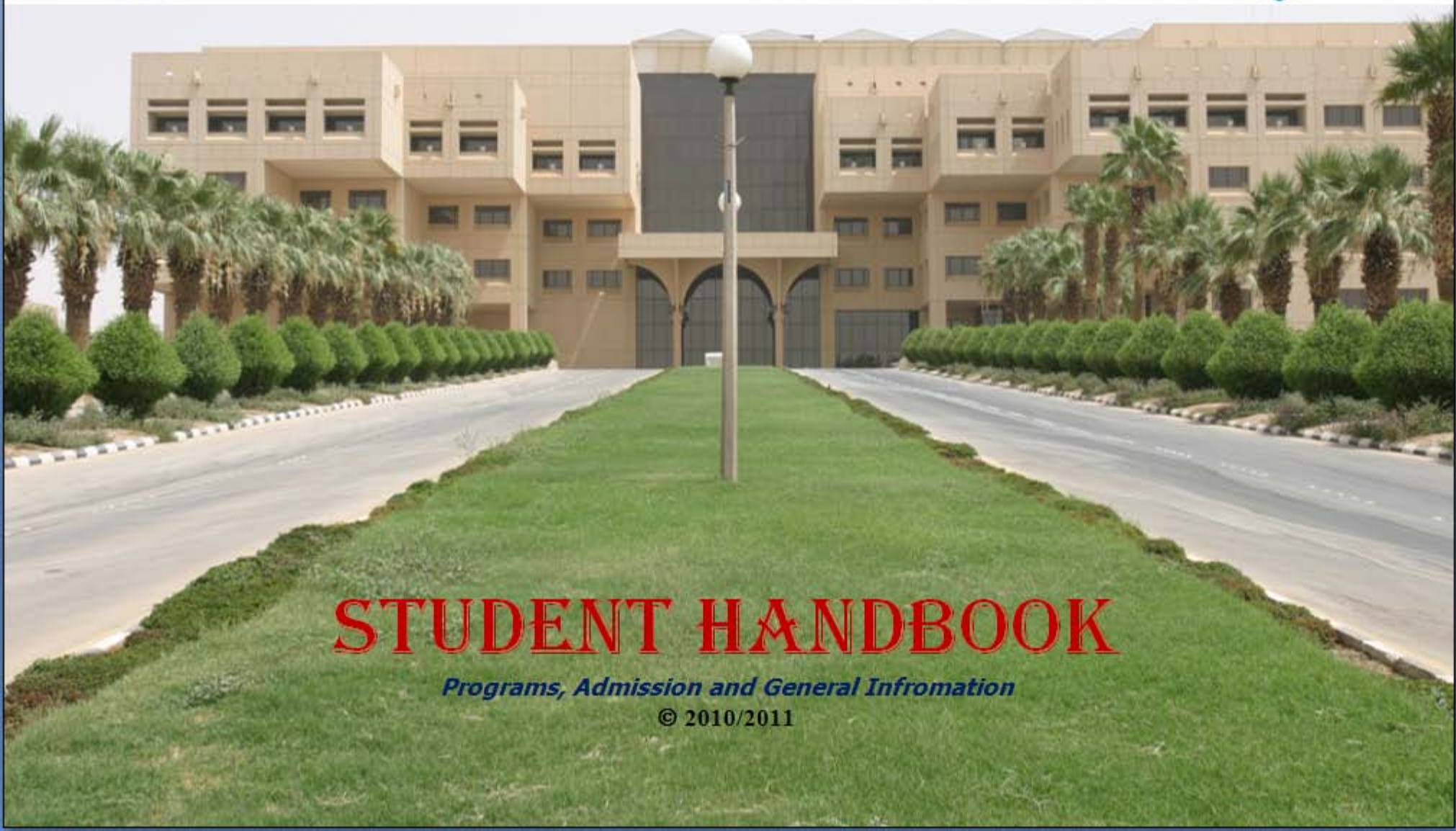
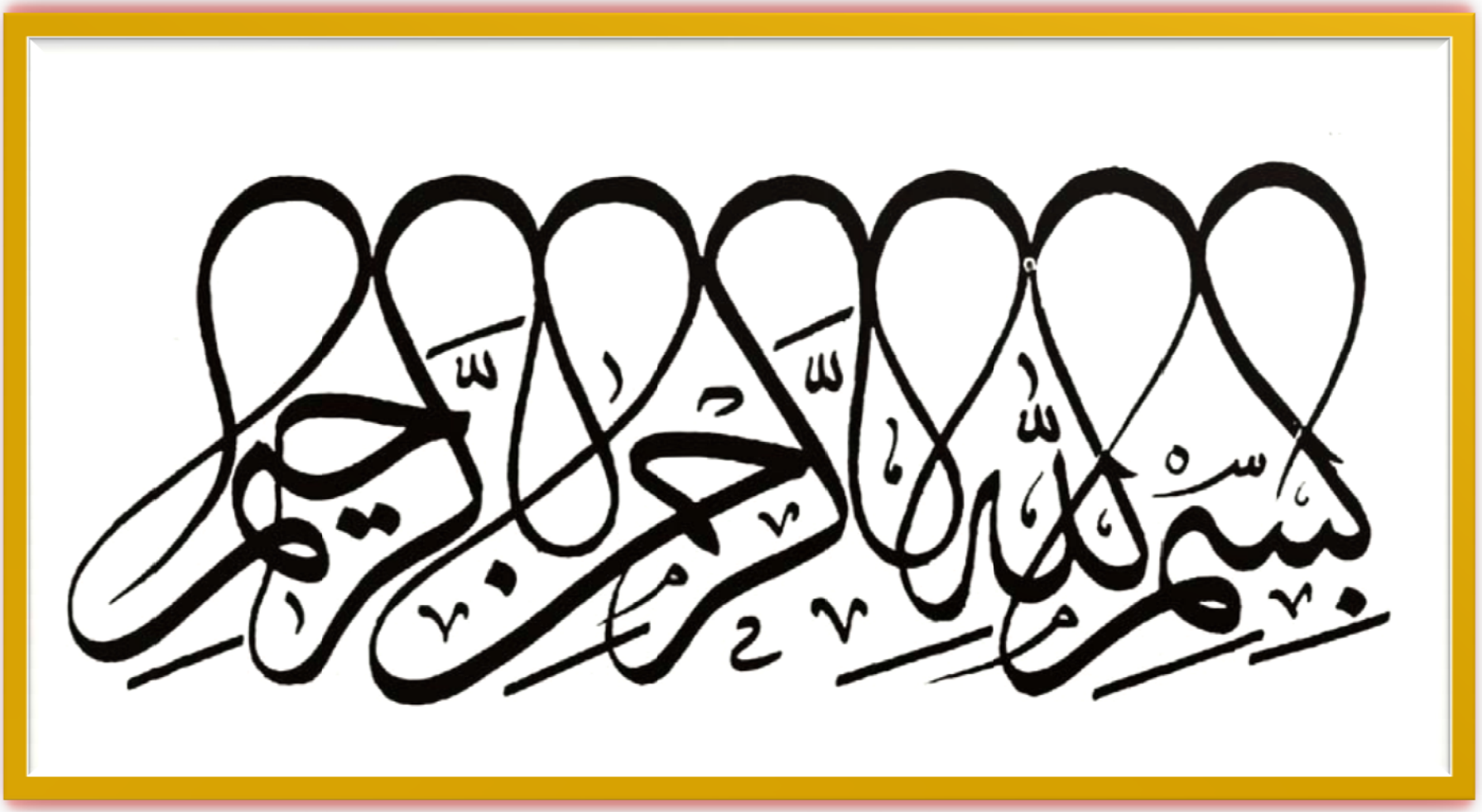
King Saud University
College of Science
Physics & Astronomy Department



STUDENT HANDBOOK

Programs, Admission and General Infromation


بسم الله الرحمن الرحيم

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A strategic plan for the future

Over higher education in the Kingdom of Saudi Arabia through several stages, universities adopted a temporary strategies which were hard to meet the needs of society and providing education of university graduates and high school graduates wishing to complete their university studies. It is no secret who study the development of higher education in the Kingdom that he was focused on attention to the absorption of high school graduates: So was the acceptance of the most important priorities of the universities including King Saud University and the consequent special attention to numbers of admissions and the provision of desks and adequate faculty members the right.

After today we have about 32 universities between government, civil, and an ambitious program of scholarship is a Custodian of the Two Holy Mosques, which provides an opportunity for universities to think more clearly in the formulation of competitive strategies led to world-class status.

And where the world this century in an era of global competition, which stem from the ability of people to compete and win the most important and greatest resources; and because the most important and most precious resource is the human race. Everyone is seeking, including universities, to make dear to them in order to attract global talent and investment of distinguished researchers and faculty members, students, and job competencies. The new realities of higher education in the Kingdom of calls from King Saud University to adopt a future strategy to achieve all its goals and ambitions and hopes.

The Plan of King Saud University strategic thinking that takes into account the situation of the University of totalitarianism, where strong infrastructure and budget support and expert distinguished and highly qualified of the finest universities in the world. As well as be flexible, realistic and achieve all ambitions.

It also takes the strategic plan of King Saud University in mind that become the university attractive place to work and study and be the University of apical play a pivotal role during the next twenty years to achieve global leadership in the production and generation of knowledge and be graduates unable to find employment opportunities in support of the national economy. The university expects the strategic plan to contribute to improved internal efficiency of the University and achieve quality outcomes and building an attractive environment for distinctive competencies and meet the requirements of evaluation and academic accreditation at the local and global levels and to strengthen the partnership between the University and various sectors of society.

Finally, we should be proud of belonging to this prestigious university and to be makers of life and history, looking forward to play the University during the next twenty years a significant role in knowledge production and generation with appreciation to all those contributing to the advancement of the university.

Prof. Abdullah bin Abdul Rahman Al Othman

University Rector

College of Science Dean's Message

Dear colleagues, faculty members, lecturers, technicians, administrators, and students;

In the Name of Allah Most Compassionate, Most Merciful;

The College has worked persistently and systematically during the last few years to develop the educational process with the aim of achieving quality in the education offered to our students. This has included the development and modernization of the academic programs in all eight departments, the development of the teaching methods and the students' assessments criteria, and providing all necessary tools in terms of materials, programs, equipment, and laboratories. Furthermore, the College has placed an emphasis on the improvement of the classrooms, know-how technology relating to teaching methods, and the creation of an attractive learning environment for the students, imparting upon them the skills and abilities required to compete in the labor market. It is important to mention here that such development programs were accompanied by setting the College's Strategic Plan for the next five years to keep pace with the University's Strategic Plan.

All the College Departments had completed all the required documents for the academic accreditation by the end of summer of the academic year 1430/1431 H. The documents have been sent to the Commission for Academic Accreditation (ASIIN) in preparation for the experts' visit at the end of the first semester of this year (mid-January 2011).

It is important to note that scientific research and publication, in specialized scientific journals, have attracted most of the College's efforts towards development and distinction. Thus, many research groups have emerged within each department, and the number of faculty members, participating in conferences and seminars within and outside the Kingdom, has increased. In addition, the number of scientific publications in ISI journals has increased significantly to a degree leading to the expectation that the College of Science would occupy first place in scientific publishing, amongst other University's departments and faculties, for the third consecutive year, God willing.

There is no doubt that the cornerstone of the development of scientific research and publication quality is the graduate student. Thus, the College is working actively at improving the graduate programs, attracting talented students and increasing their numbers to contribute to the expansion and development of the knowledge - economy.

The College of Science, embodying its role in serving the community, approaches that aspect with great importance to achieve one of its most valued objectives. Therefore, the College is working to establish programs that contribute to the community service and provide the services needed to effect development and solve problems. The College's Strategic Plan includes many initiatives that meet this objective. We ask God to help our sons and daughters to achieve their ambitions, and to bless our work for the elevation of this generous country.

Dean of College of Science

Prof. Awad M. Al-Johany

Physics & Astronomy are exciting and rewarding fields of study. They explore many of the deeper mysteries of the universe and matter, and can lead to a wide range of intriguing career and employment opportunities.

Department of Physics & Astronomy at King Saud University, founded in 1957, is one of the largest departments in the university. We are the first Physics departments in the country. Our community includes 64 full-time faculty, more than 250 undergraduate, and around 100 graduate students, in addition to serving more than 1800 students from other disciplines. We are committed to excellence and innovation in forefront research and in teaching, and support strong programs within the fields of Theoretical Physics, Condensed Matter Physics, Computation and Theory, Laser and Spectroscopy, Renewable and Environmental Physics, Nuclear, Medical and Biophysics. We offer B.Sc., M.Sc. and Ph.D. degrees in all of these areas with the help of 7 research groups equipped with all necessary scientific equipments and modern laboratories.

Recently, the department, as part of KSU, has been furnished with the latest teaching facilities including all-computerized e-podiums, Blackboard system, smart boards and self learning advanced computer labs.

Following the new trend of KSU; the department has extended collaboration to many hot research spots worldwide. Many of faculty members are involved on joint projects with their colleagues in different locations. For instance, Laser group has strong collaborative program with Max Planck Institute of Quantum Optics in Germany. Condensed matter research group has strong ties with researchers in Poland and Algeria. King Abdullah Institute for Nanotechnology built its powerful laboratories within the building of the department and permitted department members to use them.

As a consequence of this outreach and under a program called: *The external joint supervision program*, female students from the department can get their graduate degrees from other universities like: Monash University - Australia, Queensland University of Technology - Australia , and University of Leeds - UK with more than 7 other UK universities, without leaving Saudi Arabia except for minimal stay in these countries.

Nasser S. Alzayed
Department Chairman

Vision and Mission of King Saud University

Vision:

To be a world-class university and a leader in developing Saudi Arabia's knowledge economy.

Mission:

To provide students with a quality education, conduct valuable research, serve the national and international societies and contribute to Saudi Arabia's knowledge economy through learning, creativity, the use of current and developing technologies and effective international partnership.

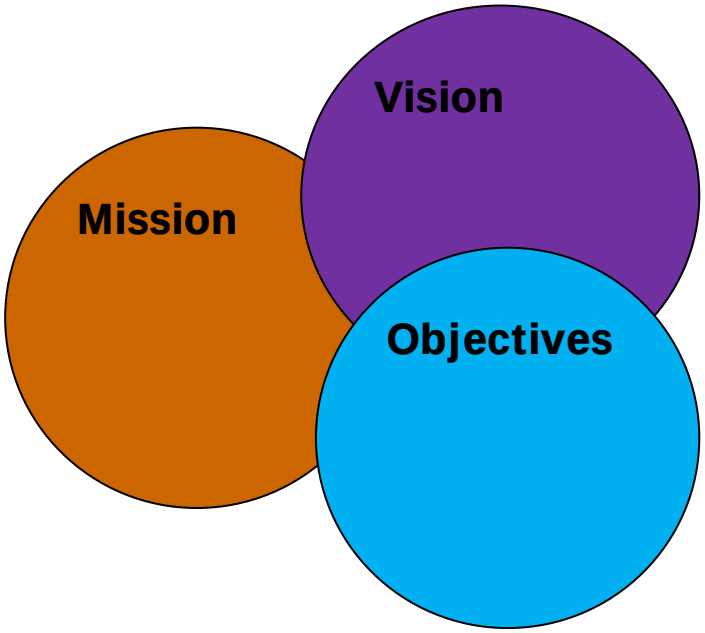
Values:

Based on our Islamic and traditional cultural values, we strive for:

- **Quality and Excellence:** We hold our values according to extremely high standards, honoring lofty ambitions and the pursuit of excellence through a commitment to the rigorous intellectual standards in teaching, learning and innovation.
- **Leadership and Teamwork**: We are committed to promoting individual and institutional leadership roles, which drive social development, professionalism, responsibility, and innovation. collaboration and cooperation are recognized as necessary means of attaining excellence.
- **Freedom of Inquiry**: Rigorous and honest intellectual exploration is fundamental to our academic traditions, and reflected in every facet of scholarship at King Saud University.
- **Fairness and Integrity**: We abide by the principles of social justice, equal opportunity and cultural diversity, holding members of our community to the highest standards of honesty, respect, and professional ethics.
- **Transparency and Accountability**: We are committed to openly placing our scholarly ideas and works for society and scholars to judge. In our pursuit of excellence, we hold everybody in our community accountable for respecting and upholding our values in all forms of their scholarly activities.
- **Lifelong Learning**: We are committed to lifelong learning inside and outside the KSU community, ensuring continued intellectual growth and welfare of society.

Strategic Objectives:

1. Establish excellence in all fields of scholarship and research;
2. Maintain a distinctive faculty possessing the highest credentials and abilities;
3. Provide graduate students with the best education and opportunities that will enhance their knowledge, skills and relevant experience;
4. Building bridges locally, nationally and internationally;
5. Provide a supportive learning environment for faculty, staff and students;
6. Ensuring a sustainable environment for the pursuit of excellence;
7. Establishing flexibility and accountability.

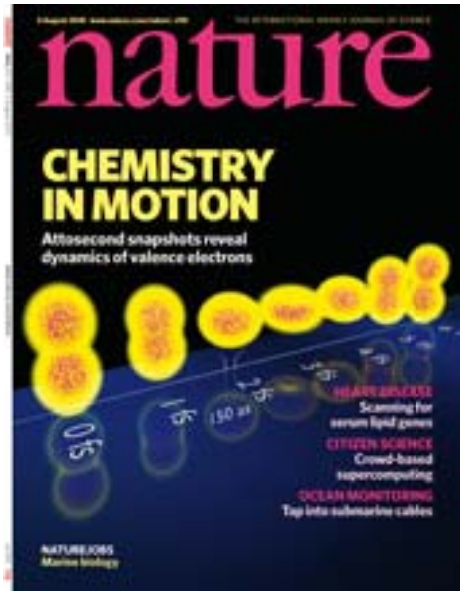


***Vision**: To be a leader in Physics and Astronomy sciences and their application to build knowledge based society*

***Mission**: Offer highly distinguished education and creative research to serve society and contribute toward knowledge based economy through creating a stimulating educational, creative and scientific research environment of continued quality that guarantee the ideal use of technology and general partnership with the social institutions of connection to the disciplines of physics and astronomy*

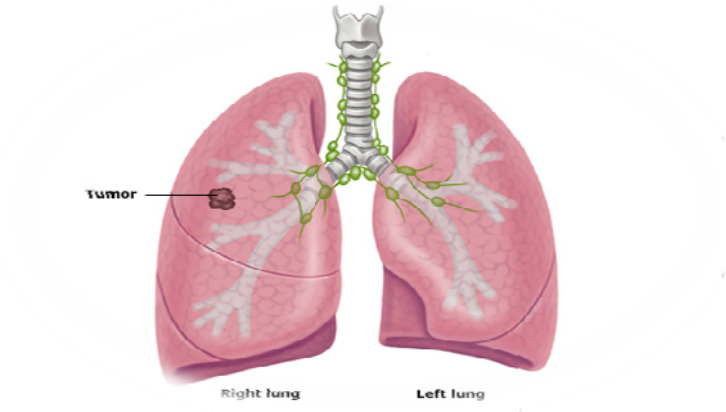
Objectives:

1-Attain a distinctive level in higher education, research and social service
2-Develop methods to guarantee the quality performance and outcome.
3-Demonstrate the ideal use of modern technology.
4-Provide stimulating administrative and academic environment
5-Attract distinguished faculty members, administrative staff and students
6-Establish local and international effective co-operations with universities and related social groups.
7-Enhance scientific culture and its effectiveness.
8-Establish distinguished research schools of international endorsement.



We are on cover pages of Nature & Science Magazines

Our produced Solar Eclipse movie for the year 2010 has been selected by the International Astronomical Union (IAU) Eclipses working Group as the best movie. The movie showed our team observations for that Eclipse.



Yet ... we are still looking forward for more distinguished research and education.

We have few Patents in early detection of cancer by Laser

Introduction:

The B.Sc. Program in the Physics and Astronomy Department in the College of Science aims at providing the students with the required knowledge for employment within and outside the university. The College of Science has been consistently carrying out the development of all its programs including a preparatory year for the admitted secondary school students.

This introduction gives a brief recapitulation of the history of the Department, its goals, Program requirements as well as the overall structure of the plans and contents of the main courses and other support courses. Full approval of the overall structure and Department's plans has been decided by the year 1429-1430 H, and was partially modified in the year 1430-1431 H.

About the Department:

The Department of Physics and Astronomy has been established as part of the College of Science in the year 1378 H (1957 G). The College of Science at King Saud University, at that time, consisted of six departments: (Mathematics, Physics, Chemistry, Zoology, Botany, Geology). Subsequently, the College expanded into other disciplines and the departments of Geophysics, Astronomy, Statistics and Operations research, Biochemistry, and Microbiology were established.

Since its inception, the Department growth was brisk both in the numbers of the students and Faculty Staff. Simultaneously, developments of research laboratories, study plans and course contents have been undertaken continuously.

When the Faculty of Education was established in the University, a branch of the of the Physics Department was established within it to provide educational services up to the time of the relocation of the University to the new premises near the town of Dereyah, when the Branch was integrated fully with the main Department at the College of Science. The Department started postgraduate programs with a Master Program (M.Sc.) in 1400 H and expanded later into a Ph.D. Program in theoretical physics in all offered areas in the year 2009/2010.

In 1412 H, a branch of the Department was established at the Females' Section in the College of Science where female students are awarded a Bachelor's Degree (B.Sc.) in Physics which has been upgraded later to join the Master and Doctoral programs in the Department.

In the academic year 1413-1414 H the Department adopted the academic-level system based on full semester course choices. This was to replace the earlier point (hour) system.

In the academic year 1424/1425 H, the Department of Astronomy was merged into the Physics Department of and the joint name "Department of Physics and Astronomy" was adopted in 1425 H. and the Unit of Astronomy was established.

At present, the Department of Physics and Astronomy awards male and female students, who successfully complete 136 study units, the degree of Bachelor's of Science in Physics. The M.Sc. and the Ph.D. degrees are awarded in separate programs.

The Department in numbers:

- *Total No. of faculty members: 56*
- *Total No. of support staff: 32*
- *Total No. of the Department's students (undergraduate): 250*
- *Total No. of the students of service courses: 1800 approximately*
- *No. or research groups: 7*
- *Total Courses tauaht: 126*

Graduates' Job Opportunities

Physics & Astronomy graduates usually find suitable jobs upon their graduation. These jobs are such as joining academic areas in universities, research centers and in public education, in Saudi ARAMCO, SABIC, the Ministry of Education, and in different other governmental and private sectors.

The Physics & Astronomy Department Landmarks:

The following represents the main landmarks of the Physics and Astronomy Department:

Laser Research Laboratory:

Laser Physics is a relatively new branch of Physics and provides a fertile ground for study either side of the pure or applied Physics in Laser. The development of lasers, and the quest to obtain new materials that can emit a laser beam, have become an attractive topic for many physicists. The characteristics of the laser beam have made it a wonderful tool in many medical applications, applied informatics, industrial, and military applications. Since these areas are of vital importance to the development of Saudi Arabia, the need for qualified personnel in the field of laser has become extremely necessary.

There are many different laser laboratories available in the Physics Department of King Saud University fully equipped with different detectors, analysis tools and various optical and laser systems such as Tai Sapphire Laser, Neodymium-Yag Laser, Argon Ion Laser, Nitrogen Laser, Dye Lasers and Semiconductor Lasers.

These laboratories are managed by a group of faculty members who specialize in the field of laser and have a good experience in the graduate program. A Master's Degree Program in Laser Physics has been offered for more than twenty years where more than thirty students had obtained their degrees in this field. Furthermore, a Ph.D. Program has been recently initiated to offer opportunities for advanced research in this area.

The aim of these laboratories is to contribute to the empowerment of distinguished students to pursue their studies towards the Master's and Doctorate degrees in Laser Physics. Furthermore, research in this area is aimed at encouraging specialized competencies in the field of laser for the development and enrichment of human knowledge. Moreover, this work meets the needs of the development of the Kingdom, in both government and private sectors, to prepare qualified personnel to work in many scientific fields.

Bio-and Medical Physics Research Laboratory:

The Biophysics Laboratory provides measurements of physical properties of materials, whether solid or liquid, particularly biological materials such as blood, Liposomes composed of fat, or chlorophyll in the leaves of existing plants and other samples, whether natural or unnatural, irradiated or affected by external radiation such as nuclear or non-ionizing radiation such as electric fields, magnetic fields and

microwave. Equipment in this laboratory serves the Research Group as well as graduate students and research projects for undergraduate students.

Solar and Renewable Energy Research Laboratory:

In this laboratory various research activities are performed such as electrical, optical, thermal measurements, chemical treatment, crystal characterization, solar energy applications, preparation of thin films, materials science, and preparation of materials by molecular or electronic radiation.

Also, this Laboratory houses equipments for Hall Effect measurements, measurement of thin thicknesses, a spectrophotometer, electrical resistivity measurements, and current – voltage measurements. Currently, the Laboratory houses instrumentation for heat-treatment, advanced system of analysis and characterization of x-ray crystallography, measurements of solar radiation, water pumping, testing of photovoltaic panels, fruits dehydrating, and illustrative applications and models. In addition, it contains a thermal evaporation unit as well as tools and equipment associated with the preparation of samples under testing, such as the MBE System and EBC System.

Materials Research Laboratory:

This Laboratory houses a full range of equipments which can be used for most of the measurements or processing of materials. For example, there is a system, built locally, to measure magnetic A.C. susceptibility. There is a great list of the furnaces in the form of boxes or horizontally shaped, in addition to press tools. Recently, a PLD system for the preparation of thin films has been added in collaboration with King Abdullah Institute for Nanotechnology. This collaboration with the Institute also helped the Research Group to make diagnosis with SEM, TEM, XRD and other major characterization equipment. Currently, arrangements have been undertaken to purchase a PPMS which allows different physical measurements under a very high magnetic field (14 Tesla). Furthermore, numerous other equipments are available in this laboratory, such as XRF, a complete nature - simulation apparatus, an apparatus for the analysis of atom sizes, and a number of refrigeration equipments able to secure temperatures near absolute zero both in the presence of a magnetic field or in its absence.

Nuclear Energy and Medical Physics Research Laboratory:

The Group activities (on-going research):

1. Studies in Nuclear Structure.
2. Measurements of radiation and environmental studies.
3. Biophysical studies of many of the biomaterials.

Scientific equipments available in this Laboratory:

1. A laboratory for radiation measurement; (Detectors: germanium, sodium iodide, silicon and a device for measuring the thermal flash).
2. A laboratory for neutron measurement: neutron source (Am-Be and 252Cf).
3. A laboratory for chronological age measurement: (a device for measuring the age of PET in the material and systems for the measurement of nuclear levels).
4. The Biophysics Laboratory.
5. A Laboratory for the measurements of nuclear impact.

Planetarium:

The Astronomy Unit contains a small dome that is enough for about 10-15 spectators who can watch a variety of astronomical phenomena explained simply and attractively. The Planetarium is one of the important landmarks in the Department visited by many schools each year from various regions of the Kingdom, particularly the schools scattered in the Riyadh area and its environs.

Astronomical Observatories:
There are two observatories in the Astronomy Unit; one of the 15 cm telescope type and the second has a telescope of 50 cm. The small dome unit opens once a week, specifically on Monday each week, for visitors from inside and outside the University to watch some celestial bodies and the astronomical phenomena that occur intermittently. There is also a portable breaker telescope that can be moved for outside monitoring.

Radiation Laboratory:
This Laboratory is one of the Department's laboratories and is part of the University Radiation Committee which provides services, in the measurements of radiation levels, to various sectors in the University and the University Hospitals in particular. The Committee also performs services to broad sectors of the community, especially the medical ones.

Scientific Exhibition in the Astrounit:
This Science Exhibition contains ancient and modern telescopes, as well as an embodiment of the sky illustrating the positions of the stars and their movements. There are also models of Astrolabes in various forms, including the flat and spherical types. Moreover, there are several interesting pictures and illustrations offering useful astronomical information which can be enjoyed by the exhibition visitors. There are also some interesting scientific experiments, such as the application of solar energy which is keenly visited by the public.

Self - Learning Laboratory:
A modern laboratory containing 20 computers enhanced with modern equipment and is supervised by the Development and Quality Deanship in the College.

E-Podiums Platforms (Smart Boards):
All teaching rooms are equipped with smart boards fully integrated with the e-podium platforms. This helps to make education more attractive and exciting to the students.

Distance Education Halls:
Due to the need for remote teaching, especially in some courses that are taught to the females' sections, some halls have been equipped with the latest means of communication and distance education. It allows viewing of the educational material and the full interaction with the students on the other side of the University.

The Max Planck Institute of Quantum Optics Collaboration:
In January 2008 a visit to the Max Planck Institute of Quantum Optics in Germany was undertaken by a delegation, composed of high-ranking officials and leading scientists from Saudi Arabia, led by the Saudi Minister of Higher Education. This was the initial step towards a future long-term cooperation in the fields of applied physics, particularly in the areas of lasers, nanotechnologies, quantum technologies, energy and power technologies, electronics, and photonics. One of the positive results of this cooperation is the step undertaken by KSU to establish a satellite laboratory in the Max Planck Institute of Quantum Optics. The MPQ-KSU cooperation is part of the KSU Nobel Program that aims at promoting novel technologies in the Saudi society.

This cooperation is represented, at MPQ, by the laser spectroscopy Nobel Laureate Professor Theodor Hänsch, and Prof. Krausz who supervises the areas of Attosecond and High-Field Physics. The Saudi research team is led by Dr. Abdallah Azzeer. As a first step, scientists and PhD students from King Saud University will work together with MPQ scientists on the development of novel radiation sources for coherent ultrashort intense light pulses.

Teaching Facilities:

- Books are made available for staff and students on a subsidized basis.
- Photocopiers are available in the Library and the Department for common use.
- Computers with online facilities are mostly available for staff, and computer laboratories for students are widely available.
- Library catalogue and a large number of citation as well as full text databases are also available on-line.
- Many of the equipments required for teaching and for research are available.
- Many class rooms are equipped with smart board systems.
- The laboratories are mostly well equipped. The scientific and safety requirements are reviewed every year.
- Most facilities and instruments are regularly updated and serviced.
- Various required facilities for crippled students are also mostly available.

Students And Skills:

In keeping with the overall objectives of the University and its active scientific development adopted currently, the Physics & Astronomy Department aspires to achieve scientific leadership in the fields of Physics and Astronomy providing the graduate with a vital sense of responsibility and a high level of learning skills putting him at a bar with international students of prestigious institutions. The main required skills are; Knowledge, Cognitive skills, Interpersonal skills, Responsibility, Communication skills, IT skills, Numerical skills, and English Language skills.

1- *Knowledge*

Obtaining knowledge comes from gathering information, for each course, from several sources. These sources include textbooks, scientific references from the University Library, and the Internet, in addition to the course instructor. It is expected that the graduate should have an acceptable basic information upon which the fields of physics and astronomy depend. In particular, he should have a reasonable degree of deep knowledge in classical mechanics, quantum mechanics, materials physics, nuclear physics, astrophysics, electromagnetism, energy physics, optics, biophysics, and theoretical physics. It is also expected that the graduate should have a clear information about many of the applications of those areas in our lives and the general themes of modern research.

2- *Cognitive skills*

Through the student's studies, he should learn how to understand and think about the physical phenomena and how to simulate it. Also, he should learn how to address the physical issues and problems, and how to use the appropriate mathematical tools to describe the physical phenomena. The student should practice the planning, implementation, and reporting in his laboratory experiments or during the handling of a physical problem. He should learn how to simplify the problem to be solved, to structure the information, and to develop devices to increase the accuracy desired to understand or study a physical phenomenon. The student should be trained on the operations of derivation and deduction that face him during his studies.

The development of the student's intellectual skills comes from a review of those points during his practice in the educational process, whether by the instructor or the student's personal efforts. Also, it emanates from the student's interest in the experimental study, as well as during the periods of solving problems and while discussing how to address the phenomenon during the lecture or by searching on the Internet. The use of computers and computer programs to understand and analyze the laboratory results or to track experimental details in the computer simulation programs. All of those activities are means of helping the student in the formation of a high-level knowledge. Furthermore, interest in the experimental laboratory work, their consequent results, and comparing them with the physical theories previously learnt by the student play an important role in building a cognitive ability in a practical way.

3- *Interpersonal skills and responsibilities*

One of the main objectives of the educational process is the development of personal skills and the ability to undertake responsibility through pursuing some of the following strategies:

- Training students to search in the internet and the library.
- Educating them on how to compensate the lectures, from which they were absent, by getting the help from other colleagues.
- Learning how to collect the scientific material for any course being studied, to compile and re-arrange it in a simplified manner. This is one of the means of increasing the personal capacity of learning.
- Discussing how to overcome learning difficulties and solving scientific problems.
- Using the laboratory experiments and the computer to simulate the practical aspects of the scientific topic.
- Attending seminars and general scientific lectures.
- Visiting the institutes, research institutions, and industrial foundations related to the specialization to experience the practical reality in the community.

The achievement of these skills can be facilitated by requesting guidance from the course instructor.

4- Communication Skills

Communication skills can be divided into three skills: ***I- Communication with colleagues*** that can be practiced through team work to solve problems, searching in the internet, or studying a particular idea or a specific topic. Of help in this regard is the raising of the level of cooperation in solving the educational problems and furthering the communication with the student's colleagues and peers. It must be emphasized that The process of communication with peers is the way to perform in a spirit of team work which is important to achieve success in research activities.

II- The student's communication with the course instructor: Communicating with the instructor is important for solving the student's problems in learning, developing his skills, and overcoming educational difficulties.

III- The student's communication with the community: This can be achieved through undertaking field visits to factories, companies, research institutions, hospitals, and astronomical observatories. This ability can also be enhanced through communicating with various groups of the society in which the student lives. Furthermore, the student should have the ability and courage to explain physical phenomena to members of his family, relatives, and his neighborhood. Also, he should have the desire and zeal to communicate with the activities of the scientific community either within, or outside, the University. Hence, the importance of the graduate's skills, characterized by social and scientific networking, can not be over-emphasized.

5- Information Technology Skills:

These skills can be realized by searching through the information network, the use of computers in writing reports, performing drawings and calculations, learning languages, and applying different software that increases in depth in accordance with the course level.

6- Numerical Skills:

These skills can be acquired through solving problems, performing numerical analysis for the outputs, the ability to estimate numbers in terms of their numeric value, and the ability to use statistical and analytical software.

7- English Language

The student needs to pay attention to the English language as a skill that can be used in the scientific areas, especially in the fields of research and learning physics. A research physicist requires the English language since both research work and scientific references are often written in English. Hence, the researcher must master the English language for reading, and in the case of traveling abroad, he needs to conduct his conversations through the medium of the English language. Furthermore, the student needs the skill of writing in English when writing his graduation projects, Master's thesis, Ph.D. thesis, and submitting a report or research work resulting from his study.

The Study System at the College of Science

Teaching at the College of Science is subject to the following scheme:

1. The school year consists mainly of two regular semesters and a summer session, if available.

2. The stage of academic progress is indicated by the academic level since the number of levels to graduate is at least eight levels in

conformity with the approved Study Plan.

3. The duration of the level is a full semester (not less than 15 weeks) and this period does not include the periods of registration and final exams.

4. The duration of the summer semester is not less than eight weeks where the teaching time allocated for each course is doubled.

5. A number of courses (subjects) are taught during each academic level according to the program of each specialty in the different departments.

6. Students have to complete 136 class units (credit hours) to obtain a Bachelor's Degree as follows:

a. The student studies a number of 31 credit hours during the Preparatory Year (two semesters in one academic year).
b. The student studies 97 credit hours (optional + compulsory) in the Program of Specialization in the various College departments throughout the six semesters following the Preparatory Year (beginning with the third semester).
c. University Requirements: The student selects 8 credit hours of the requirements of the University out of 22 optional credit hours during the period of study at the College.

7 The student chooses the specialty department before the end of the Preparatory Year based on the conditions set by each department.

Academic System (e-Register) Registration

is the cornerstone of the academic system, the center of the educational process, and the first step to start university life. The new Academic System (e-Register) offers new students the following opportunities:

1. To create an e-mail through the site of the Deanship of Electronic Transactions and Communications; go to this link:
http://www.ksu.edu.sa/sites/KSUArabic/Deanships/Computer/Pages/

1. To have an access to the academic system by using the link:
http://edugate.ksu.edu.sa
then, entering a user name and a password.

2. Online Registration (registration, adding, and dropping): a student can register, in person, from any location during the periods of registration and dropping plus an additional period specified in the academic calendar; thus, without having to visit the College or the Department, the student can perform the following:

   a. **Registration**: Registration of courses and deciding the required number of credit hours.
   b. **Adding and dropping**: The student may drop and add courses during the first week of teaching provided that the study load does not go above , or lower than, the allowed course load.

3. To view the course schedule of the College and the available/closed groups.
4. To view the study schedule and print it.
5. To view the Academic Record and print a copy (an unofficial copy).
6. To view the results of the final exams as soon as they are put online.
7. To view the Study Plan, the courses passed by the student, and the ones remaining to be studied.
8. To know about the penalties imposed upon the student.
9. To view the financial rewards.
10. To make suggestions and submit complaints.
11. To write the academic performance evaluation of faculty members.
12. To exchange electronic messages and change the password. * In case of any problem while registering, please consult the College Registration Office (room 1 a 7 - Building 4).

Rules for Registration of Courses

• The Course is a module that meets the needs of the level specified in the approved Study Plan in each specialty (Program). The Course has a number, a code, a title, and a description depending on the different departments (see the Department's Manual Guide).

• The Course is divided into a set of theoretical lectures and practical lessons (study units) taught weekly during the academic level.

• The Credit Hour is a weekly theoretical lecture that is not less than fifty minutes, or a practical lesson which is not less than one hundred minutes.

• The registration of the courses for all students is done automatically through the website: http://edugate.ksu.edu.sa

• The academic levels vary in the number of the units of study, from 12 units to 20 units, for each level.

• The Courses are registered automatically at the beginning of the following semester for the student's convenience. Then, the student can modify the course schedule by adding or dropping.

• The following table shows the student's study load corresponding to the cumulative average:

GPA	2	2.5	3	3.5	4	4.5	5
Hours allowed for registration	14	15	16	17	18	19	20

• The Processes of dropping and adding are performed by the student electronically in the first week of the semester through accessing the gate of the academic system of the University Deanship of Admission and Registration (http://edugate.ksu.edu.sa).

• No student has the right to register a course without passing its pre-requisite course.

• Students, who pass all courses without failures, are registered in the courses of the level beginning gradually with the lower levels according to the study plans approved.

• Students, who fail in some courses, are registered in courses that ensure their minimum study load in each semester taking into account the following points:

- No conflict in the course study schedule.
- Satisfying the previous requirements of the course or courses to be registered.

Calculating the Average and Cumulative GPA:

The Average and cumulative GPA are calculated every semester for the student automatically by the system. To know how to calculate the averages, you should follow the following steps:

Calculating the Semester Average:

The GPA is calculated considering the following points:

1. Knowing the number of hours of the courses.
2. knowing the mark obtained in each course.
3. Knowing the corresponding grade of each mark.
4. Knowing the value of each grade.
5. Knowing the points = number of hours of the course × value of the grade.
6. Determining the total points obtained in all courses of the semester.
7. Determining the total number of hours registered in the semester.
8. The average is calculated every semester according to the following equation:

$$GPA = \frac{Total\ No.of\ \ Point\ (item\ 6)}{No.of\ Hours\ (item\ 7)}$$

The following table shows the percentage of marks, grade and value obtained by the student in each course, which is used to calculate the points:

Mark	Grade	Letter	Value
95-100	Excellent +	A+	5.00
90 to < 95	Excellent	A	4.75
85 to < 90	Very Good+	B+	4.50
80 to < 85	Very Good	B	4.00
75 to < 80	Good +	C+	3.50
70 to < 75	Good	C	3.00
65 to < 70	Pass +	D+	2.50
60 to < 65	Pass	D	2.00
< 60	Failure	E	1.00
Absent	Debarred	H	1.00

Calculating the Average Cumulative:

The GPA semester average is calculated as follows:
The grand total of points (for all semesters that have been studied).
The grand total of credit hours (for all semesters that have been studied).
The cumulative average is calculated according to the following equation:

$$GPA = \frac{Grand\ Total\ of\ \ Point}{Grand\ total\ of\ credit\ hours}$$

Here is an example of how to calculate the grades above:

Calculating the grade of the first semester:

Course	Credits	Mark	Grade	Grade Value	Points
Phys 101	4	67	D+	2.5	4 ×2.5=10
Chem101	4	73	C	3	4 ×3.0=12
Eng 121	3	77	C+	3.5	3 ×3.5=10.5
Arab 101	2	81	B	4	2 ×4.0=8
	13				40.5

GPA = Total points ÷ No. of hours registered in semester = 40.5 ÷ 13 = 3.12

Calculating the grade of the second semester:

Course	Credits	Mark	Grade	Grade Value	Points
Math 101	3	61	D	2	3 × 2 = 6
Stat 101	3	73	C	3	3 × 3 = 9
C.S. 206	3	80	B	4	3 × 4 = 12
Arab 103	3	88	B+	4.5	3 × 4.5 = 13.5
Islam 101	2	92	A	4.75	2 × 4.75 = 9.5
Eng 122	3	97	A+	5	3 × 5 = 15
	17				65

GPA = Total points ÷ No. of hours registered in semester = 65 ÷ 17 = 3.82

To Calculate the average cumulative:

$$GPA = \frac{Total\ no.\ of\ Points}{Total\ Hours\ of\ the\ Semester} = \frac{105.5}{30} = 3.52$$

Dropping and adding of a course:

- The process of dropping and adding is performed through portal (http://edugate.ksu.edu.sa) during the first week of the semester only; but the number of credit hours registered has to be at least 12 hours.

- The student may drop only one course due to an excuse acceptable to the Dean of the College. This procedure should occur at least five weeks before the final exams begin. The student has the right to apply for such a procedure at a maximum of four courses during the whole period of study at the College.

Attendance, postponing and dropping out of College:

• The student must be regular in attendance attending at least 75% of the lectures and the practical classes.

• If any student has a percentage of absence of 25% , or more, in any course, he is denied access to the final exam of this course and his result is F.

• A student may apply for postponement of the study before the beginning of the semester for an excuse accepted by the College Board. The postponement should not exceed two consecutive semesters or three intermittent semesters as a maximum limit while studying at the College.

• The University Council may, in case of necessity, exempt the applicant from the previous provision.

• If a student drops out of College for one semester without requesting the postponement of his registration, the University has the right to dismiss his registration. The University Council has the right to do this for a lesser period of time.

• The student is not considered as dropping out of College if he is a visiting student at another university.

Visiting Student:

The Visiting Student is a student who studies some courses at another university, or at a branch of the university to which he belongs without being transferred. The courses he studied are accredited according to the following regulations:

• The student has to have a transcript (including a grade point average) for, at least, two semesters at his college before he applies as a visiting student.

• The student must obtain a prior approval from his college permitting him to study as a visiting student while specifying the courses that will be studied. The College has the right to require a specific grade to be achieved by the student to offset the course. The student should obtain an official letter from the Deanship of Admission and Registration directing him to study as a visiting student.

• The student has to join a college or a university officially recognized.

• The courses, under consideration by the student to be studied outside the University, must be equivalent in their description to the University courses, and their course units should be no less than the units of any of the courses contained in the graduation requirements.

• The maximum of the total units of study that can be calculated from outside the University is twenty percent (20%) of the total units required for graduation at King Saud University.

• The courses that are studied by the visiting student are not included in the cumulative average. These courses are recorded in his academic record.

• The student must provide the Deanship of Admission and Registration with the results he obtained during the first two weeks of study in the semester following the period of study as a visitor. If not reported within that period, the student is considered as dropping out of College during those semesters.

Dismissal from the University:

The student is dismissed from the University in the following cases:

• If he receives three consecutive warnings due to a cumulative average below a minimum of 2.

• The student may be given a fourth opportunity by the Council of the University based upon the recommendation of the College Council to raise his cumulative GPA by studying the available courses.

• The University Council may give the dismissed students, due to warnings, an opportunity that does not exceed two semesters as a maximum.

• If the student does not fulfill his graduation requirements at the College in a period of up to half of the period prescribed for graduation in addition to the duration of the Program.

• The student is given an exceptional opportunity by the University Council to meet the graduation requirements during a maximum period not exceeding twice the original term specified for graduation.

• The University Council may allow dismissed students, due to the exhaustion of failure times, to attend twice the duration of the Program. This extension should not exceed a maximum of two semesters.

Examinations and Grades:

• Based on a proposal from the Department Council, the College Council specifies a mark for the student's semester work, varying from 40% to 60% of the final grade of the course.

• The mark of the course's semester work is calculated by one of the following two methods:

1. Oral, practical tests, research, or other forms of classroom activity, or from all the above or some of them, in addition to at least one written exam.
2. Two written exams at least.

• Based on the recommendation of the course instructor, it is permissible for the Department Council, that teaches the course, to allow the student to complete the requirements of any course in the following semester and to give the student a grade of I (incomplete) in his academic record. Only the grades achieved by the student are included in the GPA or cumulative after the completion of the requirements of that course.

• If one semester passes without changing the grade incomplete (I), the student is given an F which is calculated in the GPA and cumulative.

• The grades obtained by the student in each course are calculated according to the schedule mentioned above.

Restrictions of the Final Examination:

• No student may be tested in more than two courses in one day.
• The student is not allowed to enter the final exam after half an hour of its beginning, and is not allowed to leave the exam room before half an hour after its beginning.

• Based on a recommendation from the relevant department council, the College Council specifies the duration of the final written exam to be within a period not less than one hour, and not more than three hours.
• Cheating in the exam, initiating it, or violating the instructions and rules of examination procedures are actions punishable in accordance

with the Regulations of the Students' Discipline issued by the University Council.

• In cases of necessity, the College Council, in charge of teaching a course, has the right to approve re-marking of the answer sheets in a period of time not later than the beginning of the following semester in accordance with the following rules:

A student may apply for re-marking the answer sheets of only one course per semester.

The student, who wishes to re-mark his answer sheets, may apply for re-marking to the department, that teaches this course, not later than one month after taking the final exam.

A student, who has already applied for re-marking and proved the invalidity of his application, should never apply for re-marking his answer sheets in any exam in the future.

Transferring:

1)Transferring from one college to another within the University:

• It is permissible, with the consent of the respective deans of the colleges, to transfer from one college to another in accordance with the conditions approved by the College Council to which the student wishes to transfer.

• The student's college academic record has to show all courses previously studied, including grades, semester and cumulative averages throughout the study at the college from which he is transferred.

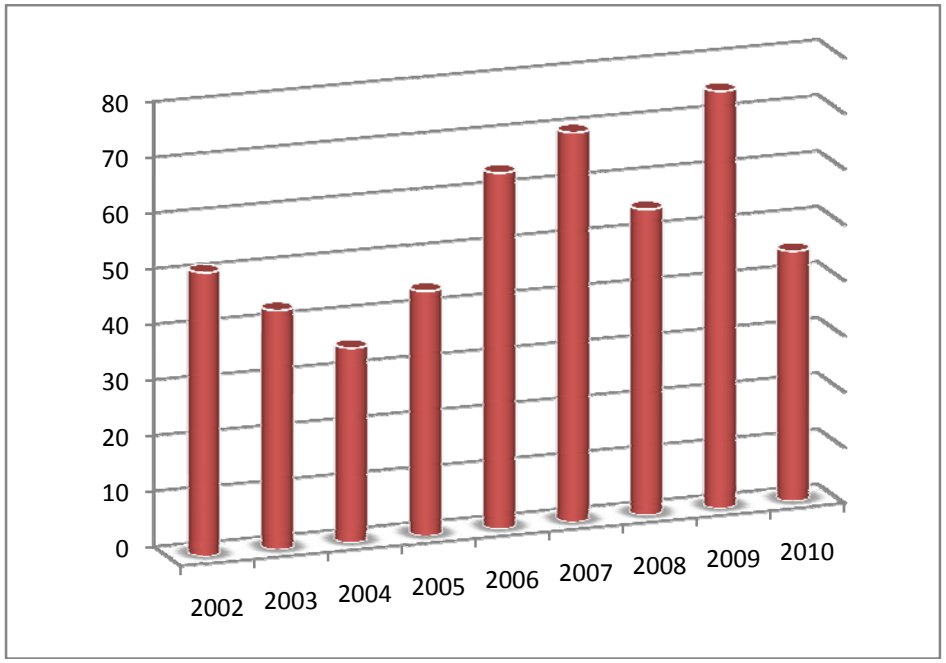
2)Transferring from one major to another within the College:

• The student may, after the approval of the Dean, transfer to another specialty within the College according to the guidelines established by the College Council.

• The student's college academic record has to show all courses previously studied, including grades, semester and cumulative averages throughout the study at the college from which he is transferred.

Graduation:

The student graduates after completing successfully the graduation requirements in accordance with the study plan, provided that his cumulative average is no less than 2 (Pass)



No. of B.Sc. Graduates since 2002

Physics & Astronomy Programs

The Department offers three Programs in Physics: Bachelor's, Master's and Ph.D. degrees. The Department teaches female and male students (and students of other scientific colleges of the University) more than 54 different scheduled curriculum courses in Physics at the undergraduate level, and more than 72 scheduled curriculum courses at the postgraduate level (Master and PhD).

The Department awards a Master's and Ph.D. Degrees to both male and female students in seven distinct Physics disciplines as follows:

1. Condensed Matter Physics
2. Nuclear Physics.
3. Theoretical Physics.
4. Laser & Spectroscopy Physics.
5. Renewable energy and Environmental Physics.
6. Bio and Medical Physics

The Department will soon award a Master's Degree in Astronomy upon receiving final approval of the program which has been submitted.

Human Resources:

Currently, the Department has 64 faculty members in all disciplines of physics which include 12 professors, 16 associate professors and 20 assistant professors. It also has 1 lecturer, 3 demonstrators, 6 technicians, 3 demonstrators having scholarships to complete their higher studies, 3 researchers and 4 administrators. The Females' Branch has 11 faculty members which include 1 professor, 3 associate professors and 7 assistant professors. It also has 3 lecturers, 11 demonstrators, 2 technicians and one administrator. Because of the limited number of the female faculty members, the male faculty members assist in teaching graduate courses and some of the undergraduate courses at the Females' Branch.

A - Bachelor's Degree

The Department offers the of Bachelor's Degree Program in Physics for male students since it was established in 1958, and in 1413H teaching to female students was initiated. This Program is taught in the Arabic language, but the Department is planning to convert to the English medium gradually starting from the academic year 1429/1430 H.

Furthermore, the Department is planning to introduce a new Bachelor's Degree Program in Astrophysics.

The Degree Requirements

The student should successfully complete 136 credit hours in at least 8 semesters, as shown in the Study Plan**.**

Admission to the Department:

The College of Science requires the candidate to obtain a high school certificate (science section) in addition to the two examinations set by an independent testing education association (Qias). The acceptance grade is set by the College Council. The candidate, after his/her initial acceptance, is expected to successfully pass the Preparatory Year with a grade not less than 3.0 out of 5.

The Degree Title:

The male or female student is awarded the Bachelor's of Science in Physics upon the completion of the Preparatory Year, University, College and Department requirements.

Course Coding:

Course codes and numbers are adopted in accordance with a specific methodology that takes into account the level of the curriculum and the sub-specialization to which the course belongs.
The code "Phys" refers to the title of the scientific specialization of the course; namely (Physics).
The "percentage number" represents the annual level at which the course is offered. The "decimal number" represents the sub-specialization to which the course belongs. The "unilateral number" represents the serial number of the course within its specialized group of courses.
For example, the digital symbol 481 indicates a course in the Plan at the fourth year (level 7 or level 8) and belongs to a specialized subject with the code 8 (nuclear Physics). Number 1 indicates that this is the first course in that group.

The modules of each course are given by a number indicating the total approved number of hours for the course followed by a bracket having three numbers separated by a plus sign. The first number indicates the approved theoretical number of hours, the second indicates the approved laboratory number of hours of this course, and the last number indicates the approved number of hours given for the exercises, which are presented to this course. Note that each approved credit hour allocated for the laboratory or exercises is equivalent to two contact hours.

For example, the course "Phys 342" (Thermal and Statistical Physics) has a total approved modules of 4 hours; 3 hours for the theory (lectures), followed by exercises of approved one-credit hour and has no laboratory work. Its modules are written as 4(3+0+1).

Undergraduate Study Plan for Physics and Astronomy Department

In line with the policy of the University and its aspirations to modernize its study programs and the study plans, the College of Science had undertaken the task of developing and improving the programs of its Departments. It has set a comprehensive and continuing review and evaluation program for the development of education in the light of the academic variables and the needs set by the job market. The plan is set to highlight the shortcomings, study deficiencies and imbalances in order to set appropriate solutions to these problems. The Physics Department has completed a comprehensive restructuring to its Study Plan to take into account new developments and to meet the requirements of the Academic Accreditation.

- Restructuring of the Study Plan and the classification of courses:

- The Study Plan for the students of the College of Science is designed to contain the basic aspects of knowledge in the following areas:
1- Initial courses in the Preparatory Year,
2- Islamic Culture and Arabic Language,
3- Specialization courses: these courses are taught beginning from the third semester to the eighth-semester. Specialized courses of the various physics branches (theory, atomic and nuclear, laser, renewable energy, materials, mechanics, electromagnetism, thermal and wave, with other supportive courses) as well as practical courses intended to train the students to conduct physical experiments and to conclude results from the observed data. Most of these courses, not less than 40%, will be taught in English.

Such a Study Plan for undergraduate studies in the Department of Physics and Astronomy has been built, similar to that in other departments in the College, to be composed of 136 credit hours distributed over eight semesters as follows:
i- The Preparatory Year: two semesters of 31 credit hours after

receiving a secondary education certificate (scientific section) in addition to the two tests set by an independent testing education association (Qias).

ii- The remainder of the units are distributed into six semesters with a total of 105 credit hours, of which:

A- Eight credit hours University requirements (four courses) selected by the student from 12 credit hours available (6 courses of two credit hours each)

B- Six credit hours from the elective courses from outside the Department (two courses of three credit hours each) selected by the student from the College courses

C- The remainder of the credit hours are devoted to the specialization requirements; 91 credit hours including 82 compulsory credit hours and 9 elective credit hours (1 of 3 hours course + 3 of 2 hours courses) where the student selects 1 elective course from 12 hours available, and 3 electives from 14 courses of two credit hours each.

The following table shows the details of the Study Plan which was approved by the Department Council at its 15h meeting on 9/6/1431 H.

Requirements	No. of courses	Credit hours	%	Actual hours	%
Preparatory Year	8	31	22.8	31	19
University requirements	4	8	5.9	8	4.8
Dept. compulsory	24	74	54.4	102	63
Non-dept. compulsory	2	8	5.9	10	6.0
Dept. electives	4	9	6.6	9	3.6
Non-dept. electives	2	6	4.4	6	3.6
Total	**44**	**136**	**100**	**166**	**100**

Description of the Plan

The student should successfully pass 136 credit hours before graduation. This can be achieved through eight semesters distributed on the following levels:

The Preparatory Year: (first and second levels):

Course	Code	Course name	hours
140	Ngm	English I	8
150	Ngm	English II	8
140	Math	Mathematics Skills: Intro. to Math.	2
150	Math	Mathematics: calculus	3
140	Tec	Computer Skills	3
140	Nhg	Learning, Thinking and Research Skills	3
140	Hel	Health and Fitness	2
140	Sci	Communication Skills	2
Total			**31**

Third Level:

Course	Course name	hours
Phys 110	General Physics I	4(3+1+0)
Phys 111	General Physics II	4(3+1+0)
Math 111	Methods of Integration	4(3+0+1)
Phys 201	Mathematical Physics I	3(2+0+1)
xxx	University Elective*	2(2+0+0)
Total		**17**

Fourth Level:

Course	Course name	hours
Math 209	Differential Equations	4(3+0+1)
Phys 210	Classical Mechanics I	4(3+0+1)
Phys 222	Electromagnetism	4(3+0+1)
Phys 234	Vibrations and Waves	4(3+0+1)
xxx	College Elective **	3(3+0+0)
Total		**19**

Fifth level:

Course	Course name	hours
Phys 301	Mathematical Physics II	3(2+0+1)
Phys 312	Classical Mechanics II	3(3+0+0)
Phys 331	Optics	4(3+0+1)
Phys 352	Modern Physics	4(3+0+1)
Phys 394	Electromagnetism Lab.	2(0+2+0)
Phys 395	Wave Physics Laboratory	2(0+2+0)
Total		**18**

Sixth level:

Course	Course name	hours
Phys 325	Electronics	3(2+1+0)
Phys 343	Thermal and Stat. Physics	4(3+0+1)
Phys 371	Solid State Physics I	3(3+0+0)
Phys 391	Thermodynamic Laboratory	2(0+2+0)
Phys 396	Modern Physics Laboratory	3(0+3+0)
xxx	University Elective *	2(2+0+0)
Total		**17**

Seventh level:

Course	Course name	hours
Phys 400	Computational Physics	2(1+1+0)
Phys 404	Math. Physics III	3(3+0+0)
Phys 453	Quantum Mechanics	4(3+0+1)
Phys 481	Nuclear physics I	3(3+0+0)
xxx	College Elective **	3(3+0+0)
xxx	University Elective *	2 (2+0+0)
Total		**17**

Eighth level:

Course	Course name	hours
Phys 491	Solid State Physics Lab.	2(2+0+0)
Phys 492	Nuclear Physics Laboratory	2(2+0+0)
499 Phys	Graduation Project	3(3+0+0)
xxx	1 Elective from Group 1	3(3+0+0)
xxx	3 Electives from Group 2	6 (6+0+0)
xxx	University Elective *	2(2+0+0)
Total		**18**

Elective Requirement Courses from the Department

Group 1: the student selects 1 course only

Course.	Code	Course Title	hours
435	Phys	Laser Physics	3(3+0+0)
460	Phys	Biophysics	3(3+0+0)
473	Phys	Material Science	3(2+1+0)
477	Phys	Energy & Environment Physics	3(3+0+0)
12 credit hours; the student selects 1 course only			

Group 2: the student selects 3 courses (6 credit hours)

Course	Code	Course Title	hours
411	Phys	Astrophysics I	2 (2+0+0)
412	Phys	Astrophysics II	2 (2+0+0)
444	Phys	Physics Teaching Skills	2 (2+0+0)
423	Phys	Semiconductor Physics	2 (2+0+0)
456	Phys	Atomic and Molec. Spectr.	2 (2+0+0)

457	Phys	Laser laboratory	2 (2+0+0)
462	Phys	Medical Physics	2 (2+0+0)
472	Phys	Solid State Physics II	2 (2+0+0)
476	Phys	Nano Science and Technology	2 (2+0+0)
480	Phys	Elementary Particles Physics	2 (2+0+0)
483	Phys	Nuclear Physics II	2 (2+0+0)
485	Phys	Accelerators Physics	2 (2+0+0)
486	Phys	Radiation Physics	2 (2+0+0)
488	Phys	Nuclear Reactors Physics	2 (2+0+0)
28 credit hours; the student selects 3 courses (6 credit hours)			

8 credit hours from the University Requirements:

Course	Code	Course name	hours
101	Slm	Introduction to the Islamic culture	2 (2+0+0)
102	Slm	Islam and Society	2 (2+0+0)
103	Slm	The Economic System in Islam	2 (2+0+0)
104	Slm	The Political System in Islam	2 (2+0+0)
101	Arb	Arab Skills	2 (2+0+0)
103	Arb	Arabic Editing	2 (2+0+0)
The student selects only four courses; (8+0+0) - two Slm courses must be included			

** The student selects a total of 6 credit hours from the following elective courses from the College:

Course	Code	Course name	hours
102	Astr	Intro. to Stellar and Solar System	3 (2+1+0)
100	Stat	Introduction of Statistics	3 (2+0+1)
103	Chem	General Chemistry-1	3 (3+0+0)
140	Micb	Microbiology	3 (2+1+0)
The student selects only two courses; 6(6+0+0)			

Teaching Physics courses to other disciplines:

The Department teaches 12 physics courses required by the various departments of the College of Science, such as Mathematics, Statistics and Operations research, Chemistry and Geology. Furthermore, the Department teaches the physics service courses required by the other colleges in the University; namely: Food and Agriculture Sciences, Engineering, Computer and Information Sciences, Architecture, and the Public Health Science Program for the Colleges of Medicine, Dentistry, Pharmacy and Applied Medical Sciences, as shown in the following table:

Course	Course Name	College	hours
PHYS 101	General Physics-1	Colleges of Science - Food and Agriculture	4(3+1+0)
RAD 101	Radiation Physics	Nursing College	3(2+0+1)
PHYS 102	General Physics-2	Science (Chemistry – Geophysics)	4(3+1+0)
PHYS 103	General Physics-1	Engineering	4(3+1+0)
PHYS 104	General Physics-2	Engineering - Computer and Information Science	4(3+1+0)
PHYS 105	General Physics	Architecture and Planning	3(2+1+0)
PHYS 145	General Physics	Medicine – Dentistry- Pharmacy - Applied Medical sciences	3(2+0+1)
PHYS 201	Math. Physics-1	Science (Geophysics)	3(2+0+1)
PHYS 205	Biophysics for zoology	Science (Zoology)	2(0+0+0)
PHYS 209	General Biophysics -1	Science (Botany - Microbiology)	3(0+0+0)
PHYS 221	Electromagnetism-1	Science (Geophysics)	3(3+0+0)
PHYS 232	Waves and Vibrations	Science (Geophysics)	3(3+0+0)

***Table** 1: Courses introduced by the Department as service courses for male and female students of the University*

B - Master's Degree

Master's Degree (thesis and courses option)
Degree Title: Master of Science in Physics (M.Sc.).
Program Objectives

1- To provide qualified graduates in physics to the academic and scientific research fields.
2- To raise the standards of postgraduate studies at the M. Sc. level and studies leading to the Ph. D. Program in the Department.
3- To contribute to the Kingdom's need for specialists in the areas of theoretical and experimental physics.

Admission Requirements

1- The admission requirements as detailed in the Unified Graduate Studies Statutes for Saudi universities.
2- Candidates should hold a Bachelor's Degree (B.Sc.) in Physics from King Saud University or other universities and teachers' colleges in Saudi Arabia, or their equivalent.
3- Candidates must qualify to specific other department's requirements in addition to passing a written test in General Physics (in English).

Degree Requirements

1. A successful completion of 24 credit hours of graduate courses distributed as follows:
   i) 15 credit hours of basic core courses in physics; except in the Astronomy Track where students should complete 12 credit hours of the basic core courses in Physics.
   ii) 9 credit hours composed of courses (compulsory or elective) related to the Program Track. In the Astronomy Track, the student should complete 12 credit hours (compulsory or elective) related to the Track Requirements Plan.
2. Completing a successful thesis.

M.Sc. in Physics Program Structure

Twenty-four Credit hours and a thesis are required:

Number and Type of Courses	Credit Hours
Basic courses	8
Compulsory or elective courses	16
Total	24
600 phys Thesis	6

Program Courses and Schedules for Five Specialized tracks of the M. Sc Degree:

A- Core Courses: (8 credit hours) required by all tracks:

First Semester

Course Code	Course Title	Credit Hours
Phys 504	Mathematical Physics	3(3+0)
Phys 505	Modeling & Physical Analysis	2(1+1)
Phys 553	Quantum Mechanics	3(3+0)
	Total	**8(7+1)**

B- All students from all tracks have to take thesis in Fourth Semester and after**:**

Course Code	Course Title	Credit Hours
Phys 600	Thesis	6

C- Compulsory or elective Courses (16 credit hours) based on track:

1- Solar Energy:

Second Semester

Course	Course Title	Hours
Phys 560	Physics and Technology of Semiconductors	3(2+1)
Phys 566	Crystallography and X-ray Applications	3(2+1)
Phys 574	Materials Science	3(3+0)
	Total	**9(7+2)**

Third Semester

Course	Course Title	Hours
Phys 564	Renewable Energy	2(2+0)
Phys 565	Vacuum and Thin Film Technology	3(2+1)
Phys 567	Solar Cells	2(2+0)
	Total	**7(6+1)**

2- Nuclear Physics:

Second Semester

Course	Course Title	Hours
Phys 540	Statistical Mechanics	2(2+0)
Phys 580	Nuclear Structure	3(3+0)
Phys 583	Radiation Measurements	3(2+1)
	Total	**8(7+1)**

Third Semester

Course	Course Title	Hours
Phys 585	Nuclear Reactors Physics	3(3+0)
Phys 587	Health Physics	3(3+0)
Phys 588	Experimental Nuclear Physics Laboratory	2(0+2)
	Total	**8(6+2)**

3- Theoretical Physics:

Second Semester

Course	Course Title	Hours
Phys 507	Elementary Particles Physics (1)	2(2+0)
Phys 540	Statistical Mechanics	2(2+0)
Phys 554	Advanced Quantum Mechanics	2(2+0)
Phys 555	Quantum Field Theory (1)	2(2+0)
	Total	**8(8+0)**

Third Semester

Course	Course Title	Hours
Phys 511	Classical Mechanics	2(2+0)
Phys 530	Electromagnetic Theory	2(2+0)
Phys 5***	Two Optional Courses***	2(2+0) 2(2+0)
	Total	**8(8+0)**

*** The student must select two optional courses (4 units) from the followings:

Phys 514 Relativity Theory 2(2+0)
Phys 515 Cosmology 2(2+0)
Phys 556 Quantum Field Theory (2) 2(2+0)
Phys 508 Elementary Particles Physics (2) 2(2+0)
Phys 558 Applications of Quantum Field Theory in Solids (1) 2(2+0)
Phys 559 Applications of Quantum Field Theory in Solids (2) 2 (2+0)

4- Laser Physics:

Second Semester

Course	Course Title	Hours
Phys 531	Laser Physics	3(3+0)
Phys 532	Quantum Optics Laboratory	2(2+0)
Phys 533	Advanced Optics	2(2+0)
Phys 536	Applied Electromagnetism	2(2+0)
	Total	**9(7+2)**

Third Semester

Course	Course Title	Hours
Phys 537	Laser Applications	2(2+0)
Phys 538	Optical Detectors	2(2+0)
Phys 539	Laser Spectroscopy	3(3+0)
	Total	**7(7+0)**

5- Materials Physics:

Second Semester

Course	Course Title	Hours
Phys 540	Statistical Mechanics	2(2+0)
Phys 566	Crystallography and X-Ray Applications	3(2+1)
Phys 574	Materials Science	3(3+0)
	Total	**8(7+1)**

Third Semester

Course	Course Title	Hours
Phys 570	Theory of Solids	3(3+0)
Phys 576	Theory of Magnetism	2(2+0)
Phys 5***	Optional Course***	3(3+0)
	Total	**8(8+0)**

***The student must select one optional course only (3 credit hrs) from the followings:

Phys 560 Physics and Technology of Semiconductors 3(2+1)
Phys 571 Electron Spin Resonance 3(3+0)
Phys 577 Special Topics 3(3+0)

C- Ph.D. Degree

Degree Title: Doctorate of Philosophy in Physics

Program Objectives

1. To meet the increasing demand from students in the Kingdom and neighboring states who seek a graduate degree in physics.
2. To facilitate the exchange of experience between Saudi and foreign students.
3. To provide candidates with the training and experience required to develop and communicate original scholarly contributions in this field of science.
4. To encourage research activities in the Department and induce more collaboration with other researchers in physics worldwide.

Admission Requirements:

1. The admission requirements as detailed in the Unified Regulatory Articles organizing the Graduate Studies at Saudi universities.
2. The applicant must have a Master's Degree in Physics or an equivalent degree.
3. The applicant must obtain at least 500 score in the TOEFL test or its equivalents (IBT 61, IELTS 5, STEP 84.5). This condition may be waived for students whose native language is English, or for those who obtained their M.Sc. degree from English speaking countries.
4. The applicant must obtain a score of at least 600 in the GRE test (Physics), or pass the Department's Admission Test.
5. Competitive applicants will be subjected to interviews by a Departmental committee.

Tracks and Specializations:

There are no tracks in this Program. However, There are subsidiary specializations in the areas mentioned in the M.Sc. Program.

Degree Requirements:

A. A successful completion of Quantum Mechanics II "Phys 652" (3 credit hours).
B. A successful completion of 15 credit hours of graduate courses selected from the pool of courses offered by the Department in accordance with the direction of the student's advisor or the Committee of Higher Studies.
C. A successful completion and defense of the Dissertation.

Ph.D. Dissertation:

The student must follow the regulations governing dissertation writing according the Graduate College rules. The Physics & Astronomy Department follows these regulations and rules. The student's advisor, however, may permit some changes as long as they are still within these rules.

Summary of the credit hours of the Ph.D. program:

Courses	Type of Courses	Hours
PHYS 652	Core Course	3
PHYS 6xx	Total of 15 credit hours regardless of number of courses taken from List 2 below	15
PHYS 700	Dissertation	-
Total		18

Courses of the Ph.D. program in Physics

1. Core Courses (List 1):

1	PHYS 652	Quantum Mechanics II	3 (3+0)

2. Elective Courses (List 2):

Course	Course Title	Credits
PHYS 603	Diff. Geometry and Quantum Field Theory	3 (3+0)
PHYS 604	Lie Groups and Algebras	3 (3+0)
PHYS 617	Cosmology and Particle Physics	3 (3+0)
PHYS 631	Nonlinear Optics	3 (3+0)
PHYS 632	Ultra Fast Phenomena	3 (3+0)
PHYS 633	Laser - Matter Interaction	3 (2+1)
PHYS 634	Photonics	3 (3+0)
PHYS 635	Applications of Lasers	3 (3+0)
PHYS 636	Quantum Optics	3 (2+1)
PHYS 637	Optical Instrumentation	3 (2+1)
PHYS 641	Vacuum and Thin film Technology	3 (2+1)
PHYS 642	Applied Renewable Energy & Env. Physics	3 (3+0)
PHYS 643	Solar & Environment Materials Technology	3 (2+1)
PHYS 644	Phot. Processes in Semiconductors	3 (2+1)
PHYS 645	Characterization Techniques of Materials	3 (2+1)
PHYS 653	Quantum Electrodynamics	3 (3+0)
PHYS 657	Advanced Quantum Field Theory	3 (3+0)
PHYS 658	The Electroweak Model	3 (3+0)
PHYS 663	Advanced Particles Physics.	3 (3+0)
PHYS 664	Quantum Chromodynamics	3 (3+0)
PHYS 665	Grand Unification	3 (3+0)

PHYS 666	Supersymmetry.	3 (3+0)
PHYS 667	String Theory	3 (3+0)
PHYS 668	Supergravity	3 (3+0)
PHYS 669	Selected Topics in Current Research	3 (3+0)
PHYS 671	Physics of Low-Dimensional Structure	3 (3+0)
PHYS 672	Advanced Solid State Physics	3 (3+0)
PHYS 674	Band Theory and Elec. Properties of Solids	3 (3+0)
PHYS 675	Magnetism in Materials	3 (2+0)
PHYS 677	Computational Physics	3 (2+1)
PHYS 678	Optical Properties of solids	3 (2+1)
PHYS 680	Advanced Nuclear Structure	3 (3+0)
PHYS 683	Radioecology	3 (3+0)
PHYS 685	Neutron scattering	3 (3+0)
PHYS 686	Nuclear and Particle Track Detectors	3 (3+0)
PHYS 687	Nuclear Spectroscopy	3 (3+0)
PHYS 691	Biophysical Techniques	3 (3+0)
PHYS 692	Radiotherapy	3 (3+0)
PHYS 693	Medical Imaging Techniques	3 (3+0)
PHYS 694	Magnetic Resonance Imaging	3 (3+0)
PHYS 695	Biomagnetism	3 (3+0)
PHYS 696	Free Radicals in Biological Systems	3 (3+0)
PHYS 697	Environmental Radiation Biophysics	3 (3+0)

Details of the courses of the Ph.D. Program in Physics can be obtained from the Department or from website

Ph.D. Course Distribution over 3 semesters

Students of Ph.D. Program in Physics can register and select their specialty based on the following course distribution:

Key for Tables:

All Students	All
Theoretical Physics	T.P.
Nuclear Physics	N.P.
Biophysics/medical	B.P.
Laser Physics	L.P.
Renewable Energy & Environmental Physics	R.E.
Solid State Physics	S.S.

During or Prior to registration; students should contact the Graduate Studies Committee (GSC) organizer, or Graduate Program Director (GPD). Or contact one of the Research Group leader as shown in this List.

First Semester (First Year): All students must register Phys 652 + one other course from the table below. This course also specifies your area of interest for the rest of program. Hence, you should contact your advisor of other program organizers before you register.

Course	Description Course	Credits	Track
Phys 652	Quantum Mechanics II	3 (3+0)	All
Phys 653	Quantum Electrodynamics	3 (3+0)	T.P.
Phys 680	Advanced Nuclear Structure	3 (3+0)	N.P.
Phys 691	Biophysical Techniques	3 (3+0)	B.P.
Phys 633	Laser - Matter Interaction	3 (3+0)	L.P.
Phys 641	Vac. and Thin film Technology	3 (3+0)	R.E. **
Phys 672	Advanced Solid State Physics	3 (3+0)	S.S. ++

** Solid State students can also take this course as an elective instead of the elective course shown in the last table below (3rd semester).

Also they can take it in replacement of Phys 672 but only with approval of their advisor or GSC organizer or GPD. This will not affect their area of specialty.

++ Students of Renewable Energy and Env. Phys. can also take this course as an elective instead of the elective course listed in the last table (3rd semester) but only with the approval of their advisor or GSC organizer or GPD.

Second Semester (First Year):

Student is expected to register for 2 courses from next table based on their specialty:

Course	Course Description	Credits	Track
Phys 652	Quantum Mechanics II	3 (3+0)	All
Phys 657	Advanced Quantum Field Theory	3 (3+0)	T.P.
Phys 658	The Electroweak Model	3 (3+0)	T.P.
Phys 685	Neutron scattering	3 (3+0)	N.P.
Phys 687	Nuclear Spectroscopy	3 (3+0)	N.P.
Phys 695	Biomagnetism	3 (3+0)	B.P.
Phys 693	Medical Imaging Techniques	3 (3+0)	B.P.
Phys 631	Nonlinear Optics	3 (3+0)	L.P.
Phys 634	Photonics	3 (3+0)	L.P.
Phys 643	Solar & Env. Materials Technology	3 (3+0)	R.E.
Phys 644	Phot. Processes in Semiconductors	3 (3+0)	R.E.
Phys 674	Band Theory and Elec. Prop. of Solids	3 (3+0)	S.S.
Phys 675	Magnetism in Materials	3 (3+0)	S.S.

First Semester (2nd Year):

One course is required from next table:

Course	Course Description	Credits	Track
Phys 652	Quantum Mechanics II	3 (3+0)	All
Phys 663	Advanced Particles Physics.	3 (3+0)	T.P.
Phys 686	Nuclear and Particle Track Detectors	3 (3+0)	N.P.
Phys 692	Radiotherapy	3 (3+0)	B.P.
Phys 637	Optical Instrumentation	3 (3+0)	L.P.
Phys 645	Charact. Techniques of Materials	3 (3+0)	R.E.
Phys 671	Physics of Low-Dimensional Structure	3 (3+0)	S.S. **

** Renewable Energy and Env. Phys. and Laser Physics students can also take this course instead of any of the elective courses shown in the next table. But approval of their advisor is requested for registration.

Elective Courses: Every student must register for one of the elective course in the next table during 3rd semester (First semester of 2nd year). Selecting the course is based on his/her specialty that has been assigned from the first semester. Please make sure to select the right course.

Course	Course Title	Credits
PHYS 603	Diff. Geometry and Quantum Field Theory	3 (3+0)
PHYS 604	Lie Groups and Algebras	3 (3+0)
PHYS 617	Cosmology and Particle Physics	3 (3+0)
PHYS 632	Ultra Fast Phenomena	3 (3+0)
PHYS 664	Quantum Chromodynamics	3 (3+0)
PHYS 665	Grand Unification	3 (3+0)
PHYS 666	Supersymmetry	3 (3+0)
PHYS 667	String Theory	3 (3+0)
PHYS 668	Supergravity	3 (3+0)
PHYS 635	Applications of Lasers	3 (3+0)
PHYS 636	Quantum Optics	3 (2+1)
PHYS 642	Applied Renewable Energy & Env. Physics	3 (3+0)
PHYS 669	Selected Topics in Current Research	3 (3+0)
PHYS 677	Computational Physics	3 (2+1)
PHYS 678	Optical Properties of solids	3 (2+1)
PHYS 683	Radioecology	3 (3+0)
PHYS 694	Magnetic Resonance Imaging	3 (2+1)
PHYS 695	Biomagnetism	3 (3+0)
PHYS 696	Free Radicals in Biological Systems	3 (3+0)
PHYS 697	Environmental Radiation Biophysics	3 (2+1)

Please note:

If you miss one course other than Phys 652, you will have to wait for next year to take it. Last table is an open pool of courses. Accordingly; student may register any course as long as it fits in his specialty. Student shall contact his advisor or Program organizer for help.

Examples:

Theoretical Physics:

First Semester: Phys 652 + Phys 653
Second Semester: Phys 657 + Phys 658
Third Semester: Phys 663
+ PHYS 603 OR PHYS 604 OR PHYS 617OR PHYS 664 OR PHYS 665 OR PHYS 666 OR PHYS 667 OR PHYS 668 OR PHYS 669

Solid State Physics:

First Semester: Phys 672 + Phys 652 (OR Phys 641 Advisor approval required)
Second Semester: Phys 675 + Phys 674
Third Semester: Phys 671
+ PHYS 641 OR PHYS 669 OR PHYS 677 OR PHYS 678

Note:

All students can take Phys 669 as an elective course with the approval of advisor.

All Courses Description

B.Sc. Courses

PHYS 101 General Physics (I) For None Physics Specialists 4(3+1+0)
Reflection and refraction of light, lenses, optical instruments, wave theory of height, interference, diffraction and polarization of light. Electrostatics, electric current and DC circuits, electromagnetism and AC circuits, electrical instruments. Introduction to quantum theory, atomic spectra, X-rays, properties of nuclei, radioactivity.

PHYS 102 General Physics (II) For None Physics Specialists 4(3+1+0)
Vectors, Motion in straight line, Newton's Laws of motion, work, energy and momentum, simple harmonic motion, elasticity, mechanics of non-viscous fluids, flow of viscous fluids, surface tension, temperature, quantity of heat, work and heat.

PHYS 103 General phys. For Engineering and Computer Science 4(3+1+0)
1. Introduction (Vectors)
2. Motion in one dimension with constant acceleration
3. Motion in two dimension with application to projectile motion and circular motion
4. Newton's Laws of Motion
5. Work and Energy
6. Potential Energy and conservation of Energy
7. Linear Momentum and Collisions
8. Rotation of rigid object about a fix axis

PHYS 104 General Physics (II) for Engineering 4(3+1+0)
Electricity and Magnetism: Coulomb's law, electric fields, Gauss' Law, electric potential, potential energy, capacitance and dielectric, currents and resistance, electrical energy and power, direct current circuits, Kirchhoff's rules, magnetic fields, motion of charged particle in a magnetic field, sources of the magnetic field, Ampere's law, Faraday's law of induction, self inductance, energy in a magnetic field, mutual inductance, alternating current circuits, the RLC series circuit, power in an A.C. circuit, resonance in RLC services circuit.

PHYS 105 General Physics for Architecture Engineering Students 3(2+1+0)
1. Mechanics : Scalars and vectors, speed, velocity and acceleration, free fall, motion in a vertical plane, Newton's laws of motion.
2. Properties of matter : Density, elasticity, Young's modulus, shear and bulk modulli, Fluid pressure, fluid flow.
3. Wave motion and sound : Waves, resonance, sound, interference of waves, sound intensity.
4. Light: Reflection, refraction, elimination, image formation, the lens equation, magnification, the telescope, spherical mirrors.
5. Heat: Temperature, Thermal Expansion, Boyles and Charles Laws, Ideal gas law, Internal energy and heat, Specific heat capacity, Heat Conduction, Convection and radiation.
6. Electricity: Couloumbs' Law, electric field, potential difference, electric current, Ohm's law, determining wire size, electric power, resistors in series and parallel, ammeters, voltmeters and ohmmeters, A.C. circuits.

PHYS 145 Physics for Health Science Students 3(2+1+0)
Specific Course Objectives: This course is designed for students in Health Science to enable them to appreciate the basic concepts of physics which are relevant to their further studies.
1. Mechanics:
a) Basic Principles of Mechanics : Units & dimensions, vector analysis, velocity & acceleration, forces, Newton's law of motion, gravity, work, energy, power.
b) Properties of Fluids (liquids): Density & Specific gravity, pressure, flow of ideal liquid, viscosity, diffusion, surface-tension, simple medical applications.
2. Basic Electricity and Magnetism : Coulomb's law, electric field, electric potential, capacitance, steady electric currents, Ohm's law, magnetic field, generators and transformers, motors, galvanometers, mass spectrometer,

cyclotron.
3. Optics (6 hours):
a) Ray-Optics: Nature of light, reflection and refraction of light, lenses, human eye, simple optical instruments, simple medical applications. (e.g. vision defects, colour vision … etc.).
b) Wave Optics : Huygen's principle, interference and diffraction of light, medical applications, (e.g. Medical imaging, the laser and its applications).
4. Modern Physics (Atomic & Nuclear Physics) : Electromagnetic spectrum, photon, wave properties of matter, atomic structure, Bohr atom and atomic spectra, X-rays, Nuclear radiation, interaction of radiation with matter, nuclear hazards, medical applications (e.g. Radiations therapy, diagnostic use of radioisotopes, etc.).

Phys 110 General Physics I 4(3+1+0)
Units and dimensions, Introduction to vectors, Motion in straight line, Newton's Laws of motion, work, energy and momentum, simple harmonic motion, elasticity, mechanics of non-viscous fluids, flow of viscous fluids, surface tension, temperature, quantity of heat, work and heat.

Phys 111 General Physics II
- Vectors and forces analysis, Electric forces, field and potential. motion of charged particle in electric field, Capacitance, Energy of charged capacitor, Direct current (DC), Ohm's law, Resistance and temperature, energy and power, Kirchhoff's rules, Current in charged Capacitor.
- Reflection and refraction of light: reflection and refraction laws, refraction by plane-parallel plate, Prism, total internal reflection and the critical angle.
-Introduction to quantum theory, Black Body radiation, Photoelectric effect, X-Rays, Nuclear Decay, Decay Law, Nuclear reactions, Radioactivity

Math 111 Integral Calculus 4(3+0+1)
Definition of Definite Integral and its Properties, The Anti-derivative, Indefinite Integral and the Fundamental Theorem of Calculus. Change of Variables. Integrals of natural and general exponential functions. Integrals of natural and general Logarithmic functions. Derivatives and Integrals of Hyperbolic and Inverse-Hyperbolic functions. Techniques of Integration: by parts, Trigonometric substitutions, Completing the square, Integrals of rational functions, Miscellaneous Substitutions. Indeterminate forms, Improper Integrals. Applications of Integration: Area, Solids of Revolutions, Arc length and Surface of Revolution, Linear Motion, Work, Momentum and Center of Mass. Numerical Integration. Polar coordinates, relation between polar and Cartesian coordinates, Graphs of polar curves, Area in polar coordinates. Parametric Equations.

Phys 201 Mathematical Physics I 3(2+0+1)
- System of Linear Equations: Methods of solving Systems of Linear equations (Elimination methods, Gauss- Jordan …).
- Matrices: (Definitions, Operations on Matrices, Transpose Matrix, the trace…). The inverse, Elementary row operation method, the determinant, Cramer's rule.
- Vector spaces: Two and Three dimensional vector spaces, Distance in two and Three dimensional spaces. Norms, Dot product, projection, cross product, N-dimensional (linear) spaces: Euclidean spaces, Inner product spaces, Linear Transformations, Eigen values and Eigenvectors problems

Math 209 Differential Equations 4(3+0+1)
- Sequences limit, infinite series, geometric series, tests for convergence (integral, comparison and ratio tests…etc) alternating series, absolute convergence.
-Series of functions: Pointwise convergence, Taylor and Maclaurin Series. Fourier series, Fourier integral.
-Differential Equations: First Order Differential equations, definitions. Separable Equations. Linear Equations, Method of integrating Factor. Homogenous First Order Equations. Bernoulli Equations, Modeling Physical Problems with differential equations.

Phys 210 Classical Mechanics I 4(3+0+1)
2D and 3D motion, projectiles, Systems of Particles: Center of Mass, Motion of the center of mass, Linear Momentum of a Particle, Linear Momentum of a System of particles, Conservation of Linear Momentum, the rocket. Collisions: What is a Collision, Impulse and Momentum, Conservation of Momentum During Collisions, Collisions in one Dimension, Two Dimensions Collisions, Center of Mass Reference Frame. Rotation: Rotational Motion, The Rotational Variables, Rotation with Constant Angular Acceleration, Rotation Quantities as Vectors, Relationships between Linear and Angular Variables: Scalar Form, Relationships between Linear and Angular Variables: Vector Form, Torque, Work. Rolling, Torque and Angular Momentum: Rolling Motion, Kinetic Energy, Torque, Angular Momentum of Rotating rigid Bodies, Conservation of Angular Momentum, Conservation of Angular Momentum, The processing Top.

Equilibrium and Elasticity: Equilibrium, Requirements for Equilibrium, Equilibrium and the Force of Gravity, Stacking block. Gravity: The Gravitational Force, The gravitational constant G, Free fall acceleration, Gravitational Potential Energy, Motion of planets, The law of Area, Orbits and Energy, Special theory of Relativity.

Phys 222 Electromagnetism 4(3+0+1)
Gauss law and its applications, Electric Potential, Potential gradient and applications, Capacitors and Dielectrics, Dielectrics and Gauss theory, Electric displacement, polarization, Susceptibility, Dielectric Strength. The magnetic field of conductors, Ampere's law and its applications. Motion of charged particle in magnetic field and its applications. Electromagnetic induction, Induced electromotive force, Faraday's law& Lenz's law, Self and mutual Induction, Current in inductive circuit. Vector operations; Electric and magnetic fields in materials; magnetic potential vector, Electrostatic and magnetic energy; Maxwell's equations in differential forms ; Electromagnetic waves , propagation and radiation. Ac Circuit, Series and Parallel connection, Resonance AC Circuit, Complex Numbers in AC Circuit.

Phys 234 Vibrations and Waves 4(3+0+1)
Periodic motion. Free Vibrations, mathematical and Fourier analysis. Super position of periodic motion. Sound, plasma, molecular and electrical circuit oscillations analysis. Damped vibrations, heavy light and critical damping. Forced Vibrations. Superposition. Transients. Resonance circuits. Waves: travelling , standing, dispersive and nondispersive. Fourier Theory.

Phys 301 Mathematical Physics 2 3(2+0+1)
Comprehensive introduction to the physics of the charged particle beams and modern particle accelerators. Basic components of accelerator. Various types of accelerators including electrostatic accelerators, induction linear accelerators, linear radio-frequency (RF) accelerators, and various circular accelerators such cyclotrons, synchrotrons, charged particle in electromagnetic fields, beam acceleration and phase stability. Applications of accelerators.

Phys 312 Classical Mechanics II 3(3+0+0)
Normal coordinates, some methods in the calculus of variations, Hamilton's and Lagrangian's principles. Lagrangian's and Hamiltonian's dynamics, central force motion, dynamics of a system of particles, dynamics of rigid bodies, motion in a non-inertial reference frame, coupled oscillations, wave equation

Phys 325 Electronics 3(2+1+0)
Semiconductors, semiconductor doping, the p-n junction properties and applications, the diode, the bipolar transistor, signal amplification, the field effect transistor, Circuit symbols and components, Semiconductor devices, Amplifier operation, feedback. Lock-in operational amplifiers and applications, modulation and detection, integrated circuits. A brief introduction to digital electronics and analog to digital (A/D) conversion.

Phys 331 Optics 3(3+0+0)
-Waves theory of light: wave equation, sinusoidal waves, phase velocity, complex representation, and plane waves. Superposition of waves: superposition principle, superposition of waves of the same frequency, standing waves, phase and group velocities, energy and power, random and coherent Sources. Interference: two-beam interference, Young's double-slit experiment, double-slit interference with virtual sources, interference in dielectric films, Newton's Rings. Optical Interferometers: Michelson, and Fabry-Perot interferometer. Polarization: Linear, circular, and elliptical polarization, production of polarized light, double refraction (birefringence), optical activity, and photo elasticity. Diffraction of light: types of diffraction, Fraunhofer diffraction by single slit, by double slit, and by many slits, rectangular and circular apertures, beam spreading, and resolution. Diffraction grating, grating equation, dispersion, types of grating and grating instruments.

Phys 343 Thermal and Statistical Physics 4(3+0+1)
General definitions and basic concepts of thermal Physics, Introduction in thermal units, heat capacity, enthalpy and entropy , Kinetics theory of gases , First law of thermodynamics, (isochoric and isobaric processes, internal energy function, thermal work, reversible and irreversible thermal processes in ideal and real gases, Carnot cycle and thermodynamic performance), Second law of thermodynamics (Entropy function and its various applications in thermal systems), Third law of thermodynamics (Free energy and thermodynamic equations), The thermodynamic functions U,H , F and G ; the Maxwell relations. -The thermal equilibrium distribution, the Boltzmann distribution, constructing the partition function and using it to obtain thermodynamic quantities of interest, Quantum statistics; the Fermi – Dirac, Bose –Einstein and Maxwell-Boltzmann distributions. Computing in thermal physics (Solving problems and graphics using standard programs).

Phys 352 Modern Physics 4(3+0+1)
Postulates of quantum mechanics; wave particle duality, probability, and the Schrödinger equation; one-dimensional Schrödinger equation; operator methods in quantum mechanics, eigenvalues, eigenfunctions; angular momentum; the Schrödinger equation in three-dimensions and the hydrogen atom; matrix representation of operators ; spin; the addition of angular momenta; time-independent perturbation theory.

Phys 371 Solid State Physics I 3 (3+0+0)
Definition of the Solid State and Crystal Growth, Crystalline Amorphous and Nano solids, Atomic Binding, Crystal Lattices and Structures, Miller indices Elastic Constants, Crystal Defects, Fourier Analysis of Periodic Structures, Reciprocal Lattice, X-ray Diffraction, Brillouin Zones, Lattice Vibrations and Phonons, Thermal properties of Solids, Einstein and Debye Models of Heat Capacity, Phonon Density of States, Planck Distribution. Free Electron (Fermi gas) model, Electron Density of States, Electrical, thermal and optical properties of the Electron Gas.

Phys 391 Thermal physics lab 2(0+2+0)
Specific Heat – longitudinal expansion – Joule's Law (The mechanical equivalent of heat) – Boyle's Law - Newton's law of cooling – Viscosity - Heat Engine - Carnot Engine - Heat Transfer- Determination of density and expansion of fluids.

Phys 394 Electromagnetism lab 2(0+2+0)
Milikan experiment, Resonance in RCL services circuits, Full wave rectification, Determination of magnetic field intensity using the search coil, Determination of the charge to mass ratio for the electron (e/m), Determination of dielectric constant using RCL resonance circuit. Transformers.

Phys 395 Waves Physics lab 2(0+2+0)
Young's double slit experiment, Diffraction grating, Newton's rings, (Abbe's) study of polarization of light, Lloyed's Mirror, Fresnel biprism experiment, Prism Spectrometer, Refractometer. Verification of the inverse square law for light radiation and determination of the absorption coefficient of light in glass using a photocell, determination of refractive index Meld's experiment. Determination of diffraction coefficient of liquids using Abbe's apparatus. Specific rotation measurements using polarometer.

Phys 396 Modern Physics lab. 3(0+3+0)
Fabry-Perot interferometer, Laser Diffraction in Ultrasonic phase grating. Electro-optic Kerr-Effect, Magneto-optic Faraday Effect. Measurement of Line Spectra using Spectrograph. Rydberg Constant measurement. Determination of Planck's constant, Michelson interferometer. Zeeman Effect. Franck-Hertz experiment. Study X-ray spectrum. Characteristics of Microwaves. Waveform analysis and synthesis.

Phys 400 Computational Physics 2(1+1+0)
1. Introduction: Computation and science, The emergence of modern computers, Computer algorithms and languages, Applications: Newton and Kepler Laws.
2. Numerical Linear Algebra: Systems of linear equations, Eigenvalues and eigenvectors.
3. Interpolation, Extrapolation and Data Fitting : Polynomial Interpolation, Data fitting, least squares fit.
4. Ordinary differential equations: Initial-value problems, The Euler and Picard methods, The Runge-Kutta method , Chaotic dynamics of a driven pendulum , Boundary-value and eigenvalue problems , The one-dimensional Schroedinger equation.
5. Numerical Integration: One-dimensional integral, Multi-dimensional integral, The Runge-Kutta method, Monte Carlo Method.

Phys 404 Mathematical Physics III 3(3+0+0)
1- Complex numbers: Algebra of Complex numbers, Point representation of complex numbers, Vector and Polar Forms, The complex Exponential, Powers and Roots.
2- Analytic Functions: Function of a Complex variable, Limits and continuity, Analyticity, Cauchy-Riemann Equations.
3- Elementary Functions: Polynomials and Rational Functions, Trigonometric and Hyperbolic
Functions, Logarithmic Function, Complex Powers and Inverse Trigonometric Functions.
4- Special Functions: The Gamma, Bessel Functions, Legendre Functions, Spherical Harmonics.
5- Hermite Functions , Laguerre Functions.

Phys 411 Astrophysics I 2(2+0+0)
Stars: magnitude – Luminosity – introduction to spectra – stellar spectra –

stellar parallax, stellar velocities- H-R diagram – binary stars and stellar masses – star formation – series of stellar nuclear reactions and stellar ages- stellar evolution and structure.

Phys 412 Astrophysics II 2(2+0+0)
Interstellar matter(ISM): distribution – structures- Physics of ISM – HI and HII regions – Inter stellar clouds – star formation – astrochemistry – Physics and chemistry of planetary nebulae – Interstellar matter in galaxies.

Phys 423 Semiconductors Physics 2(2+0+0)
Electronics and materials, Semiconductors brief, Diode & applications, Bipolar junction transistors, BJT amplifiers, Principles of integrated circuits, Field effect transistors and applications, Frequency response in electronic devices, Operational amplifier theory & applications, Power amplifiers, Power supply, voltage regulators, Digital-to analogue and analogue-to-digital converters.

Phys 435 Laser Physics 3(3+0+0)
Waves in dielectric media, Gaussian beams, waveguides, geometrical optics, fibre optics, Fourier optics. Photons and Atoms. Optical materials. Non-linear optical properties. Optical amplifiers. Laser development, semiconductors and nano structures (materials technology), ultra-fast phenomena, modern optics, and instrumentation (opto-electronic components).

Phys 444 Physics Teaching Skills 2(2+0+0)
This course is aimed to provide skills for Physics graduates that help them teach in a good way for the high schools Physics. Advance method in teaching, using e-learning, using computers and simulations, wring good home work problems, wring good exams, using visuals.

Phys 453 Quantum Mechanics I 4(3+0+1)
The real hydrogen atom; atomic and molecular structure; time dependent perturbation theory; the interaction of charged particles with electromagnetic field; radiative decays; radiation; scattering theory.

Phys 456 Atomic and Molecular Spectroscopy 2(2+0+0)
Spin –Orbit Interaction in H-atom , Pauli Exclusion Principle. Electron configuration in many electron atoms, Atoms with a valance electron , Atoms with two valance electrons ($\ell\ell$ coupling, ss coupling , LS coupling and jj coupling), Hund's Rule . The interaction of many-electron atoms with magnetic fields, Zeeman Effect, Pachen-Bach Effect, Stark Effect. Molecular Structure, Electronic, vibrational and rotational energy levels of a diatomic molecule. Spectroscopic techniques: Optical spectroscopy , IR spectroscopy, Raman spectroscopy, Magnetic Resonance , Excitation Sources, and data acquisition systems.

Phys 457 Laser laboratory 2(0+0+2)
Laser Safety, Coherence Length, Analysis of Gaussian Beam, Laser Cavity Design, Laser Modes Structure, Dye absorption and emission Spectra, Fourier Optics, Fiber Optics, Second Harmonic Generation, Fresnel Equations.

Phys 460 Biophysics 3(3+0+0)
Biomechanics. Forces affects on our bodies. Vector analysis. Levers and equilibrium of rigid bodies. Stress - Strain curve. Young's and Shear modulus for materials and biological tissues. Properties of fluids. Viscosity and surface tension. Bernoulli's equation and its applications. Effect of gravity and acceleration on the blood pressure. Nature of sound and sound intensity level. Ultrasound, production and its applications in diagnostic and treatment. Nervous System and electricity within the body. Equilibrium potential and Nernst equation. Factors affecting the propagation of action potential. Action potential measurements of some organs; ECG, EEG and ERG. Non-ionizing Radiation. Physical and biological effects.

Phys 462 Medical Physics 2(0+0+2)
- Introduction to Medical Physics, Electromagnetic Spectrum and Radiation, Basic Interactions of ionizing and non-Ionizing Radiation with biological matter.
-Radiological Imaging: Introduction to Imaging, Conventional X-ray imaging, Computed Tomography, Diagnostic Ultrasound.
-Radiation Therapy: Introduction to Radiotherapy Physics, Linear Accelerators, Introduction
to External Beam Treatment Planning, Brachytherapy, Machine calibration and quality assurance.
-Magnetic Resonance Imaging: Introduction, Basic NMR Physics, MR Imaging Principles, Applications.
- Nuclear Medicine: Introduction, Isotopes, PET scan

Phys 472 Solid State Physics II 2(2+0+0)
Fermi surfaces, Energy levels in one dimension, Energy bands, Energy gap

calculations, Electrical transport theory, Hall effect. Theory and applications of bands and carriers in semiconductors and devices. Magnetism in solids and superconductivity. Interaction of solids with radiations.

Phys 473 Materials Science 3(2+1+0)
States of matter (liquid, crystalline & vitreous); Crystal structure of metals; Metallography (reflecting optical microscope, transmission electron - microscope) specimen preparations; Mechanical testing (hardness & tensile test); Defects in crystals (point defects and dislocations); Diffusion in solids; (Phase transformation and Phase diagrams) Strengthening mechanisms (alloying, cold work, precipitation & fiber strengthening); Heat treatment of steel & TTT curves.

Phys 476 Introduction to Nanoscience and Nanotechnology 2(2+0+0)
Part A: Introduction to nanophysics and nanotechnology – scaling laws and limits to smallness; quantum nature of nanoworld; nano fabrication (top-down and bottom-up process); nanoscopy (electron microscopy, atomic force microscopy, scanning tunneling microscopy).
Part B: Properties and application of dielectric and metal nanostructures - individual nanoparticles and nanoclusters; nanostructured materials; carbon nanostructures; nano spin and nanomagnets.
Part C: Properties and application of semiconductor nanostructures - fabrication of semiconductor nanowires and quantum dots; electronic and optical properties (2D and 3D quantum confinement); optical spectroscopy of semiconductor nanostructures (local probe techniques); quantum dots nanowire- and quantum-dot-based electronic and photonic devices.

Phys 477 Energy & Environment Physics 3(3+0+0)
Energy fundamentals, Fossil fuels, Renewable energy Part-I: Solar radiation and solar energy (thermal, photovoltaics and electrochemicals), Renewable energy Part-II: Alternatives (hydropower, wind power, ocean thermal energy conversion, biomass, geothermal energy, tidal & wave energy), Energy conservation & storage, Energy and transportation, air pollution and environment.

Phys 480 Elementary Particle Physics 2(2+0+0)
-Elementary particles: properties , classifications and detections.
-Fundamental forces between elementary particles.
-Symmetries and their role in studying elementary particle Physics.
-Strong force - Electromagnetic force - Weak force
-Relativistic quantum mechanics - Feynman diagram.

Phys 481 Nuclear Physics I 3(3+0+0)
- Properties of the nucleus: Isotopes, nuclear binding energy, angular momentum, nuclear
electromagnetic moments, nuclear forces.
- Radioactivity: Decay law (τ, t1/2), natural radioactivity, successive decay, artificial radioactivity basic α – decay process, β-decays and γ-transitions.
- Nuclear reactions: Q-value, threshold energy (Eth), Internal Conversion, Decay Schemes.
- Interaction of radiation with matter: Interaction of heavy (α, p, d) and light (e^-, e+), charged particles with matter, stopping power, interaction of gamma radiation with matter
(Photoelectric, Compton and pair production).
-Binding energy and the liquid drop model.

Phys 483 Nuclear Physics II 2(2+0+0)
-The deuteron properties.
-Nuclear models: nuclear shell model, Collective model, nuclear decay schemes.
-Nuclear reactions and decay modes: nuclear scattering, compound nucleus.
-Introductory to elementary particle Physics.

Phys 485 Accelerator Physics 2(2+0+0)
Comprehensive introduction to the Physics of the charged particle beams and modern particle accelerators. Basic components of accelerator. Various types of accelerators including electrostatic accelerators, induction linear accelerators, linear radio-frequency (RF) accelerators, and various circular accelerators such cyclotrons, synchrotrons, charged particle in electromagnetic fields, beam acceleration and phase stability. Applications of accelerators.

Phys 486 Radiation Physics 2(2+0+0)
Definition of radiation quantities ,doses and their units, instruments for measuring personal doses, radiation monitoring and radioactive contamination, biological effects of radiation, external and internal radiation exposure, radiation protection and shielding, recommendations of IAEC, protection against different radiation sources, decontamination, radioactive waste management.

Phys 488 Nuclear Reactor Physics 2(2+0+0)
- Neutron reactions: cross-sections, attenuation, reaction rate, fission cross-section.
- Nuclear fission, fission yield, Energy distribution among fission neutrons and fragments,
regeneration factor.
-Thermal neutrons: energy distribution, effective cross section, moderation, average energy loss, Average energy logarithmic decrement, SDP, MR and resonance escape probability.
-The Nuclear chain reaction: neutron cycle, thermal utilization factor and calculating the four
factors formula.

Phys 491 Solid State lab 2(0+2+0)
Experiments will be performed by the students:

X-Ray diffraction, Dielectric constant, Hall effect, Magnetic Succipility, Magnetic Resonance, Solar Cells, Energy gap for semiconductors, Noble metal resistance, Electron diffraction, Photoelectric effect. Optical absorption of solids and solids with defects and nano inclusions.

Phys 492 Nuclear Physics Lab 2(0+2+0)
Experiments will be performed by the students:

Geiger Counter, Absorption of nuclear radiation, Counting statistics, Gamma ray Spectroscopy using NaI (Tl) and SCA, Gamma ray Spectroscopy using NaI (Tl) and MCA, β-Ray Spectrum using Magnetic Spectrometer, β-Ray Spectrum using MCA,
Neutron Diffusion, Study of alpha particle Spectra, Compton Scattering.

Phys 499 Graduation project 3(0+3+0)
This course aim is to guide the student to perform scientific project in selected areas of theoretical or experimental Physics and to train him/her to write a scientific report using the necessary references.

Courses Description in M. Sc Physics

Phys 560 Physics and Technology of Semiconductors 3(2+1)
Semiconductor materials, Energy bands and carrier concentration, Carrier transport phenomena, p-n junctions, Metal-semiconductor junctions (unipolar devices), Diffusion and ion implantation, Photonic devices (Optical absorption, Luminescence and Carrier lifetime and photoconductivity) and other Optional Topics: Photolithography, Etching, Bulk crystal growth, Thermal oxidation, Epitaxial growth, Metallization, MIS devices, LED's, Semiconductor lasers and Microwave devices.

Phys 564 Renewable Energy 2(2+0)
Energy concepts, Energy resources & assessment, Conventional energies (Oil, Gas, Coal, Nuclear), New and renewable energies (Geothermal, Hydro, Solar-thermal, Solar-photovoltaic, Wind, Tidal-Wave, Biological, Hydrogen& Fuel cells), Energy storage and conservation, Environment and Energy future.

Phys 565 Vacuum and Thin Films Technology 3(2+1)
Vacuum principles: gas kinetics and flow, pumping speed theory, pumping methods, pressure measurements, sorption processes and vacuum system design basics. Thin film growth by sputtering, evaporation, and chemical techniques, molecular beam epitaxy and laser ablution methods. Thickness measurements and monitoring: electrical, mechanical, optical interference, microbalance and quartz crystal methods. Characterization and classification: optical, electrical, mechanical and magnetic properties of films.

Phys 566 Crystallography and X-Ray Applications 3(2+1)
Properties of X-rays, Diffractometer measurements, Geometry of crystals, Diffraction, Laue photographs, Powder photographs, Orientation and quality of single crystals, Structure of polycrystalline aggregates, Determination of crystal structure, Precise parameter measurements, the reciprocal lattice, Neutron and electron diffraction.

Phys 567 Solar Cells 2(2+0)
Photovoltaic energy theory, Photovoltaic materials, Crystalline & polycrystalline silicon solar cells, Amorphous silicon cells, Gallium arsenide & other III-V materials, Cadmium telluride & other II-VI materials, Copper indium diselenide and I-III-VI2 materials, New solar cells, Nanotubes, Photovoltaic systems and PV Applications.

Phys 580 Nuclear Structure 3(3+0)
Alpha Decay: Refresher on alpha, theory of barrier penetration, role of angular momentum,
Beta Decay: Role of neutrino, Fermi theory, shape of energy spectrum, Decay rate, selection rules, electron capture, mass of neutrino, double Beta decay, parity non-conservation.
Gamma decay in nuclei: Excited states in nuclei, gamma decay, decay rates, selection rules, spectroscopic information from gamma decays, internal conversion, isomers, resonance absorption, Mossbauer effect.
Nuclear moments: Multi-pole expansion of nuclear charge and current density, magnetic dipole moment, electric quadrupole moment, hyperfine structure, nuclear magnetic resonance.
Nuclear forces: Introduction to nuclear force, the deuteron, nucleon scattering, properties of nuclear force, exchange model.
Nuclear models: Review of single particle shell model, Particle-hole configuration, Magnetic dipole moments, Electric quadrupole moments, Collective properties, Rotation, Vibrations, Single particle states in deformed nuclei, Multi-particle configurations, Back pending, and Super deformation.

Phys 583 Radiation Measurements 3(2+1) Radiation measurements: counting rates, error reduction, stopping power and range for particles ($Z \leq 2$ and $A \leq 4$) and electrons and positrons.
Nuclear Detectors: Gas scintillators and semi conductor detectors (working principle, applications, advantages and disadvantages).
Source-detector geometry effects on measurements: point and disk type sources, detectors with circular aperture, count rates and source strength.
Energy spectra: resolution and factors affecting resolution, Ge (Li) and HPG detectors, silicon detectors and electron spectroscopy.

Phys 585 Nuclear Reactors Physics 3(3+0)
Neutron Physics: Properties of neutrons, Neutron sources, microscopic and macroscopic cross-sections, elastic and inelastic scattering, absorption and Fission reactions, BF3 detectors, Mechanism of energy loss by scattering collisions, Scattering law, Neutron lethargy and average logarithmic decrement, Moderating ratio, Slowing down equation for homogenous mixture , Neutron current density.
Nuclear Fission by thermal neutron in homogenous reactors: Scattering Cross Section, Energy release from fission, Neutron yield, Energy distribution among fission neutrons and fragments. Reproduction constant, neutron balance, Resonance Escape Probability, Reactor Criticality, Neutron cycle and the multiplication factor.
Neutron diffusion: Diffusion equation and its solutions, Measurement of diffusion length, Albedo concept, Application to infinite slab reactor and a point source in a neutron moderator.
The Critical equation in steady homogenous reactors: Diffusion equation applied to thermal for infinite and finite reactors, Fast neutron diffusion and Fermi age equation, Effective Multiplication for finite reactors, Critical equation and Reactor Buckling, Critical size and Geometrical Buckling (Cube and Semi-Cubic shape, sphere, cylinder), Critical volume and critical fuel mass calculations.
Heterogeneous Reactors: Effect of fuel distribution on the parameters of the multiplication factor, Non-steady nuclear reactors.

Phys 587 Health Physics 3(3+0)
Radiation Dosimetry: Units, Absorbed dose, Exposure, Free air chamber, Air wall chamber, Bragg-Gray principle, Kerma, Dose from surface and skin contamination.
Radiation Effects: Acute effects, Delayed effects, Genetic effects, Risk coefficient estimates, Quality factor and Radiation weighting factor.
Basic Radiation Safety: Occupational exposure, Medical exposure, Effective dose equivalent, Annual limit of intake, , Derived air concentration .
Dose-Measuring Instruments: Personal monitoring, Pocket dosimeters, Film badges, Thermoluminescent dosimeters , Electronic dosimeters , Ion current chambers , Neutron dosimetry ,Calibration measurements with gamma sources.
External Radiation Measurement: Time, Distance, Shielding.
Internal Radiation Protection: Control of the source, Environmental control, Control of the worker, Surface contamination limits.

Phys 588 Nuclear Lab. Experiments 2(0+2)
Nuclear Spectroscopy Experiments: Gamma Spectroscopy, Internal conversion, Coincidences.
Radiation experiments: Radioactivity measurements in environmental samples, Gamma spectrometer (HPG digital spectrum analyzer and lead shield). Sealed point source (226Ra), Mixed liquid gamma source, Reference materials (soil, grass,.etc).
Biophysics Experiments: Effects of gamma irradiation on electric properties of blood, Measurement of viscosity of different biological samples (liquid and

blood, normal and diseased).

Phys 504 Mathematical Physics 3(3+0)
Review of ordinary differential equations, Special functions (Bessel, Legendre, Hermite, Laguerre, Beta and Gamma), Integral transform (Fourier and Laplace), Partial differential equations of first order, Partial differential equations of second order, Methods of solving partial differential equations, Applications of partial differential equations in multiple dimensions, Using integral transform for solving partial differential equations, Using Green's function for solving partial differential equations.

Phys 505 Mathematical Physics 2(1+1)
Theory of measurement and degree of accuracy, Analog and digital methods and use of computers in experimentation and data analysis. Experimental setups and methods of measurement. Statistical methods and probability theories in physics. The electromagnetic spectrum and its applications in physicsl measurements. Potential functions and their use in description of quantum systems. Approximation methods perturbation theory and variational principles. The experimental/computing part in this course contains 10 experiments according to the research group (M.Sc. path). Examples of such experiments are as follows:
1- Statistical distribution (normally Maxwell-Boltzman, Fermi-Dirac) analysis. 2- Potential wells calculations. 3- Density of charge carriers in semiconductors. 4- Study of laser transition probabilities and black body radiation. 5- Fourier's analysis. 6- Simple perturbation calculations. There are also more experiments to be executed by the students dependent on their path in the M. Sc program.

Phys 507 Elementary Particle Theory (I) 2(2+0)
Historical introduction for the elementary particles, Elementary particle dynamics, Relativistic kinematics, Symmetries, Boundstates, Feynman calculus, Quantum Electrodynamics, Electrodynamics of quarks and hadrons, Quantum chromodynamics, Weak Interactions, Gauge theories.

Phys 508 Elementary Particle Theory (II) 2(2+0)
Gauge symmetries, Quantum gauge theories, Quantum chromodynamics, Standard electroweak theory I: Basic structure, Standard electroweak theory II: Phenomenological implications.

Phys 511 Classical Mechanics 2(2+0)
The Hamilton equations of motion, Canonical transformations, Hamilton-Jacobi theory, Canonical perturbation theory, Special relativity in classical mechanics, Introduction to the Lagrangian and Hamiltonian formulations for continuous systems and fields.

Phys 514 General Relativity 2(2+0)
Principle of equivalence, principle of general covariance, the metric tensor, Reimann tensor, Ricci tensor, ideal fluid, Einstein's field equations, Motion in Schwarzchild metric, Gravitational slowing down of light, and Schwaezchild radius.

Phys 515 Cosmology 2(2+0)
The isotropic homogeneous line-element, Properties of the Robertson – Walker line – element, Expansion of the universe, Dynamical equations in Cosmology, Some consequence of the dynamical equations in cosmology, Cosmic microwave background, Anisotropies in the background radiation, Nucleosynthesis, Baroysnthesis, Space time problems, and Dynamical dark matter.

Phys 530 Electromagnetic Theory 2(2+0)
Review of Maxwell's equations, Propagation of electromagnetic waves, Reflection and refraction, Wave guides of resonant cavitiy, Radiating systems, Special relativity and electromagnetic fields.

Phys 540 Statistical Mechanics 2(2+0)
Postulates of quantum statistical mechanics, Micro canonical ensemble, canonical ensemble, Grand canonical ensemble, Ideal Bose gas, Photon gas, Ideal Fermi gas, Degeneracy pressure (Equilibrium in stellar structure), Interacting systems, Mayer cluster expansion.

Phys 553 Quantum Mechanics 3(3+0)
Review of time independent perturbation, The variational principle, The WKB approximation, Time dependent perturbation theory, Generalized theory of angular momentum, Applications in atomic, molecular and nuclear physics, Scattering.

Phys 554 Advanced Quantum Mechanics 2(2+0)
Relativistic wave equation for spin zero particle (Klein-Gordon equation), Wave equation for spin half particle (Dirac equation), Lorentz-Covariance of the Dirac

equation, Spinors under spacial reflection, Bilinear covariant of the Dirac spinors, Dirac particles in external fields, The hole theory, The Weyl equation- The neutrino.

Phys 555 Quantum Field Theory (I) 2(2+0)
Photon and electromagnetic field, Lagrangian field theory, Klein-Gordon field, Dirac field, Covariant theory of photons, S-matrix expansion, Feynman Digrams in QED, Lowest order QED processes

Phys 556 Quantum Field Theory (II) 2(2+0)
Basic in field quantization, Introduction to renormalization theory, Renormalization group, Radiative correction in QED, Regularization in QED.

Phys 557 Quantum Field Theory in Condensed Matter (I) 2(2+0)
General properties of many-particle systems at low temperatures, methods of quantum field theory for T = 0, the diagram technique for T 0.

Phys 558 Quantum Field Theory in Condensed Matter (II) 2(2+0)
Theory of Fermi liquid, Systems of interacting bosons, Electromagnetic radiation in an absorbing medium.

Phys 531 Laser Physics 3(3+0)
Theory of stimulated and spontaneous emission, Radiative transition, Emission line width, decay of excited states, line shape function, line broadening mechanism, quantum mechanical description of radiating atoms, laser amplifiers, absorption and gain , threshold of laser, laser oscillation above threshold, pumping processes, laser resonators, laser cavity modes, properties of laser modes, stable resonators, Gaussian beams , propagation of Gaussian beams, ABCD law, stability condition, propagation of Gaussian beam in homogenous and guiding media, unstable resonators, Q-switching, mode locking, Ring laser, Distributed Feedback (DFB) laser, Distributed Bragg reflection lasers, high power semiconductor lasers, Quantum well lasers.

Phys 532 Quantum Optics Laboratory 2 (0+2)
The student should do number of experiments in the following:
He- Ne laser , laser dyes , stimulated Raman Scattering(SRS) , semiconductor laser , Raman scattering , Ar ion laser , Nd - Yag laser

Phys 533 Advanced Optics 2(2+0)
Coherence; coherence time and coherence length, temporal and spatial coherence. Matrix treatment of polarization, Jones vectors and Jones matrices. Fourier optics; Fourier analysis and transform, Nonlinear optics; non-linear susceptibility, second harmonic generation, wave mixing, Effects of Pockels, Kerr, Faraday and acousto-optics, phase conjugation.

536 Phys Applied Electromagnetism 2(2+0)
Maxwell's equations in differential and integral form, Maxwell's wave equations, Uniform Plane Electromagnetic waves in general medium, Uniform Plane waves in free space, Uniform Plane waves in conductors, The Poynting theorem, Uniform Plane electromagnetic waves in good conductors, The skin effect, Plane electromagnetic waves in Plasma, Reflection and Refraction of Plane electromagnetic waves, Propagation of electromagnetic waves between conducting Planes (waveguides), Dielectric waveguides

537 Phys Lasers Applications 2(2+0) hours:
Laser saftey, Lasers in Optical Communication and Data Storage, Medical Applications, Industrial Applications, Metrological Applications, Holography.

Phys 538 Optical Detectors 2(2+0) hours:
Detector Theory and Performance Parameters, Thermal Detectors (pneumatic, pyroelectric, thermoelectric, bolometers,), Photon Detectors (photoemissive, vacuum photodiode, photomultiplier, photocounting, image intensifier), Junction detectors (PIN, APD, Schottky , phototransistor), Vidicon , Diode arrays, CCD Camera. Noise in photon devices.

539 Phys Laser Spectroscopy 3(3+0) hours:
Bohr's atom; Vector atom models; Space, Spin quantization. Fine structure of one electron, two electrons and many electrons systems; L-S and j-j coupling; Zeeman effect; Low and high magnetic fields; Stark effect; Electronic, vibrational and rotational energy levels; Electronic configuration of simple molecules; Vibrational modes; P.Q.R. branches of rotational transition; Fluorescence, phosphoresce; Frank, Condon factors; Raman effect, stimulated Raman scattering(SRS), Stimulated Brillouin Scattering(SBS), Tunable lasers; Spectral and temporal tuning; Raman lasers; CARS; Horses; Harmonic and parametric oscillators; Picosecond, continuum, femtosecond spectroscopy;

LIBS, PAS, Rydberg states; Photo galvanic, multiphoton spectroscopy; High resolution spectroscopy; Lamb dip and saturation spectra; and Laser cooling.

Phys 570 Theory of Solids 3 (3+0) hours:
Band theory for metals, semiconductors and insulators - Properties of metals, semiconductors and insulators – Transport theory - Magnetic properties superconducting materials – Photovoltaic and thermoelectric effects – Interaction of radiation with solids – Elementary excitations.

Phys 571 Electron Spin Resonance 3(3+0) hours:
Magnetic properties of the electron - Interaction with the proton - Zeeman splitting phenomena - Quantum mechanics of electron spin resonance - Absorption, Saturation and relaxation - Multispin systems - Magnetic resonance of crystals and anisotropic systems - Free radicals - Iron group - Magnetic resonance spectrometers at medium and high frequencies.

Phys 574 Materials Science 3(3+0)
Crystalline and amorphous solids – Metallic, semiconducting and insulating materials – Crystal growth – Thin films – Nanoproperties – Phase change in solids and phase diagrams – X-ray diffraction – Elemental analysis – Preparation of alloys and ceramics – Types of defects – Elasticity and hardness – Polymers and plastics - Ultraviolet and infrared properties of materials.

Phys 576 Theory of Magnetism 2(2+0)
Electronic and atomic magnetism – Types of magnetism – Paramagnetism – Ferromagnetism and Antiferromagnetism – Heisenberg and Ising models – Impurity magnetism – Kando effect – Transition element magnetism – Effective field theories – Amorphous and magnetic glasses – Magnetic energy – Magnetic phenomena in superconducting materials.

Phys 577 Special Topics 3 (3+0)
This wide and opened course is exceptional, since it will be given and selected by the supervisor/staff member to help the student in research work.

Phys 600 Thesis 6 hrs
This research project will be taken with his supervisor

Ph. D. Courses Description

PHYS 603 Differential Geometry and Quantum Field Theory 3 (3+0)

Differential manifolds, tangent space, vector fields, local diffeomorphisms, cotangent space, differential forms, exterior derivative. Differential geometric aspects of Lie groups, Lie algebras, orbit, homogeneous spaces, non-linear – model. Fiber bundles, principal bundles, connections. Yang-Mills gauge theories, applications of differential geometry in gauge.

PHYS 604 Lie Groups and Algebras 3 (3+0)
Lie groups, Lie algebras, cartan sub-algebra, roots, Dynkin diagrams, classification of simple Lie algebras. Toda equations and their integrability. Higgs fields, self-dual monopoles. Classification of unitary representations of simple Lie groups. Weyl's character formula.

PHYS 617 Cosmology and Particle Physics 3 (3+0)
Standard cosmology, Robertson-Walker metric, thermal history of the universe, relativistic thermodynamics, phase transitions. Nucleosynthesis, dark matter, density fluctuations, galaxy formation. Inflation. Cosmic strings. Recent work on cosmological models; super-strings. Recent work on cosmological models; super-strings, super-gravity, Kaluza-Klein.

PHYS 631 Nonlinear Optics 3 (3+0)
Crystal optics (tensors, symmetry, anisotropy, resonance, momentum-space). Optical modulation (electrooptics, acoustoptics, magnetooptics). Second order nonlinearity (frequency doubling, parametric interactions, cascaded nonlinearity), Third order nonlinearity (optical Kerr effect, stimulated Brill scattering, stimulated Raman scat., bistability, phase conjugation, self focusing, solitons).. Nonlinearities in semiconductors. Ultrafast nonlinear optics. Nonlinear interaction of radiation with matter.

PHYS 632 Ultra Fast Phenomena 3 (3+0)
Nano, pico, femto second pulse generation. Q-switching, mode-locking, DFB, relaxation oscillation. Measurement: auto and cross correlation function, two photon, SH generation for detection, optical time delay, femto second, chirping, cooling pulses-generating compression. Applications in molecular relaxation, biology, semiconductor dynamics…etc.

PHYS 633 Laser - Matter Interaction 3 (2+1)
Laser beam characteristics- Beam focusing effects - Semi classical theory of

absorption and emission – Reflectivity & transmission of matter – Photon transport theory - Laser beam heating, melting, vaporization – Plasma formation- Rate of heating and cooling – Operational regimes in material processing -Depth of penetration – Key hole effect – Surface treatment (modification, cladding, alloying and hardening) – High power laser int. with solids (welding , cutting) – Optical properties of tissue - Laser tissue interaction (thermal, photochemical, photo mechanical, photo ablation, plasma induced ablation and photo description).

PHYS 634 Photonics 3 (3+0)
Propagation of EM waves in Dielectric wave guide – Fiber optics (boundary conditions, phase and group velocity, attenuation and dispersion, cut off frequency, single and multimode fibers) – Emitters (LED &laser diodes DH, QW, BDR, DFB, VCSEL's) - Fabrication techniques – Materials for photonics – Laser modulation (AM, FM and PM) and Demodulation – Receivers (Detectors PIN, PMT, APD), homodyne and heterodyne detection – Sensors – Switching devices and wave guide switching.

PHYS 635 Applications of Lasers 3 (3+0)
Laser safety, Lasers in Optical Communication and Data Storage, Medical Applications: Optical properties of tissue – Models of laser-tissue propagation – Montecarlo simulation of laser tissue interaction – Laser effects on tissue (thermal, photochemical, photmechanical, ionizing..) – Medical applications (Opthalmology, dermatology, dentistry, surgery, NET, gynecology, urology, neursurgery…..) - Low level laser therapy(LLLT) – Laser safety and precautions- Diagnostic by laser – Laser types in medicine. Industrial Applications, Metrological Applications, Holography. Detectors, Laser system for remote sensing (CO2, Excimer, dye, semiconductor lasers. Optics. Telescopes). Basic equation for sensors. LIDAR, Differential Absorption, LIF, Raman, Atmospheric & Hydrospheric Monitoring., Industrial Pollution, Atmospheric / Underwater transmission, Practical Considerations, Deep Sea Coral Reefs, Industrial Pollution, Oil Spills.

PHYS 636 Quantum Optics 3 (2+1)
Mixtures and the density operator (level damping, density matrix, vector model of density matrix)- CW field interactions(polarization of two-level medium, inhomogeneous broadened media, polarization of semiconductor gain media) – Laser theory(laser self-consistency equations, single-mode semiconductor laser theory, transverse variations and Gaussian beam....) - Coherent transient – Field quantization (single and multimode field quantization, coherence of quantum fields..)- Interaction between atoms and quantized field- Squeezed states of light(squeezing the coherent state, two-side mode master equation, two-mode squeezing, squeezed vacuum).

PHYS 637 Optical Instrumentation 3 (2+1)
Exp. Data Analysis, Detector Theory and Performance Parameters, Thermal Detectors (pneumatic, pyroelectric, thermpelectric, bolometers,) , Photon Detectors (photemissive, vacuum photodiode, photomultiplier, photncounting, image intensifier), Junction detectors (PIN, APD, Schottky PD, phototransistor), Vidicon , Plumbicon , Diode arrays, CCD Camera. Noise in photon devices.
Gas Laser Design: Gas discharge phenomena – Vacuum techniques- Cooling systems – Power supplies for low and high power cw lasers – High power pulsed lasers(CO2, TEA…) - Blumbin circuits (TEA, Excimer, N2 dynamic and chemical lasers design). Liquid Lasers Design: Preparation of dye solvents – pump geometry –jet flow transverse pumping – high energy dye laser (flash and laser pumped) – fs lasers. Insulator Solid Lasers: Flash and arc lamp – Diode pumped YAG lasers – Ti:sapphire laser design – Ring and Traveling wave laser design. Injection Lasers: Fabrication and characterization- Diode array lasers for pumping. Laser Mirrors: Dielectric coating – thin films – dichroic mirrors. Detection circuits problems.

PHYS 641 Vacuum and Thin film Technology 3 (3+0)
Vacuum principles and vacuum system design basics, Overview of thin film technology, crystal structures of thin films, Defects sin Thin films, Nano crystalline, polycrystalline, and epitaxial thin films, thin film nucleation and growth models, (2D, 3D, and 2D- Epitaxial growth of thin films, super lattice structures and quantum wells, diffusions: inter-diffusion, grain boundary diffusions, reaction and phase transformation, Thin film growth techniques (CBD, Spray, Reactive evaporation, PVD, Sputtering, MBE, Laser MBE PLD, CVD, PECVD, MOCVD, Sol-Gel, PAD.), Thin film processing, Thin film characterization techniques.

PHYS 642 Applied Renewable Energy & Environment Physics 3 (3+0)
Renewable energy assessment, Solar radiation models, Solar-Thermal, Photovoltaic systems, Wind energy systems, Fuel cells applications, Biomass: Gas and liquid conversion, Hydrogen energy applications, Other renewable energies, Renewable energy economics and feasibility studies, Environmental factors and renewable energy, Typical examples at national and international

levels. Waste and recycled energy, Ecological effects and thermal pollution and Energy policy for future.

PHYS 643 Solar & Environment Materials Technology 3(3+0)
Structure in Materials, Techniques and advanced systems in materials, Destructive and non-destructive testing, Mechanical properties, Metals, Polymers,, Ceramics and carbon materials, Composites, Electronics and Optical properties, Nano Materials, Biomaterials and Biological Materials, Gas ensing Materials, Photo & IR Detectors.

PHYS 644 Photoconduction Processes in Semiconductors 3 (3+0)
Energy States in Semiconductors, Perturbation of Semiconductors by external parameters, Absorption, Relationships between Optical constants, Absorption spectroscopy, Radiative and nonradiative transitions, processes in p-n junctions, stimulated emission, Excitation of luminescence and lasing in semiconductors, Photoelectric emission, Photovoltaic and photochemical effects, Effect of traps on luminescence, Optical characteristics related to mobile electrons, Absorption of light by electronic transitions, Interaction of radiation with oriented quantum wells, Photoconductivity.

PHYS 645 Characterization Techniques of Materials 3 (3+0)
Electrical conductivity, mobility, and Hall effect in semiconductors, Temperature dependence of mobility , Geometric magneto resistance, Four point probe and sheet resistivity, Spreading resistance techniques, Capacitance - voltage techniques, Depth profiling and electrical assessment, Deep Level transient Spectroscopy, Determining the structures of semiconductors using X-rays, Rocking curves and crystal perfections, EXAFS and SEXAFS, Raman spectroscopy, The experimental measurement of optical constants, Photoluminescence, photoconductivity and photo thermal effects, Secondary ion beam spectroscopy, Auger electron spectroscopy, Electron microscopy, Atomic Force Microscopy (AFM), FTIR (Fourier Transform Infra Red Spectroscopy), TED, LEED, RHEED.

PHYS 652 Quantum Mechanics II 3 (3+0)
Symmetry in quantum mechanics: Symmetries, conservation laws, and degeneracies. Discreet symmetries, parity. Lattice translation, Time –Reversal.
Identical particles: Permutation symmetry, Symmetrization postulate, two-electron system. The Helium atom. Permutation symmetry and Young Tableaux.
Scattering theory: The Lippmann-Schwinger equation, The Born approximation, Optical theorem. Methods of partial waves, Low energy scattering and bound states, Resonance scattering. Identical particles and scattering, Coulomb scattering.

PHYS 653 Quantum Electrodynamics 3 (3+0)
Quantization of a free scalar field. Classical e.m. field, gauge transformations. Quantization of the e.m. field, Lorentz gauge, extended Fock space, Green's functions. Dirac equation. Interaction picture, Perturbation theory, Feynman rules, phase space. The processes eg , em and e+e-. Divergences, regularization and renormalization., General gauges.

PHYS 657 Advanced Quantum Field Theory 3 (3+0)
Renormalization of quantum field theories, normalization conditions, counter-terms, Zero-mass limit, asymptotic behavior. Functional method in Q.F.T., path integrals, generating functional, effective action, effective potential. The d-model, Renormalization, symmetry breaking, anomalies, Gauge fields, Quantization of gauge fields.

PHYS 658 The Electroweak Model 3 (3+0)
Gauge theories, symmetry breaking. Standard electroweak model, particle representations, generations, neutral currents, relation to four-fermion theory, particle masses, GIM mechanism, universality. The electroweak interactions. Kobayashi-Maskawa matrix, experimental determination of the parameters. The running coupling constants, implications of the renormalization group equations, grand unification.

PHYS 663 Advanced Particles Physics 3 (3+0)
Quark model of hadrons, solutions, bag models. Gluon exchange, mass formulae, quark masses, heavy quarks. Quark-parton model, deep inelastic electron-nucleon scattering, scaling, corrections to scaling behaviour, jets. Chiral symmetry, chiral symmetry breaking, quark masses.

PHYS 664 Quantum Chromodynamics 3 (3+0)
The colour group, asymptotic freedom, scaling violatius in deep in elastic scattering. Renormalization group – functions. Operator-produce expansions, anomalous dimensions. Non-perturbative QCD, dispersion sum rules. The QCD vacuum, U(1)-problem, confinement; strong CP violation.

PHYS 665 Grand Unification 3 (3+0)
Review of Lie groups and their representations. The groups SU(5), SO(10) and E6. Unification I the standard model. Georgi-Glashow SU(5) model. Proton decay. Other unification models: SO(10), E6, SU(4) x SU(4). Problems of grand unified models. Future outlook.

PHYS 666 Suprsymmetry 3 (3+0)
Two-dimensional superspace, superfield, scalar and vector multiplets; N=1/2, N=1, N=2. Four-dimensional superspace, supersymmetry groups, super-integration, expansion, projection operators. Classical N=1, superfield propagators, super . Explicit and spontaneous supersymmetry breaking, super-Higgs.

PHYS 667 String Theory 3 (3+0)
Path integrals, Faddeev-Popov quantization. Free bosonic strings. Quantization; light-cone, BRST. Trees, vertex operators, closed strings. Superstrings, NSR-model, ghosts, extended supersymmetry. String group, tangent space, connections, covariant derivative. Anomalies, Atiyah-Singer theorem.

PHYS 668 Supergravity 3 (3+0)
Classical N=1 supergravity, covariant approach to supergravity, constraints, actions, Quantum superields, regularization, anomalies, Quantum N=1 supergravity, background splitting, ghosts, Feynman's rules, dimensional regularization. Supergravity and symmetry breaking.

PHYS 669 Selected Topics in Current Research 3 (3+0)
Selected topics are chosen by the supervisor related to the PhD dissertation.

PHYS 671 Physics of Low-Dimensional Structure 3 (3+0)
Histostructure concepts and low dimensional systems, Quantum Wells, nanowires, quantum dots, tunneling transport, Quantum physics applied to such systems, Optical properties of low dimensional systems (transition rules, polarization etc). Transport properties of 2D and 1D systems. Quantized conductance with Landauer-formalism. Scattering phenomena in 1D. Devices based on quantum phenomena and Coulomb blockade

PHYS 672 Advanced Solid State Physics 3 (3+0)
electron-electron interactions, electron-phonon interactions, Magnetism in solids, Magnetic Properties, Magnetic Resonance, Dielectric and Optical Properties, Diamagnetism and Paramagnetism, Superconductivity and Ginzburg-Landau equations.

PHYS 674 Band Theory and Electronic Properties of Solids 3 (3+0)
Classical models for the electronic properties of metals: Drude and Sommerfeld models. Quantum mechanics of particles in periodic potentials (Bloch's theorem). Band structure models: Nearly Free and Tight Binding electronic models. Semiconductors and insulators: Energy gap, Number of carriers, Density of states. Associated physical phenomena: electrical, optical, thermal and magnetic properties. Characterization and device applications. Wavevector (K) and effective mass of electrons in solids. Band-structure engineering: multilayers and quantum wells. Magnetoresistance and the quantum Hall effect.

PHYS 675 Magnetism in Solids 3 (3+0)
Magnetic field in free space and matter, magnetic quantities and units, types of magnetism. Spin and atomic magnetism. Quantum mechanics of magnetic properties. Interaction of spins. Exchange interactions. Itinerant electrons and localized interactions. Magnetization curves. Magnetic resonance ESR and NMR. Magnetic properties of superconductors. Magnetoresistance. Superparamagnetism. Nanoscale magnetism, spintronics. Spin entanglement.

PHYS 677 Computational Physics 3 (2+1)
Introduction to Fortran 90,Numerical integration (basic integration schemes, stochastic methods for multidimensional integrals), Numerical solutions of differential equations (classical equations of motion, studies of systems with chaotic dynamics, eigenstates of the Schrodinger equation, time evolution of wave-packets in quantum mechanics), Molecular dynamics simulations (basic schemes for classical many-particle dynamics, simulations at fixed energy and temperature), Monte Carlo simulations (the Metropolis algorithm for equilibrium statistical mechanics, studies of the phase transition in the Ising model of magnetism, liquids and gases), Optimization using simulated annealing, Exact diagonalization of quantum systems (ground state and finite-temperature properties of quantum magnets).

PHYS 678 Optical Properties of solids 3 (2+1)
Introduction, the complex refractive index, Lorentz oscillators, dispersion, birefringence, Interband absorption, excitons, Luminescence, Quantum wells,

Metals, doped semiconductors, Phonon absorption and reflectivity, Nonlinear optics.

PHYS 680 Advanced Nuclear Structure 3 (3+0)
Nuclear Collective Motion: Review of collective vibration, collective rotation of nuclei.
Variable moment of Inertia: Backbending phenomenon , physical interpretation through broken pairs, band crossing, band mixing.
Many-Body States: Deformed Potentials for deformed nuclei, deformed harmonic oscillator potential, deformed single particle states, and deformed many particle states.
Algebraic Models: The interacting boson model, Deformed Lie algebra models.
Superdeformed Nuclei: High spin states of nuclei, dynamic and kinematic moment of inertia, properties of superdeformed nuclei, population of superdeformed nuclei, superdeformed rotational bands. Nilsson –Strutinsky approach

PHYS 683 Radioecology 3 (3+0)
Sources of environmental radioactivity; Analysis of environmental radionuclides; Radioactivity in the terrestrial environment; Radioactive aerosols; Marine radioactivity; U-Th series radionuclides in the environment.

PHYS 685 Neutron scattering 3 (3+0)
Neutron sources , Introduction to elastic neutron scattering theory, Diffraction, Spectroscopy , Small Angle Neutron Scattering, Polarised neutrons, Experimental Technique, Data treatment .

PHYS 686 Nuclear and Particle Track Detectors 3 (3+0)
Introduction to Nuclear track Detectors, Interaction of charged particles with matter, The nature of charged- particle tracks and some possible Track formation Mechanisms in Insulating Solids.
Track etching: Methodology and Geometry, Thermal Fading of Latent Damage Trail, The use of Dielectric Track Recorders in Particle Identification, Some applications of Track detectors.

PHYS 687 Nuclear Spectroscopy 3 (3+0)
Basic principles, Nuclear activation analysis, Nuclear magnetic resonance, Particle induced x-ray emission

PHYS 691 Biophysical Techniques 3 (3+0)
X-ray crystallography - Nuclear Magnetic Resonance - Fluorescence, Fluorescence Microscopy - Ultraviolet-Visible, and Infra Red and Fourier Spectroscopy - AC & DC Dielectric relaxation - Chromatography.
The aims of this course are: 1) to provide students with an understanding of the fundamental principles of a range of advanced biophysical techniques. 2) to give students an understanding of how to use these techniques to get an information about the structure of macromolecules, electronic structure, size, shape, and modes of interaction of biological molecules along with studying the dynamics of cellular processes.

PHYS 692 Radiotherapy 3 (3+0)
Radiobiology: Effects of ionizing radiations on living cells and organisms, including physical, chemical, and physiological bases of radiation cytotoxicity, mutagenicity, and carcinogenesis.
Radiological Physics and Dosimetry: Interactions and energy deposition by ionizing radiation in matter; concepts, quantities and units in radiological physics; principles and methods of radiation dosimetry.
Radiotherapy Physics: Ionizing radiation use in radiation therapy to cause controlled biological effects in cancer patients; physics of interaction of the various radiation modalities with body-equivalent materials; physical aspects of clinical applications.

PHYS 693 Medical Imaging Techniques 3 (3+0)
- Introduction to medical imaging, Image formation and quality, Processing and reconstruction of medical images, Imaging modalities.
- X-ray imaging: X-ray imaging methods, Computed tomography (CT), clinical applications of x-ray imaging,
- Nuclear medicine imaging: Radiopharmaceuticals materials, Single photon emission computed tomography (SPECT), Positron emission tomography (PET), and their clinical applications.
- Ultrasound imaging: Physics of ultrasound, applications of ultrasound imaging in medicine.

PHYS 694 Magnetic Resonance Imaging 3 (3+0)
Electronic and nuclear spin. Electronic and nuclear magnetism. Magnetic atoms and ions. Microwave and radio frequency absorption. Magnetic resonance. Nuclear Magnetic Resonance (NMR) and Electron Spin Resonance (ESR). Magnetic interactions, saturation and relaxation. Computerized detection of

magnetic resonance. Magnetic Resonance Imaging (MRI). Image detection and enhancement. Magnetic Resonance applications in physics, chemistry and medicine.

PHYS 695 Biomagnetism 3 (3+0)
Biomagnetic fields. The Josephson effect. SQUID Magnetometers: layout, noise cancellation, rf, dc, and high Tc SQUIDs. Magnetoencephalography (MEG). Magnetocardiography (MCG). Magnetoneumography (MPG).

PHYS 696 Free Radicals in Biological Systems 3 (3+0)
General molecular bonding and structures - Definition of free radicals - Free radicals in chemical and biochemical interactions – Chemical properties of free radicals – Magnetic properties of free radicals – Biradicals – Generation of free radicals by spin resonance of free radicals – Hyperfine interactions of free radicals – Free radical labeling – Beneficial and damaging roles of free radicals in biological systems – Antioxidants and free radical scavengers.

PHYS 697 Environmental Radiation Biophysics 3 (3+0)
Radiation and environmental radioactivity. Sources of environmental radioactivity. Radioecological pollution. radiation interaction with matter. radiation effects on living system. stochastic and non-stochastic effects. delayed effects and physic-chemical properties of radiation effect in cells. environmental pathways analysis and dose assessment; radioactivity risk assessment

Full List of Department Members

Name	Rank	Univ. Of Last Degree	Field	e-mail @ksu.edu.sa
Ahmed Al-Soraye	Professor	Edinburgh University, UK	Radiation Physics	alsoraya@ksu.edu.sa
Abdallah S. Al-Rawaf	Professor	Durham University,UK	Theoretical Physics	arawaf@ksu.edu.sa
Abdullah A.I.AL-Bassam	Professor	Durham University , UK	Solar Cells	aabassam@ksu.edu.sa
Mohamed S A Alayed	Professor	University College of Swansea, UK	Solar Cells	malayed@ksu.edu.sa
Abdullah M. Aldhafiri	Professor	University of Wales Cardif, UK	Solar Energy	adhafiri@ksu.edu.sa
AbdulRahman Al-Aql	Professor	University of Wales Swansea , UK	Lasers	alaql@ksu.edu.sa
Vladivel Masilamani	Professor	India	Lasers	masilamani@ksu.edu.sa
Magdy Ghannam	Professor	Cairo Univ. - Univ.Paris Sud.-France	Medical Physics	mmghanam@ksu.edu.sa
Hichem S. El Euch	Professor	University of Paris VI	Quantum Physics	heleuch@ksu.edu.sa
Mohamed El-Nawawy	Professor	Cairo Univ – Heidelberg, Germany	Astrophysics	msnawawy@ksu.edu.sa
Mohammad Ali Al - Issa	Professor	Durham University, UK	Magnetic Resonance	miessa@ksu.edu.sa
Mirza Rehbmat Baig	Professor	University of Reading, UK	Radiation Physics	mrehbaig@ksu.edu.sa
Thabit A. M. Barakat	Professor	Middle East Technical University	Nano-Physics	tbarakat@ksu.edu.sa
Aslam F. Wazirzada	Professor	University of London,UK	Laser Physics	khater @ksu.edu.sa
Ashraf Khater	Assoc. Professor	Cairo University, Egypt	Env. & Rad. Biophysics	malsalhi@ksu.edu.sa
Mohamed AL-Salhi	Assoc. Professor	Hull University, UK	Laser	elnaggar@ksu.edu.sa
Ahmed El-Naggar	Assoc. Professor	Clausthal U. (Germ.) - Ain-Shams U.	Solar Cells	aman@ksu.edu.sa
Amanullah Fateh Mulla	Assoc. Professor	Osmania Univ. Hyderabad (A.P), India	Thin Films -Solar Cells	uaelani@ksu.edu.sa
Ussama Elani	Assoc. Professor	Univ. of Wales, Cardiff, Wales, UK	Solar Energy	askordi @ksu.edu.sa
Ayman Kordi	Assoc. Professor	Birmingham University, UK	Astrophysics	askordi@ksu.edu.s
Hamad Al-Alhendi	Assoc. Professor	University of Texas at Austin CPT. USA	High Energy Physics	kshibani@ksu.edu.sa
khider Al-Shibani	Assoc. Professor	The Univ. of Sussex, UK	Low Temp Physics	adilh@ksu.edu.sa
Adil Haseeb	Assoc. Professor	University of Uppsala, Sweden	Magnetic Resonance	dwayyan@ksu.edu.sa
Abdullah Al-Dwayyan	Assoc. Professor	Univ. of Wales, Wales, UK	Laser and Nanoscience	azzeer@ksu.edu.sa
Abdallah Azzeer	Assoc. Professor	Univ. of Wales, College of Science, UK	Laser & Spectroscopy	omar @ksu.edu.sa
Omar M. Al-Dossary	Assoc. Professor	University of Essex, UK	Low Dim. Structure	mshahab@ksu.edu.sa
Mohammed Shahabuddin	Assoc. Professor	Indian Institute of Technology, India	Solid State	mabdulhleem@ksu.edu.sa
Mohamed A. Abdel Halim	Assoc. Professor	Tsukaba University, Japan	Medical Physics	mgarawi @ksu.edu.sa

Mohamed S.AL Garawi	Assoc. Professor	University of Kent at Canterbury, UK	Radiation Physics	nalazayed@ksu.edu.sa
Nasser S. AlZayed	Assoc. Professor	University of Kansas, USA	Materials Science	ahindi@ksu.edu.sa
Awatif A. Hindi	Assoc. Professor	Al Tarbiah College, Saudi Arabia	Theoretical Physics	ymanal@ksu.edu.sa
Manal Youssef	Assoc. Professor	Cairo university, Egypt	Celestial Mechanics	ymanal@ksu.edu.sa
Ibrahim El-Agib	Assist. Professor	Juba University, Sudan	Nuclear Physics	elagib@ksu.edu.sa
El-Sayed Lashin	Assist. Professor	SISSA, Trieste, Italy	Elementary Particles	lashin@ksu.edu.sa
Mortady I. Youssif	Assist. Professor	University of Cincinnati, USA	Solid State	mortada@ksu.edu.sa
Gehad Sadiek	Assist. Professor	Purdue University, IN, USA	Theoretical Physics	gehad@ksu.edu.sa
Hamed Al-Sewaidan	Assist. Professor	University College of Swansea, U.K	Medical Physics	hameds@ksu.edu.sa
Hamad Al-Brithen	Assist. Professor	Ohio University (USA)	Mat. & Surf. Physics	brithen@ksu.edu.sa
Zeyad A. Alahmed	Assist. Professor	Univ. of Arkansas, Fayetteville, AR	Microelect.-Photonics	zalahmed@ksu.edu.sa
Saad Al-Omran	Assist. Professor	University of Arkansas,	Solid State Physics	somran@ksu.edu.sa
Safar S. Al-Ghamdi	Assist. Professor	Manchester University, U.K	Nuclear Structure	safara@ksu.edu.sa
Saleh A. Al-Salman	Assist. Professor	Manchester, UK	Material Science	ssalman@ksu.edu.sa
Abdulla A Aljuffali	Assist. Professor	University of Wales Cardiff UK	Solar Cells	ajuffali@ksu.edu.sa
Abdulla Al-Semari	Assist. Professor	Univ. of Wales, Wales, U.K.	Multi- Color Lasers	alsemari@ksu.edu.sa
Abdullah Hamdan	Assist. Professor	University of Jordan	Laser & Spectroscopy	abhamdan@ksu.edu.sa
Ali Al-Naghmoosh	Assist. Professor	Austin Univ UK.	Theoretical Studies	nagmoosh@ksu.edu.sa
Nagi Khelifi	Assist. Professor	University of Monastir, Tunisia	Atomic and Molecular	neji@ksu.edu.sa
Hisham A. Alhadlaq	Assist. Professor	Oakland University Rochester ,MI.usa	Medical Physics	hhadlaq@ksu.edu.sa
Ahmed Ibrahim	Assist. Professor	Kyoto University, Japan	Astrophysics	ahabdalla@ksu.edu.sa
Mortady Youssif	Assist. Professor	University of Cincinnati, Ohio, USA	Solid State Physics	youssifm@ksu.edu.sa
Amany Abdalla Aly	Assist. Professor	Leeds University, UK	Biophysics	amanyaly@ksu.edu.sa
Sausan Sawaf	Assist. Professor	Ilmenau/Germany	Laser Physics	sausan@ksu.edu.sa
Abeer Almodlej	Assist. Professor	King Saud University	Elementary Particles	amodlej@ksu.edu.sa
Laila Babsail	Assist. Professor	Sussex	Solid State Physics	lbabsail@ksu.edu.sa
Salwa Al Saleh	Assist. Professor	Blaise Pascal University, France	Elementary Particles	salwams@ksu.edu.sa
Samah Albashair	Assist. Professor	Benha, Egypt	Solar Energy Physics	sbashir@ksu.edu.sa
Leda Bousiakou	Assist. Professor	University of York, UK	Condensed Matter	leda@ksu.edu.sa
Al zahra El feky	Assist. Professor	Cairo university, Egypt	Solid State Physics	malzahraa@ksu.edu.sa
Mohammed A. Al-Duraiby	Assist. Professor	University of Manchester, UK	microelectronics /nanostructure	physics@ksu.edu.sa
Hussain A M al-Trabulsy	Lecturer	Uni. of Durham, UK.	Applied Astronomy	htrabulsi@ksu.edu.sa
Reem Al saigh	Lecturer	King Saud University	Laser Physics	rsaigh@ksu.edu.sa

Noura almoneef	Lecturer	King Saud University	Solar Energy	nalmoneef@ksu.edu.sa
Latifa Al kheder	Lecturer	King Saud University	Solar Energy	lalkhder@ksu.edu.sa
Jawaher Mutlaque Alotaibi	Lecturer	King Saud University	Solar Energy	jalotibi@ksu.edu.sa
Meshaal Obeid Al-Harbi	Teaching Assistant	King Saud University	Abroad	physics@ksu.edu.sa
Khaled N. Al- Mosabeh	Teaching Assistant	King Saud University	Astronomy	physics@ksu.edu.sa
Abdou I. Rizk	Teaching Assistant	Not Specified	Radiation Physics	physics@ksu.edu.sa
Lutf Rahman Fadel	Teaching Assistant	Not Specified	Solid State	physics@ksu.edu.sa
Hasan S. Ammari	Teaching Assistant	Not Specified	Experimental Physics	alammari@ksu.edu.sa
Ahmed F. Mira	Teaching Assistant	Not Specified	Ferrites & Mossbauer Effect	amir@ksu.edu.sa
Yahya I. Sandaly	Teaching Assistant	King Saud University	Abroad	physics@ksu.edu.sa
Maeen Junid	Teaching Assistant	King Saud University	Abroad	physics@ksu.edu.sa
Ayman M. Alismail	Teaching Assistant	King Saud University	Abroad	aymanm@ksu.edu.sa
Sayed W. Magharaby	Teaching Assistant	Not Specified	Solar Wind	physics@ksu.edu.sa
Amgad M. Mazhar	Teaching Assistant	Not Specified	Laser	physics@ksu.edu.sa
Abdullah Moazen	Teaching Assistant	Not Specified	Solid State	physics@ksu.edu.sa
Nabeel N. Abdalwahed	Teaching Assistant	Not Specified	Experimental Physics	physics@ksu.edu.sa
Fahad S. Al-ghamdi	Teaching Assistant	King Saud University	Solid State (Superconductivity)	physics@ksu.edu.sa
Kamal O. Saleh	Teaching Assistant	Not Specified	Physics	physics@ksu.edu.sa
Abdalazez I. Al-Shalan	Teaching Assistant	Not Specified	Physics	physics@ksu.edu.sa
Noor Z. Khushi	Teaching Assistant	Not Specified	Physics	physics@ksu.edu.sa
Bedoor Alkurtass	Teaching Assistant	Not Specified	Condensed Matter Physics	bkurtass@ksu.edu.sa
Wafa al mujammami	Teaching Assistant	Not Specified	Laser Physics	walmujammi@ksu.edu.sa
Reem A. B. Al-Raddadi	Teaching Assistant	Not Specified	Plasma Physics	ralraddadi@ksu.edu.sa
Nadiah al onazi	Teaching Assistant	Not Specified	Physics	nalenazi@ksu.edu.sa
Fatimah Barakat	Teaching Assistant	Not Specified	Physics	fbarakat@ksu.edu.sa
Amal Riyadh Altujjar	Teaching Assistant	Not Specified	Physics	physics@ksu.edu.sa
Noura al onazi	Teaching Assistant	Not Specified	Physics	nmohamad@ksu.edu.sa
Mahasen Al mobarak	Teaching Assistant	Not Specified	Physics	malmobark@ksu.edu.sa
Khulud Bandar Almutairi	Teaching Assistant	Not Specified	Physics	kalmutairi@ksu.edu.sa
Faten al abdulaali	Teaching Assistant	Not Specified	Elementary Particle Physics	falabdulaali@ksu.edu.sa
Ohood Alharbi	Teaching Assistant	Not Specified	Physics	oalharbi@ksu.edu.sa
Tahani Albeladi	Teaching Assistant	Not Specified	Physics	talbeladi@ksu.edu.sa
Rehab Al buraidi	Teaching Assistant	Not Specified	Physics	ralburaidi@ksu.edu.sa

Abeer Al Shammari	**Teaching Assistant**	**Not Specified**	**Solid State Physics**	**aalshammari@ksu.edu.sa**
Ahalm Al Amry	**Teaching Assistant**	**Not Specified**	**Physics**	**aalamry@ksu.edu.sa**
Reem Al Thagafi	**Teaching Assistant**	**Not Specified**	**Laser Physics**	**ralthagafi@ksu.edu.sa**
Sultana A. Albabotain	**Technician**	**Not Specified**	**Physics**	**salbabtin@ksu.edu.sa**
Lamya Baeshen	**Technician**	**Not Specified**	**Physics**	**lbaashen@ksu.edu.sa**
Wadha Alonazi	**Technician**	**Not Specified**	**Physics**	**walenazi@ksu.edu.sa**
Amany A. Alobaidi	**Technician**	**Not Specified**	**Physics**	**aalobiadi@ksu.edu.sa**
Noora Altamimi	**Technician**	**Not Specified**	**Physics**	**nfowaz@ksu.edu.sa**
Fatema Alfaifi	**Technician**	**Not Specified**	**Physics**	**falfaifi@ksu.edu.sa**
Hayat S. Althebaiti	**Technician**	**Not Specified**	**Physics**	**haathbaita@ksu.edu.sa**
Iman A. Alfalah	**Technician**	**Not Specified**	**Physics**	**efalah@ksu.edu.sa**
Naeema Alobodi	**Technician**	**Not Specified**	**Physics**	**nabodi@ksu.edu.sa**
Iman I. Alabdelkarim	**Technician**	**Not Specified**	**Physics**	**ealabdulkarim@ksu.edu.sa**
Bader Hamad Al-Hazmi	**Secretary**	**Not Specified**	**Physics**	**bhalhazmi@ksu.edu.sa**
Raad Turky Al-Aredh	**Secretary**	**Not Specified**	**Physics**	**ralaredh@ksu.edu.sa**
Nouf Al-Qassim	**Secretary**	**Not Specified**	**Physics**	**nalqassim@ksu.edu.sa**
Walid A. Sulaiteen	**Ameen Huda**	**Not Specified**	**Physics**	**physics@ksu.edu.sa**

Contact information:

- Department Chairman: Phone: 4676380, Fax: 4673656
- Department Vice chairman for Girls: Phone: 4768506, Fax: 4792906
- Secretary: main campus: phone: 4676378, Fax: 4676379
- Secretary: Malaz Campus: Phone: 4768506, Fax: 4676379
- Department Website: http://physics.ksu.edu.sa
- Department Forum: http://www.ksuphysics.com
- Postal Address: P. O. Box 2455, King Saud University, College of Science, Riyadh 11451, Saudi Arabia.