE Press.
2. Hooker, S. & Webb, C. (2010). *Laser physics*. Oxford: Oxford University Press.
3. Svelto, O. (2010). *Principles of lasers*. New York: Springer.
4. Haken, H. (2012). *Laser theory*. Heidelberg: Springer.
5. Avadhanulu,M. N. & Hemne, P. S. (2001). *An Introduction to lasers-theory and applications*. New Dehli: S. Chand Publishing.

PHYS-6128 **Relativity and Cosmology** **3(3-0)**

Course Brief:

The course of Relativity and Cosmology is comprised of a wide range of topics from special relativity, general relativity and cosmology. It includes the topics starting from the very necessity of a new theory in the field of relativistic mechanics followed by answers to then questions from Einstein's special relativity. Later after the induction of acceleration in inertial frames, general relativity is discussed in details. Where special theory includes consequences of the theory and their experimental aspects, general theory is

discussed in this course with its required mathematics in manifold. In connection with cosmology, galaxies, their structures and kinds, mapping of clusters, big band theory like topics are also learnt to students.

Course Learning Objectives:

In this course, students will be introduced to the field of relativistic physics, learning about its history and its modern branches of study. This course provides students an insight of the principles of special theory of relativity and general theory of relativity and some of their main observational consequences (relativistic kinematics, higher dimensional space-time, cosmology, black holes and others).A student studying the course of Relativity and Cosmology will understand classical as well modern physics and will also acquire the skills to apply principles to new and unfamiliar problems. With this self-paced course, students get engaging lessons, expert instructors who make even the most challenging physics topics simple, and an excellent resource for getting a head start on student's physics graduate degree.
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Course Contents:

17 Einstein's postulates of special relativity
18 Lorentz transformations
19 Relativity of simultaneity
20 Time dilation (twins paradox)
21 Length contraction (ladder paradox)
22 Velocity transformation and velocity addition
23 Relativistic mechanics
24 Minkowski space-time, line element
25 Four-vectors.
26 Conservation of energy and momentum
27 Elements of tensor calculus, manifolds and coordinates, curves and surfaces
28 Tensor fields, lie derivative
29 Geodesics, parallel transport
30 Riemann tensor, metric tensor, Christoffel symbols
31 General relativity, principles of general relativity
32 Equation of geodesics, Einstein's field equations
33 Cosmology, Newtonian cosmology, cosmological redshift
34 Hubble's law, the big bang, expansion rate.

Recommended Texts:

1. Cheng, T. (2015). *A college course on relativity and cosmology* (1st ed.). Oxford: Oxford University Press.
2. Forshaw, J. R. & Smith, A. G.(2009). *Dynamics and relativity* (1st ed.).New York:Wiley.

Suggested Readings:

1. McMohan, D. (2006). *Relativity demystified* (1st ed.).New York:Mc Graw-Hill.
2. McComb, W. D.(1999). *Dynamics and relativity* (2nd ed.). Oxford: Oxford University Press.
3. Narlikar,J. V.(2002). *Introduction to cosmology* (3rd ed.). Cambridge:Cambridge University Press.

PHYS-6129 Nuclear and Elementary Particle Physics 3(3-0)

In Nuclear physics we study about atomic nuclei and their constituents and interactions. Other forms of nuclear matter are also studied.Nuclear physics should not be confused with atomic Physics, which studies the atom as a whole, including its electrons.Particle Physics evolved out of nuclear physics.

Course Learning Objectives:

On successful completion of this course, students will be able to use their conceptual understanding of the Properties of Nucleus in order to describe the Nuclear Magnetic Moments, Nuclear Electric Quadropole Moment use their ability to manage and operate different kind of detector to detect the nuclear radiation have the knowledge about the particle accelerator and can use it to work on this machine for advance research apply this knowledge in practical situations apply this knowledge for the transformation of one element to another have the knowledge of elementary particle, their classification and interaction

Course Contents:

1 Basic properties of nucleus: size and mass of the nucleus.
2 Nuclear spin, magnetic dipole moment, electric quadropole moment, parity and statistic.
3 Nuclear models, Liquid drop model, Weizacker semi empirical mass formula.
4 The nuclear shell model and its applications, collective nuclear model.
5 Detectors, Passage of charged particle through matter, ionization chamber, proportional counter, scintillation counter, semi-conductor detector, bubble chamber, cloud chamber.
6 Particle Accelerators: Linear accelerator, Van de Graff, Betatron, synchrocyclotron, Nuclear Forces, Yukawa theory, proton-proton and neutron-proton scattering, charge independence of nuclear force.
7 Introduction to particles, Fundamental Interactions, Classification of elementary particles.
8 Parameters of elementary particles, the massless bosons.
9 The leptons, the mesons, the baryons, the eight fold way, Quarks, color, charm

Recommended Texts:

1. Knneth S.Krane (2008). Introductory Nuclear Physics.
2. Martin B R. (2006).Nuclear and Particle Physics, 2nd edition. New York: Wiley

Suggested Readings:

1. Wiedemann, H. (2007). Particle accelerator physics (2nd ed.). Berlin: Springer.

2. Krane, S. (1987). Introductory nuclear physics (3rd ed.). New Jersey: Wiley.

3. Bernardeau, F., Grojen, C. & Dalibard, J. (2007). Particle physics and cosmology. Amsterdam: Elsevier Science.

Optional Courses

PHYS-6129 Advanced Electronics 3(3-0)

Course Brief:

Advance Electronics is the course of zero and one. This course includes the theoretical and practical approach for designing of computer. This course starts with number system and their inter-conversions which is the basic for designing of a digital system. The course also contains different types of logic circuits, i.e., combinational logic and sequential logic circuits. The different types of counter and register circuits are designed. The basic architecture of microprocessor and microcontroller is discussed and the concepts of RAM and ROM along with designing are given

Course Learning Objectives:

After this course the students will be able to design the small or large digital circuits. They'll also be able to study the logic gates and implementation of Boolean functions using different logic families

Course Contents:

1 .Number systems and operations (number systems their introversion).
2 Number Systems and Operations (Number systems their introversion) Codes (BCD,Excess-3, Gray) error detection and correction codes, Parity codes, Seven-segment Display Code.
3 Logic Gates and Related Devices, Logic Families- significance and types, Boolean Algebra and Simplification Techniques, Combitional Logic Design, Flip-Flops , Sequential Logic Circuits (Registers and application of shift register), Ripple Counters, Synchronous Counter, Microprocessors.
4 Introduction to Microprocessors, Inside a Microprocessor, Arithmetic Logic Unit (ALU), Register File, Control Unit, Basic Microprocessor Instructions, Data Transfer Instructions, Arithmetic Instructions, Logic Instructions, Discussion on 8085/8088, 8086 processor family.
5 Intel Microprocessor hierarchy, Microcontrollers, Introduction to the Microcontroller, applications, Inside the Microcontroller.
6 Central Processing Unit (CPU), Random Access Memory (RAM), Read Only Memory (ROM), Special-Function Registers.
7 Peripheral Components, Microcontroller Architecture, Architecture to Access Memory, Eight-Bit Microcontrollers,-Bit Microcontrollers.
8 32-Bit Microcontrollers, Interfacing (Peripheral Devices with a Microcontroller, LEDs, Electromechanical Relay, Keyboards Seven-Segment Displays), Modulation, Modulation; the power spectrum in AM, the diode modulator for AM, detection of AM signals, AVC, The SSB system of modulation, the frequency spectrum, bandwidth , generation of FM and AM.
9 The superhetrodyne receiver, a radar system.
10 Radio communication, Production of radio transmitter block diagram. Propagation of radio waves system Formation of ionosphere layers and their variations.

Recommended Texts:

1. Mano, M. M. (2017). *Digital logic and computer design* (5th ed.). New Delhi: Pearson.
2. Tokheim, R. L. (2013). *Digital electronics: principles and applications* (8th ed.). OH: MacGraw-Hill education

Suggested Readings:

1. .Floyd, T. L. (2014). *Digital fundamentals* (11th ed.). New Jersey: Prentice Hall, Pearson.
2. Morris, M., Michael, M. & Ciletti, D. (2013). *Digital design* (5th ed.). Upper Saddle River: Prentice Hall, Pearson.
3. Kumar, A. A. (2016). *Fundamentals of digital circuits* (4th ed.). New Delhi: PHI Learning.
4. Boylestad, R. &Nashelsky, L. (2002). *Electronic devices and circuit theory*. New Jersey: Pearson Prentice Hall.
5. Floyd, T. L. (2007). *Principles of electric circuits*. New Jersey: Pearson Prentice Hall.

PHYS-6130 Physical and Geometrical Optics 3(3-0)

Course Brief:

*Optics is a branch of physics that deals with the determination of behavior and the properties of light, along with its interactions with the matter and also with the instruments which are used to detect it.*There are two major branches of optics, physical and geometrical. Physical optics deals primarily with the nature and properties of light itself. Geometrical optics has to do with the principles that govern the image-forming properties of lenses, mirrors, and other devices that make use of light. This course is designed to help

students gain an understanding of the fundamental principles of optics and photonics. t is primarily a theoretical course with some application to optical design. The course focuses on physical optics including the Fresnel Laws of refraction and reflection, interference, Fourier analysis and diffraction. This course also covers the basic concepts of geometrical ray optics and aberrated imaging needed in further optician education and professional work.

Course Learning Objectives:

The course aims to help students acquire understanding and a great deal of familiarity with geometrical and physical optics principles regarding the optics instrumentation, eye and vision. Relevant skills needed for the practice of Optometry and Vision Science rely on optics background. At the end of the course students will be able to have a primary knowledge of optometry, principle of light transmission through different media, and principle of communications via optical fiber

Course Contents:

6. Light - a historical perspective
7. Production and measurement of light: electromagnetic spectrum, black body radiations, source of radiations, detectors of radiation
8. Huygens' principal, fermats' principle, reflection in plane mirror, reflection through plane surfaces, imaging by an optical system, thin lenses
9. The thick lens, the ray tracing
10. Cylindrical lenses, combining cylindrical powers, astigmatism
11. Ray and wave aberrations, spherical and chromatic aberration, aberrations in vision
12. Controlling light through optical system: controlling image brightness and field of view
13. Optical instruments: prisms, camera, magnifiers and eyepieces, microscopes, telescopes
14. Light as waves: harmonic waves, electromagnetic waves, doppler effect, superposition principle, standing waves
15. Interference phenomena: two-beam interference, young's double slit experiment, interference in dielectric films
16. Interference applications: newton's rings, film thickness measurement by interference, the michelson interferometer, holography
17. Polarized light: modes of polarization, polarizing elements
18. Fraunhofer diffraction: diffraction from a single slit, rectangular and circular apertures, resolution, multiple slit diffraction
19. Fiber optics: optics of propagation, sources and detectors

Recommended Books:

1. Pedrotti, F. L., Pedrotti, L. S. & Pedrotti, L.M. (2008). *Introduction to Optics* (3rd ed.). India: Pearson Education.
2. Eugene, H. & Ganesan, A. R. (2012). *Optics* (4th ed.). India: Pearson Education.

Suggested Readings:

1. Garbovskiy, Y. A. &Glushchenko, A. V. (2017). *A practical guide to experimental geometrical optics*. New York: Cambridge University Press.
2. Freenan, M. H. & Hull, C. C. (2013). *Optics* (11th ed.). Netherlands: Elsevier.
3. Sharma, K. K. (2006). *Optics: Principles and applications*. USA: Elsevier.

PHYS-6131 Physics of Nanotechnologies 3(3-0)

Nanotechnology is the study and creation of useful/functional materials through control of matter on nanometer length scale (1 to 100nm) and exploitation of useful novel phenomenon and properties (Physical, Chemical & Biological) on that length scale to make nanodevices. Firstly, this course introduces the

concepts of Nanophysics, Nanomaterials, Nanotechnology, Importance and Types of Nanomaterials, Origins of exceptional behavior of Nanomaterials as compared to macro materials along with their applications from different fields e.g, Industry, Agriculture, Medicine etc. Secondly, it describes in detail some universal thin film (Two dimensional nanomaterials) deposition techniques e.g, Pulsed laser deposition, sputtering, Chemical vapor deposition etc. Thirdly, it elaborates different techniques of fabrication of Zero dimensional and One dimensional nanomaterials using different Top Down (Lithography techniques e.g, Optical, e-beam and Nanoimprint Lithography) and Bottom Up (Wet chemical methods, e.g, Co-precipitation, Hydrothermal and Sol-Gel methods etc.) approaches. Last chapter is about different characterization techniques of nanomaterials to study their different properties e.g, Size, Shape, Surface morphology and Crystal structure of nanomaterials.These properties are very important to study, regarding application of nanomaterials in different fields.

Course Learning Objectives:

At the end of this course students will be able to learn

1. What is Nanophysics and Nanotechnology
2. Why we need Nanotechnology
3. What are Nanomaterials and their Types
4. Why Nanomaterials have extraordinary properties as compared to Macro-materials
5. Importance and Applications of carbon based nanomaterials (Graphene, Carbon Nanotubes)
6. Applications of Nanomaterials in Energy Sector (Fuel cells, Solar cells, Batteries, Biofuel)
7. How to prepare Zero Dimensional (0D), One Dimensional (1D) and Two Dimensional (2D) Nanomaterials
8. What are the challenges for nanotechnology regarding production, characterization and applications of nanomaterials and nanodevices.

Course Contents:

1. Introduction to Nano physics and Nanotechnology
2. Importance, Types of Nanomaterials w.r.t. Dimensions (0D, 1D and 2D Nanomaterials) and their Applications in Magnetic Data Storage and Semiconductor Chips,
3. Moore' Law (Miniaturization of devices on the Chip)
4. Origins of observed differences of properties of nano and macro materials
5. Carbon Based Nanomaterials (Graphene and Carbon Nanotubes): Introduction & Importance
6. Graphene (2D Nanomaterial): Properties and applications of graphene, Electrical & Thermal conductivity, Mechanical strength, Elasticity, Optical properties
7. Carbon Nanotubes (1D Nanomaterial) : Properties and applications of carbon nanotubes, Electrical & Thermal conductivity, Mechanical strength, Elasticity, Optical properties
8. Thin Film (2D Nanomaterials) Deposition Techniques: Introduction & Importance
9. Physical Vapour Deposition (PVD) Techniques: Pulsed Laser Deposition (PLD), Sputtering, Electron Beam Evaporation (EBE), Molecular Beam Epitaxy (MBE)
10. Chemical Vapour Deposition (CVD) techniques: Chemical vapour deposition
11. 0D & 1D Nanomaterials Fabrication Techniques: Introduction & Importance
12. Top Down Nanofabrication or Physical Fabrication Techniques: Optical lithography, Electron Beam Lithography, Nano Imprint Lithography
13. Bottom up Nanofabrication or Chemical Synthesis Techniques: Chemical reduction method, Hydrothermal method etc.
14. Nanostructures Characterization Techniques: Introduction & Importance
15. Surface Characterization or Analysis: Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM)
16. Structural Characterization or Analysis: X-ray diffraction (XRD)

Recommended Texts:

1. Wolf, E. L. (2015). *Nanophysics and Nanotechnology: An introduction to modern concepts in Nanoscience*. New York: John Wiley & Sons.
2. Dongfang Yang (2023). *Thin Films-Deposition Methods and Applications, Canada*
3. Maria Benelmekki (2019). Nanomaterials, IOP Publishing, UK
4. Gerrard Eddy Jai Poinern (2015). *A Laboratory Course in Nanoscience and Nanotechnology*, CRC Press

Suggested Readings:

1. Wiesendanger, R. (2013). *Scanning probe microscopy: Analytical methods*. New York: Springer Science & Business Media.
2. Goldstein, J. I., Newbury, D.E., Michael, J. R., Ritchie, N. W., Scott, J. H., & Joy, D. C. (2017). *Scanning electron microscopy and X-ray micro analysis. New York: Springer.*

PHYS-6132 Methods of Experimental Physics

3(3-0)

The main objective of this course is to give students a brief introduction of some important experimental techniques related to experimental research in Physics which are currently being used in different modern research labs e.g, Vacuum and Sensor Technology. Vacuum is used in research or industrial labs to make ultra pure or contamination free samples at nanoscale to get required extraordinary properties of nanomaterials. Different types of sensors are used in research labs to measure different physical parameters e.g, pressure, temperature, magnetic field, fluid flow etc. Vacuum technology part of this course includes fundamental concepts of vacuum physics, Importance, Ranges and Applications of different ranges of vacuum, Creation and measurement of vacuum, Hurdles regarding creation of vacuum, Mathematical modeling of fluid dynamics and pumping process. This course also provides a comprehensive introduction to construction and working of different vacuum creation devices or vacuum pumps (Primary, Secondary and Ultra High Vacuum pumps) as well as vacuum measuring devices or vacuum gauges (Primary, Secondary and Ultra High Vacuum gauges). Sensor technology part of this course includes comprehensive introduction to construction and working of different types of sensors e.g, Temperature, Optical, Magnetic, Fluid flow sensors and Metal detectors etc.

Course Learning Objectives:

At the end of this course students will be able to learn:

1. Some important Experimental Techniques related to Experimental Research in Physics
2. What is Vacuum Physics and Vacuum Technology
3. What is Sensor Technology
4. Importance, Types and Ranges of Vacuum
5. Applications of different ranges of Vacuum
6. Fundamental concepts of Vacuum Physics
7. How to create a Vacuum (Construction and Working of different types of Vacuum pumps)
8. Hurdles regarding creation of vacuum
9. How to measure a Vacuum (Construction and Working of different types of Vacuum Guages)
10. Construction and Working of different types of Sensors

Course Contents:

1. Introduction to Vacuum Physics: Importance, Types of Vacuum (Rough, Medium, High, Ultra High and Extreme Vacuum) and Applications of all Types of Vacuum
2. Molecular Description of Gases: Kinetic Molecular Theory of Gases, Continuum and Molecular States of Gases, Mean Free Path, Molecular Number Density, Impingement Rate
3. Surfaces Processes: Scattering of a molecule from a surface, Adsorption and Desorption Processes and their Mathematical Modeling
4. Outgassing: Origins, Importance and Mathematical Modeling of Outgassing Rate due to Different Sources e.g, Desorption, Diffusion & Permeation
5. Sputtering: Mechanism, Factors affecting Sputtering Yield, Applications of Sputtreing,
6. Gas Flow: Continuum and molecular flow of gases
7. Conductance and Pumping Speed, Mathematical modeling for conductance of long pipe for continuum and molecular flow regimes
8. Pumping process, Pump Down Time and Ultimate Pressure
9. Vacuum Pumps: Rotary & Root pumps, Turbo Molecular Pump, Ionic and Titanium Sublimation Pumps
10. Vacuum Gauges: Diaphragm & Capacitance Diaphragm Guages, Spin Rotor, Penning & Magnetron Guages
11. Sensor Technology: Temperature Sensors, Optical Sensors, Magnetic Sensors, Fluid Flow Sensors, Metal Detectors

Recommended Texts:

1. Chambers, A. (2004). *Modern vacuum physics* (1st ed.). London: CRC Press.
2. Fraden, J. (2010). *A Handbook of Modern Sensors:Physics, Design and Applications (4th ed.)*. New York: Springer.

Suggested Readings:

1. Hoffman, D. M., Thomas, J. H., Singh, B. (1997). *Handbook of Vacuum Science and Technolog.* London: Elsevier.
2. Yoshimura, N. (2007). *Vacuum Technology: Practice for Scientific Instruments*. New York: Springer.
3. Martin, L., Weissler, G.L., Carlson, R. W. (1979). *Methods of Experimental Physics. Vol 14: Vacuum Physics and Technology.* New York: Springer

PHYS-6133 Introduction to Quantum Computing 3(3-0)

Quantum computing is the use of quantum mechanical phenomena to perform computation and the computers performing quantum computations are known as quantum computers. These computers are supposed to perform much better than their contemporary counterparts. Quantum computation is a subfield of quantum information science. Quantum computing is the major impetus to the development of new general quantum technologies. This course offers a comprehensive introduction to quantum computing.

Course Learning Objectives:

The main objectives of this introductory course is to introduce the background material in mathematics and physics necessary to understand quantum computation and to develop in detail the central results of quantum computation.

Course Contents:

1. Computer technology and historical background

2. Basic principles and postulates of quantum mechanics: quantum states, evolution, quantum measurement, superposition, quantization from bits to qubits, operator function, density matrix, Schrödinger equation
3. Schmidt decomposition, EPR and bell's inequality
4. Quantum computation: quantum circuits
5. Single qubit operation
6. Controlled operations
7. Measurement
8. Universal quantum gates, single qubit and CNOT gates
9. Breaking unbreakable codes: code making
10. Trapdoor function, one time pad, RSA cryptography
11. Code breaking on classical and quantum computers, Schor's algorithm
12. Quantum cryptography: uncertainty principle
13. Polarization and spin basis, BB84, BB90, and Ekert protocols
14. Quantum cryptography with and without eavesdropping
15. Experimental realization
16. Quantum search algorithm

Recommended Texts:

1. Nielson, M. A. & Chuang, I. L. (2000). *Quantum computation and quantum information* (2nd ed.). Cambridge: Cambridge University Press.
2. McMahon, D. (2007). *Quantum computing explained* (1st ed.). New York: John Wiley & Sons.

Suggested Readings:

1. Bouwmester, P., Ekert, A. & Zeilinger, A. (2000). *The physics of quantum information: quantum cryptography, quantum teleportation, quantum computation*. Berlin: Springer Verlag.
2. Williams, C.P. (2011). *Exploration in quantum computation* (2nd ed.). Springer Verlag.

Brylinsky, A. K. & Chen, G. (2002). *Mathematics of quantum computation*. London: Chapman & Hall/CRC.

PHYS-6134 Particle Physics

3(3-0)

Particle physics has revolutionized the way we look at the universe. Along the way, it's made significant impacts on other fields of science, improved daily life for people around the world and trained a new generation of scientists and computing professionals. Because particle physics asks big questions—the biggest in all of science, we need new, unique and often very large equipment. Each year, tens of millions of patients receive X-ray, proton and ion therapy to treat cancer at more than ten thousand hospitals and medical facilities around the world. The aim of this course is of course; enable particle physicists to learn about the universe around us. Over the past half century, particle physicists have formulated the Standard Model, a beautiful framework that explains the visible universe from the smallest to the largest scales.

CourseLearningObjectives:

Upon completion of this course, the student shall: - Be able to account for central concepts within particle physics, such as symmetries, invariants, and conservation laws. In addition, the student shall be able to use these concepts in practical calculations.

CourseContents:

1 Particle classification, quantum numbers
2 Leptons, hadrons, baryons, mesons, quarks
3 The fundamental interactions, the electromagnetic coupling, the strong coupling
4 The weak coupling
5 Symmetry transformation and conservation laws
6 Translation in space, rotation in space
7 The group su (2), systems of identical particles, parity, iso-spin charge conjugation, time reversal
8 G parity, cpt theorem, the electromagnetic field, gauge invariance
9 Maxwell's equations, polarization ad photon spin
10 Angular momentum, parity and c parity of photon
11 Hadron spectroscopy, formation experiment, partial wave formalism and the optical theorem
12 The breit-wigner resonance formula, baryon resonances, phase space considerations
13 Production experiments, the quark model, the group su (3)
14 Quarks, hadrons baryons, mesons in quark model, heave meson spectroscopy
15 The quarkonium model
16 The standard model (qualitative treatment only)
17 Unification of weak and electromagnetic interactions
18 Glashow-salam-weinberg model

RecommendedTexts:

1. Griffiths, D. (2008). *Introduction to elementary particles* (2nd ed.). Weinheim: Wiley
2. Riazuddin, Fayyazuddin (2012). *Quantum mechanics* (2nd ed.). Singapore: World Scientific.

SuggestedReadings:

1. Povh, B. Rith, K. & Scholz, C. (2006). *Particles and nuclei: an introduction to the physical concepts*(5th ed.). Berlin: Springer.
2. Bjorken, J. D. & Drell, S.D. (1998). *Relatvistic quantum mechanics* (1st ed.). New York: McGraw Hill.

Halzen, F. & Martin, A. D. (1984). *Quarks and leptons* (1st ed.). New Jersey: Wiley.