10 YEARS OF UNIVERSITY RECOGNITION
20 YEARS OF ACADEMIC EXCELLENCE

REVA UNIVERSITY
Bengaluru, India

School of Applied Sciences
M.Sc. PHYSICS

HANDBOOK 2017-2019

Rukmini Knowledge Park
Kattigenahalli, Yelahanka, Bengaluru – 560064
www.reva.edu.in

REVA UNIVERSITY
Bengaluru, India

School of Applied Sciences

M. Sc. (Physics)

HAND BOOK

2017-18

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Chancellor's Message

"Education is the most powerful weapon which you can use to change the world."

- Nelson Mandela.

There was a time when survival depended on just the realization of physiological needs. We are indeed privileged to exist in a time when 'intellectual gratification' has become indispensable. Information is easily attainable for the soul that is curious enough to go look for it. Technological boons enable information availability anywhere anytime. The difference,
However, lies between those who look for information and those who look for knowledge.

It is deemed virtuous to serve seekers of knowledge and as educators it is in the ethos at REVA University to empower every learner who chooses to enter our portals. Driven by our founding philosophy of 'Knowledge is power', we believe in building a community of perpetual learners by enabling them to look beyond their abilities and achieve what they assumed impossible.

India has always been beheld as a brewing pot of unbelievable talent, acute intellect and immense potential. All it takes to turn those qualities into power is a spark of opportunity. Being at a University is an exciting and rewarding experience with opportunities to nurture abilities, challengecognizance and gain competence.

For any University, the structure of excellence lies in the transitional abilities of its faculty and its facility. I'm always in awe of the efforts that our academic board puts in to develop the team of subject matter experts at REVA. My faculty colleagues understand our core vision of empowering our future generation to be ethically, morally and intellectually elite. They practice the art of teaching with a student-centered and transformational approach. The excellent infrastructure at the University, both educational and extra-curricular, magnificently demonstrates the importance of ambience in facilitating focused learning for our students.

A famous British politician and author from the 19th century - Benjamin Disraeli, once said 'AUniversity should be a place of light, of liberty and of learning'. Centuries later this dictum still inspires me and I believe, it takes team-work to build successful institutions. I welcome you to REVAUniversity to join hands in laying the foundation of your future with values, wisdom and knowledge.

Dr. P. Shyama Raju

Vice-Chancellor’s Message

The last two decades have seen a remarkable growth in higher education in India and across the globe. The move towards inter-disciplinary studies and interactive learning have opened up several options as well as created multiple challenges. India is at a juncture where a huge population of young crowd is opting for higher education. With thetremendous growth of privatization of education in India, the major focus is on creating a platform for quality in knowledge enhancement and bridging the gap between academia and industry.

A strong believer and practitioner of the dictum “Knowledge is Power”, REVA University has been on the path of delivering quality education by developing the young human resources on the foundation of ethical and moral values, while boosting their leadership qualities, research culture and innovative skills. Built on a sprawling 45 acres of green campus, this ‘temple of learning’ has excellent and state-of-the-art infrastructure facilities conducive to higher teaching-learning environment and research. The main objective of the University is to provide higher education of global standards and hence, all the programs are designed to meet international standards. Highly experienced and qualified faculty members, continuously engaged in the maintenance and enhancement of student-centric learning environment through innovative pedagogy, form the backbone of the University.

All the programs offered by REVA University follow the Choice Based Credit System (CBCS) with Outcome Based Approach. The flexibility in the curriculum has been designed with industry- specific goals in mind and the educator enjoys complete freedom to appropriate the syllabus by incorporating the latest knowledge and stimulating the creative minds of the students. Bench marked with the course of studies of various institutions of repute, our curriculum is extremely contemporary and is a culmination of efforts of great think-tanks - a large number of faculty members, experts from industries and research level organizations. The evaluation mechanism employs continuous assessment with grade point averages. We believe sincerely that it will meet the aspirations of all Stakeholders – students, parents and the employers of the graduates and postgraduates of Reva University.

At REVA University, research, consultancy and innovation are regarded as our pillars of success. Most of the faculty members of the University are involved in research by attracting funded projects from various research level organizations like DST, VGST, DBT, DRDO, AICTE and industries.The outcome of the research is passed on to students through live projects from industries. The entrepreneurial zeal of the students is encouraged and nurtured through EDPs and EACs.

REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students. REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students become skilled with relevant to industry requirements. Structured training programs on soft-skills and preparatory training for competitive exams are offered here to make students more employable. 100% placement of eligible students speaks the effectiveness of these programs. The entrepreneurship development activities and establishment of "Technology Incubation Centers" in the University extend full support to the budding entrepreneurs to nurture their ideas and establish an enterprise.

With firm faith in the saying, "Intelligence plus character –that is the goal of education" (Martin Luther King, Jr.), I strongly believe REVA University is marching ahead in the right direction, providing a holistic education to the future generation and playing a positive role in nation building. We reiterate our endeavor to provide premium quality education accessible to all and an environment for the growth of over-all personality development leading to generating "GLOBAL PROFESSIONALS".

Welcome to the portals of REVA University!

Dr. S. Y. Kulkarni

Vice-Chancellor, REVAUniversity

PREFACE

Higher education across the globe is opening doors of its academic disciplines to the real-world experiences. The disciplinary legitimacy is under critical review. Trans-border mobility and practice learning are being fore-grounded as guiding principles. Interactive learning, bridging disciplines and facilitating learners to gain different competencies through judicious management of time is viewed as one of the greatest and fascinating priorities and challenges today.

The M.Sc. in Physics is designed keeping in view the current situation and possible future developments, both at national and global levels. This course is designed to give greater emphasis on Research. There are ample number of courses providing knowledge in specialized areas of Quantum Mechanics, Electrodynamics, Electronics, Materials Science, etc. Facilitating students to choose specialized areas of their interest. Adequate attention is given to provide students the basic concepts of analysis and modern computation techniques to be used and knowledge on application of such concepts in practical field. The project, being part of the curriculum will certainly provide students the research experience.

The L: T: P structure of teaching and learning under Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) would certainly help our students learn and build competencies needed in this knowledge based society.

This handy document containing brief information about M.Sc. Physics, scheme of instruction, course content, CBCS-CAGP regulations and its advantages and calendar of events for the year will serve as a guiding path to students to move forward in a right direction. It would mould them with knowledge, skill and ethical values to face the challenges of this competitive world with greater confidence in becoming proud citizens of mother India.

Director’s Message

Physics is a basic science which enables the students to think beyond their comfort level and brings new and deeper concepts about the Atoms, Molecules, Nanoscale, Microscale and Bulk materials physical properties. The present day buzzing “quantum computers” also rely on the principles of physics like Quantum Mechanics, Electrodynamics and Optics. The Physical sciences deals with subatomic particles to Galaxies. It also gave birth to high end sophisticated technologies like Atomic Force microscope, Tunneling Electron microscope and other advanced technologies which help the people to visualize the unexplored world. M Sc in Physics offered by REVA University aims to provide the required skills and knowledge necessary to pursue a successful career in Research, Teaching and Industry relevant jobs. This program imparts need based, practical education in contemporary world to develop global competence among students. It strives to prepare students to become leaders in the field of Physical Sciences in general and Material science/Optics/Electronics in particular by encouraging them to inculcate scientific thinking coupled with creative and innovative ideas.

The program provides hands- on training and practical skills in the field of Material Science, Optics and Electronics. This course also covers fundamental aspects of Physics in every aspect. The special emphasis on experiments related electricity, magnetism, lasers, spectral analysis and studying other materials properties by varying different parameters help the student to equip with required knowledge in the field of research, teaching & industry.

As far as employment is concerned physics courses are gaining attention in the field of data science, data analysis, statistical modelling and programming are some of the fast-growing sectors. Employment record shows that physics has a great scope in future. Physicist can find careers with electronic, optics and material science related and allied companies. They can be employed in the areas of programming, production and management of sensors and other related industries. There is a large scale employment in research laboratories run bythe government as well as the corporate sectors. Further, there is great demand for physicists in numerous industries and sectors after the completion of MSc Physics course.

This handbook provides an outline of regulations for master’s degree, scheme of instruction, and detailed syllabus. I am sure the students choosing MSc Physics at REVA University will enjoy the curriculum, teaching and learning environment, the vast infrastructure and the experienced teacher’s involvement and guidance. We will strive to provide all needed comfort and congenial environment for their studies. I wish all students a pleasant stay at REVA and grand success in their career.

The curriculum caters to and has relevance to local regional, national, global developmental needs. Maximum number of curses are integrated with cross cutting issues with relevant to professional ethics, gender, human values, environment and sustainability.

Dr. Beena G
Director
School of Applied Sciences

RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT), in the year 2002. **Rukmini Educational Charitable Trust** (RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies (RIMS), REVA Institute of Education (RIE), REVA First Grade College (RFGC), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions, the Trust seeks to fulfill its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trust is Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the Divya Sree Group of companies. The idea of creating these top notched educational institutions was born of the philanthropic instincts of Dr. P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond road park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name afew.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 11,000 students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University has been established under the REVA University Act, 2012 of Government of Karnataka and notified in Karnataka State Gazette No. 80 dated 27thFebruary, 2013. The University is empowered by UGC to award degrees any branch of knowledge under Sec.22 of the UGC Act. The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

REVA University located in between Kempegowda International Airport and Bangalore city, has a sprawling green campus spread over 45 acres of land and equipped with state-of-the-art infrastructure that provide conducive environment for higher learning and research. The REVA campus has well equipped laboratories, custom-built teaching facilities, fully air-conditioned library and central computer centre, the well planned sports facility with cricket ground, running track & variety of indoor and outdoor sports activities, facilities for cultural programs. The unique feature of REVA campus is the largest residential facility for students, faculty members and supportive staff.

The University is presently offering 23 Post Graduate Degree programs, 20 Degree and PG Degree programs in various branches of studies and has 12000+ students studying in various branches of knowledge at graduate and post graduate level and 302 Scholars pursuing research leading to PhD in 18 disciplines. It has 800+ well qualified, experienced and committed faculty members of whom majority are doctorates in their respective areas and most of them are guiding students pursuing research leading to PhD.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education has been introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under the fast track for those who have the capabilities to surpass others. These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. REVA University has also initiated many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

REVA University recognizing the fact that research, development and innovation are the important functions of any university has established an independent Research and Innovation division headed by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science & technology and other areas of study. The interdisciplinary-multidisciplinary research is given the top most priority. The division continuously liaisons between various funding agencies, R&D Institutions, Industries and faculty members of REVA University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the core areas of research wherein our young faculty members are working include Data Mining, Cloud Computing, Image Processing, Network Security, VLSI and Embedded Systems, Wireless Censor Networks, Computer Networks, IOT, MEMS, Nano- Electronics, Wireless Communications, Bio-fuels, Nano-technology for coatings, Composites, Vibration Energies, Electric Vehicles, Multilevel Inverter Application, Battery Management System, LED Lightings, Renewable Energy Sources and Active Filter, Innovative Concrete Reinforcement, Electro Chemical Synthesis, Energy Conversion Devices, Nano-structural Materials, Photo-electrochemical Hydrogen generation, Pesticide Residue Analysis, Nano materials, Photonics, Nano Tribology, Fuel Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, Resource Management and Sustainable Development, Cyber Security, General Studies, Feminism, Computer Assisted Language Teaching, Culture Studies etc.

The REVA University has also given utmost importance to develop the much required skills through variety of training programs, industrial practice, case studies and such other activities that induce the said skills among all students. A full-fledged Career Development and Placement (CDC) department with world class infrastructure, headed by a dynamic experienced Professor & Dean, andsupported by well experienced Trainers, Counselors and Placement Officers.

The University also has University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director facilitating skill related training to REVA students and other unemployed udents. The University has been recognized as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana. The Centre conducts several add-on courses in challenging areas of development. It is always active in facilitating student's variety of Skill Development Training programs.

The University has collaborations with Industries, universities abroad, research institutions, corporate training organizations, and Government agencies such as Florida International University, Okalahoma State University, Western Connecticut University, University of Alabama, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, EMC^2, VMware, SAP, Apollo etc, to facilitate student exchange and teacher–scholar exchange programs and conduct training programs. These collaborations with foreign universities also facilitates students to study some of the programs partly in REVA University and partly in foreign university, viz, M.S in Computer Science one year in REVA University and the next year in the University of Alabama, Huntsville, USA.

The University has also given greater importance to quality in education, research, administration and all activities of the university. Therefore, it has established an independent Internal Quality division headed by a senior professor as Dean of Internal Quality. The division works on planning, designing and developing different quality tools, implementing them and monitoring the implementation of these quality tools. It concentrates on training entire faculty to adopt the new tools and implement their use. The division further works on introducing various examination and administrative reforms.

To motivate the youth and transform them to become innovative entrepreneurs, successful leaders of tomorrow and committed citizens of the country, REVA organizes interaction between students and successful industrialists, entrepreneurs, scientists and such others from time to time. As a part of this exercise great personalities such as Bharat Ratna Prof. C. N. R. Rao, a renowned Scientist, Dr. N R Narayana Murthy, Founder and Chairman and Mentor of Infosys, Dr. K Kasturirangan, Former Chairman ISRO, Member of Planning Commission, Government of India, Dr. Balaram, Former Director I.I.Sc., and noted Scientist, Dr. V S Ramamurthy, Former Secretary, DST, Government of India, Dr. V K Aatre, noted Scientist and former head of the DRDO and Scientific Advisor to the Ministry of DefenceDr. Sathish Reddy, Scientific Advisor, Ministry of Defence, New Delhi and many others have accepted our invitation and blessed our students and faculty members by their inspiring addresses and interaction.

As a part of our effort in motivating and inspiring youth of today, REVA University also has instituted awards and prizes to recognize the services of teachers, researchers, scientists, entrepreneurs, social workers and such others who have contributed richly for the development of the society and progress of the country. One of such award instituted by REVA University is 'Life Time Achievement Award' to be awarded to successful personalities who have made mark in their field of work. This award is presented on occasion of the "Founders' Day Celebration" of REVA University in presence of dignitaries, faculty members and students gathering and the first "REVA Life Time Achievement Award" for the year 2015 has been awarded to Shri. Kiran Kumar, Chairman ISRO on the occasion of Founder's Day Celebration, 6th January, 2016 and the second "REVA Life Time Achievement Award" for the year 2016 has been awarded to Shri. Shekhar Gupta, Renowned Journalist on the occasion of Founder's Day Celebration, 6th January, 2017.

REVA organizes various cultural programs to promote culture, tradition, ethical and moral values to our students. During such cultural events the students are given opportunities to unfold their hidden talents and motivate them to contribute innovative ideas for the progress of the society. One of such cultural events is REVAMP conducted every year. The event not only gives opportunities to students of REVA but also students of other Universities and Colleges. During three days of this mega event students participate in debates, Quizzes, Group discussion, Seminars, exhibitions and variety of cultural events. Another important event is ShubhaVidaaya, - Graduation Day for the final year students of all the programs, wherein, the outgoing students are felicitated and are addressed by eminent personalities to take their future career in a right spirit, to be the good citizens and dedicate themselves to serve the society and make a mark in their respective spheres of activities. During this occasion, the students who have achieved top ranks and won medals and prizes in academic, cultural and sports activities are also recognized by distributing awards and prizes. The founders have also instituted medals and prizes for sports achievers every year. The physical education department conducts regular yoga classes everyday to students, faculty members, administrative staff and their family members and organizes yoga camps for villagers around.

Recognizing the fast growth of the university and its quality in imparting higher education, the BERG (Business Excellence and Research Group), Singapore has awarded BERG Education Award 2015 to REVA University under Private Universities category. The University has also been honored with many more such honors and recognitions.

About the School of Applied Sciences

The School of Applied Sciences is shouldered by well qualified and highly experienced faculty. The world class infrastructure and the serene academic atmosphere at REVA University will enhance the transfer as well as creation of knowledge. The school provides an interactive, collaborative peer tutoring environment that encourages students to break down complex problems and develop strategies for finding solutions across a variety of situations and disciplines. The school aims to develop a learning community of critical thinkers who serves as models of innovative problems solving in the university environment to enrich their academic and professional careers. M.Sc. in Physics is designed to meet the present-day demand for specific requirements of science, engineering and technology. The courses are tailored to prepare skillful students who can teach Physics, can carry out research in allied fields of Physics as well as participate in development of the society. These courses provide an opportunity for the students to know about the applications of Physics in several fields of practical interest.

The curriculum of post-graduate degree program has been designed to bridge the gap between academia-research. The minor project work students undertake as part of curriculum is integrated with industry experience. The M.Sc. Physics program exposes the students to research in order to make them eligible to get research opportunities at National and International levels. The schoolalso has research program leading to doctoral degree.

Following are the vision, mission, program educational objectives and program outcomes.

VISION STATEMENT OF UNIVERSITY

REVA University aspires to become an innovative University by developing excellent human resources with **leadership qualities, ethical and moral values, research culture** and **innovative skills** through higher education of global standards.

VISION STATEMENT OF SCHOOL

Provide a world class platform for the development of physics and its applications.

MISSION STATEMENT OF SCHOOL

- Establish the department as a global player in Science and Technology.
- Excel in scientific R&D and consultancy.
- Create an environment for society aimed at knowledge enhancement.

M. Sc. (Physics) Program

Programme Overview

Physics is a branch of natural sciences. It deals with physical matter and energy; and the natural laws that govern the behavior of matter. The core theories of Physics are: Classical Mechanics, Electromagnetism, Thermodynamics and Statistical Mechanics, Quantum Mechanics and Relativity. There are many more branches of Physics including nuclear and particle physics

Physics plays a key role in the future progress of humankind. The physics education and research in all countries is important because:

- Physics is an exciting intellectual adventure that inspires the young people and expands the frontiers of our knowledge about Nature.
- Physics generates fundamental knowledge needed for the future technological advances that will continue to drive the economic engines of the world.
- Physics contributes to the technological infrastructure and provides trained personnel needed to take advantage of scientific advances and discoveries.
- Physics is an important element in the education of chemists, engineers and computer scientists, as well as practitioners of the other physical and biomedical sciences.
- Physics extends and enhances our understanding of other disciplines, such as the earth, agricultural, chemical, biological, and environmental sciences, plus astrophysics and cosmology - subjects of substantial importance to all peoples of the world.
- Physics improves our quality of life by providing the basic understanding necessary for developing new instrumentation and techniques for medical applications, such as computer tomography, magnetic resonance imaging, positron emission tomography, ultrasonic imaging, and laser surgery.

Thus, physics is an essential part of the educational system of an advanced society. Indian Society has embraced knowledge economy and its economic growth rate is one of the highestin the world. India has shown highest level of progress in engineering, space, nuclear, aeronautics and information and communication technologies. The subject of physics has played a major role in the development of country and India has produced 2 Nobel laureates in Physics.

In this context, University across the country offer Physics as a subject at undergraduate and physics as a programme at postgraduate level.

M. Sc. (Physics) at REVA UNIVERSITY has been designed to meet the human resources needs of existing and futuristic research establishments, industries and academic institutions. The programme is designed to produce graduates with higher order critical, analytical, problem solving and research skills; ability to think rigorously and independently to meet higher level expectations of industries, research organization and academic institutions. The programme deals with courses in classical mechanics, quantum mechanics, material science, semiconductors, electrodynamics and related areas.

Programme Educational Objectives (PEOs)

The aim of the programme is to produce postgraduates with - advanced knowledge and understanding of Physics; higher order critical, analytical, problem solving and attitudinal skills(transferable) to meet expectations of research establishments, relevant industry and academia or to take up entrepreneurial route. Hence,

The Programme Educational objectives are to prepare the students to:

PEO1 Pursue higher education through continuous learning with effective communication skills

PEO2 have successful professional careers in academia, industry and government

PEO3 Start own enterprise and provide solutions to scientific research problems

PEO4 Exhibit skills as a member of a team in national and international organizations with highest ethics through lifelong learning

Programme Outcomes (POs)

After undergoing this programme, a student will be able to:

PO1 **Domain knowledge**: Apply the knowledge of physics and fundamentals for the solution of complex problems in day to day life.

PO2 **Problem analysis**: Identify, formulate, research literature, and analyze problems to arrive at substantiated conclusions using principles of physical sciences.

PO3 **Design/development of solutions**: Design solutions for real time problems to meet the specifications with consideration for the public health and safety, the cultural and societal, and environmental considerations.

PO4 **Conduct investigations of complex problems**: Use research-based knowledge, for analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 **Modern tool usage:** Apply appropriate techniques, resources, and IT tools including prediction and modeling to complex activities with an understanding of the limitations.

PO6 **Environmental and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional practice.

PO7 **Environment and sustainability**: Understand the impact of the solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 **Ethics:** Apply ethical principles and commit to ethics, and responsibilities and norms of the professional practice

PO9 **Individual and team work**: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

PO10 **Communication**: Communicate effectively with the professional community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.

PO11 **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Board of Studies

Proceedings of the meeting of the Board of Studies in Physics held on 6th June 2017 at 10.30 am, Conference Hall, Admin Block, REVA University, Rukmini Knowledge Park, Kattigenahalli, Yelahanka, and Bengaluru-560064.

Proceedings

At the outset, Prof. D V Sunitha, the Chairperson of the BOS in Department of Physics, introduced and welcomed all the members present, explained the purpose of the meeting and the agenda in brief. Then the agenda was taken up for discussion, when Prof. Bharathi Devi presented the proposed curriculum.

Agenda 1:

Preparation of Course Curriculum

The Chairperson explained briefly about the establishment of REVA University and the course being introduced under REVA University. He also explained the features of CBCS/CAGP of education the University is committed to follow since its inception itself. He requested all the members to corporate and to draft the curriculum as per the REVA University Regulations for CBCS-CAGP for PG programs.

The BOS members discussed the agenda in detail and drafted the course curriculum including the scheme of instruction, eligibility criterion, etc. The Board also drafted detailed syllabus.

Resolution:

The Board unanimously resolved to adopt CBCS-CAGP of education for M.Sc. in Physics program from the Academic Year 2017-19 and recommend the University to adopt detailed curriculum given below.

CBCS (CHOICE BASED CREDIT SYSTEM) AND CAGP (CONTINUOUS ASSESSMENT AND GRADING PATTERN) OF EDUCATION AND ITS ADVANTAGES

CBCS is a proven, advanced mode of learning in higher education. It facilitates students to have freedom in making their own choices for acquiring a Degree / Master's Degree program. It is more focused towards the student's choice in providing a wide range of Units available in a single campus across various disciplines offered by experts in the subjects. It leads to quality education with active teacher-student participation.

Studying under CBCS has following advantages:

- Students may undergo training in cross-disciplinary and multi-disciplinary subjects and acquire more focused and preferred knowledge.
- Students may get more skills from other subject(s) which are required for the career path in addition to their regular subject knowledge.
- Students may get ample opportunities to use the laboratories and gain practical exposure to the much needed Units available in other departments/schools for want of scientific inputs.
- Courses are conducted by subject experts identified on the basis of their experiences. Courses taught by such experts may provide in-depth information and clear understanding of the Units.
- Students may get an opportunity to study courses with other students of different programs and exchange their views and knowledge in a common class room.
- CBCS provides a cross-cultural learning environment.
- Students may benefit much from selecting the right options to successfully face the public service examinations like UPSC, KPSC, IES wherein the knowledge of additional subjects become mandatory for general or optional papers.
- Students are exposed to the culture of universal brotherhood during their campus life.
- Students are allowed to practice various methods of learning a subject.

Summary of REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Post Graduate Degree Program

CBCS is a proven, advanced mode of learning in higher education. It facilitates students to have freedom in making their own choices for acquiring a Degree / Master Degree program. It is more focused towards the student's choice in providing a wide range of modules available in a single campus across various disciplines offered by experts in the subjects. It leads to quality education with active teacher-student participation.

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BRIEF OUTLINE OF REVA UNIVERSITY REGULATIONS FOR CHOICE BASED CREDIT SYSTEM (CBCS) AND CONTINUOUS ASSESSMENT GRADING PATTERN (CAGP) FOR M.Sc PROGRAM IN PHYSICS, 2017

Course:

Every course offered will have three components associated with the teaching-learning process of the course, namely:

(i) L= Lecture (ii) T= Tutorial (iii) P= Practice, where:

L stands for Lecture session consisting of classroom instruction.

T stands for Tutorial session consisting participatory discussion / self study/ desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lectureclasses.

P stands for Practice session and it consists of Hands on Experience / Laboratory Experiments / Field Studies / Case Studies that equip students to acquire the much-required skill component.

In terms of credits, every one hour session of L amounts to 1 credit per Semester and a minimum of two hour session of T or P amounts to 1 credit per Semester, over a period of one Semester of 16 weeks for teaching-learning process. The total duration of a semester is 20 weeks inclusive of semester-end examination.

A course shall have either or all the three components. That means a course may have only lecture component, or only practical component or combination of any two or all the three components.

The total credits earned by a student at the end of the semester upon successfully completing the course are L + T + P. The credit pattern of the course is indicated as L: T: P.

If a course is of 4 credits then the different credit distribution patterns in L: T: P format could be:

4 : 0 : 0, 1 : 2 : 1, 1 : 1 : 2, 1 : 0 : 3, 1 : 3 : 0,

2 : 1 : 1, 2 : 2 : 0, 2 : 0 : 2, 3 : 1 : 0, 3 : 0 : 1,

0 : 2 : 2, 0 : 4 : 0, 0 : 0 : 4, 0 : 1 : 3, 0 : 3 : 1,

The concerned BoS will choose the convenient Credit Pattern for every course based on the requirement. However, generally, a course shall be of FOUR Credits and occasionally may be of TWO Credits.

Different Courses of Study are labeled and defined as follows:

Core Course:

A course which should compulsorily be studied by a candidate as a core-requirement is termed as a Core course. The CORE courses of Study are of THREE types, viz. – (i) Foundation Course, (ii) Hard Core Course, and (iii) Soft Core Course.

(i) Foundation Course (FC):

The foundation Course is a core course which should be completed successfully as a part of graduate degree program irrespective of the branch of study.

(ii) Hard Core Course (HC):

The Hard Core Course is a Core Course in the main branch of study and related branch (es) of study, if any that the candidates have to complete compulsorily.

(iii) Soft Core Course (SC):

A Core course may be a Soft Core if there is a choice or an option for the candidate to choose a course from a pool of courses from the main branch of study or from a sister/related branch of study which supports the main branch of study.

Open Elective Course:

An elective course chosen generally from other discipline / subject, with an intention to seek exposure is called an Open Elective Course.

Project Work:

Project work is a special course involving application of knowledge in solving / analyzing /exploring a real-life situation / difficult problem. A project works up to FOUR credits is called Minor Project work. A project work of EIGHT or TWELVE credits is called Major Project work. A Minor Project work may be a hard core or a Soft Core as decided by the BoS / School Council concerned. But the Major Project shall be Hard Core.

Eligibility for Admission:

The eligibility criteria for admission to Master Program of 2years (4 Semesters) are given below:

Sl. No.	Program	Duration	Eligibility
1	Master of Science (Physics)	2 Years	Passed Bachelor's Degree of 3 years with Physics as major / optional subject with 45% marks (40% in case of candidate belonging to SC/ST category) of marks in aggregate of any recognized / institution or any other qualification recognized as equivalent there to.

Duration of the program and Medium of Instruction:

A Master's degree program is of 4 semesters - 2 years duration of 96 credits. A candidate can avail a maximum of 8 semesters - 4 years as per double duration norm, in one stretch to complete Master's degree, including blank semesters, if any. Whenever a candidate opts for blank semesters, he/she has to study the prevailing courses offered by the School/Department when he/she resumes his/her studies.

Every course including project work, practical work, field work, self study elective should be entitled as Foundation Course (FC), Hard Core (HC) or Soft Core (SC) or Open Elective (OE) or Core Course (CC) by the BoS concerned. However, following shall be the Foundation Courses with credits mentioned against them, common to all branches of study.

A candidate can enroll for a maximum of 24 credits per Semester including:

(i) Dropped Courses of corresponding semester(s) of previous year(s), if any:

(ii) Additional Courses from the corresponding Semester of immediate succeeding year.

However, a candidate may not successfully earn a maximum of 24 credits per semester.

Generally a full-time candidate may register for 20 credits per semester.

Eligibility for Declaration of Ranks / Medals:

Only such candidates who register for a minimum of 24 credits per semester from I semester to IV semester and complete successfully 96 credits in 4 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full-time students and for hostel facilities.

Continuous Assessment, Earning of Credits, and Award of Grades.

The assessment / evaluation of the candidate is based on continuous assessment. The structure for evaluation is as follows:

For the purpose of assessment and evaluation, a semester is divided into 4 discrete components identified as IA1, IA2, and IA3 and Final

The performance of a candidate in a course will be assessed for a maximum of 100 marks as explained below. Scheme of Assessment & Evaluation

1. The Scheme of Assessment and Evaluation will have two parts, namely;
   i. Internal Assessment (IA); and
   ii. Semester End Examination (SEE)

2. Assessment and Evaluation of each Course shall be for 100 marks. The Internal Assessment (IA) and Semester End Examination (SEE) of UG non engineering programs and PG programs shall carry 50 marks each (i.e., 50 marks internal assessment; 50 marks semester end examination).

3. The 50 marks of Internal Assessment (IA) shall comprise of:

Internal Test	= 30 marks
Assignments	= 10 marks
Seminars	= 10 marks

4. There shall be **three internal tests** conducted as per the schedule given below. T**he students have to attend all the three tests compulsorily.**

- **1st test** for 15 marks during **2nd part of the 6th week** of the beginning of the Semester;
- **2nd test** for 15 marks during **2nd part of the 13th week** of the beginning of the Semester; and
- **3rd test** for 15 marks during **2nd part of the 16th week** of the beginning of the Semester.

5. The coverage of syllabus for the said three tests shall be asunder:

- For the **1st test** the syllabus shall be **First Unit and 1st half of Second Unit** of the Course;
- For the **2nd test** it shall be **Second half of Second Unit and Third Unit** of the Course;
- For the **3rd test** the syllabus will be **Fourth Unit** of the Course.

6. **Out of 3 tests, the highest marks secured in two tests are automatically considered while assessing the performance of the students.**

7. There shall be two Assignments and two Seminars each carrying 5 marks. Hence two assignments carry 10 marks (5+5 marks) and two seminars carry 10 marks (5+5 marks) as stated at Sl.No.3 above.

8. The Semester End Examination for 50 marks shall be held during 19th and 20th week of the beginning of the semester and **the syllabus for the semester end examination shall be entire 4 units**.

9. The **duration of the internal test shall be 75 minutes and for semester end examination the duration shall be 3 hours.**

10. The question papers for internal test shall be set by the internal teachers who have taught the course. If the course is taught by more than one teacher all the teachers together shall devise the question paper(s). However, these question papers shall be scrutinized by a Committee of senior teachers to bring in the uniformity in the question paper pattern and as well to maintain the quality of the question papers.

11. The test shall be common for all the students as it is prevailing today. The evaluation of the answer scripts shall be done by the internal teachers who have taught the course.

12. There shall be three sets of question papers for the semester end examination of which one set along with scheme of examination shall be set by the external examiners and two sets along with scheme of examination shall be set by the internal examiners. All the three sets shall be scrutinized by the Board of Examiners. It shall be the responsibility of the Board of Examiners Particularly Chairman of the BOE to maintain the quality and standard of the question papers and as well the coverage of the entire syllabus of thecourse.

13. There shall be double evaluation, viz, first valuation by the internal teachers who have taught the subject and second evaluation shall be the external examiner.

14. The average of the two evaluations (internal examiner & external examiner) shall be the marks to be considered for declaration of results.

Summary of Continuous Assessment and Evaluation Schedule

Type of Assessment	Period	Syllabus	Marks	Activity
Allocation of Topics for Assignments / Seminars / Model making	Beginning of 5th Week	First Unit and Second Unit	---	Instructional process and Continuous Assessment
First Internal Test	Second Part of 6th Week	First Unit and 1st half of Second Unit	15	Consolidation of First Unit and 1st half of Second Unit
Submission of Assignments	8th Week	First Unit and Second Unit	5	Instructional process and Continuous Assessment
Seminars	9th Week	First Unit and Second Unit	5	Instructional process and Continuous Assessment
Second Internal Test	2nd Part of 13th Week	2nd half of Second Unit and ThirdUnit	15	Consolidation of 2nd half of Second Unit and Third Unit
Allocation of Topic for 2nd Assignment / Seminars	11th Week	Third Unit and Fourth Unit	----	Instructional process and Continuous Assessment
Submission of Assignments	13th Week	Third Unit and Fourth Unit	5	Instructional process and Continuous Assessment
Seminars	14th Week	Third Unit and Fourth Unit	5	Instructional process and Continuous Assessment
Third Internal Test	2nd Part of 16th Week	Fourth Unit	15	Consolidation of entire Fourth Unit
Semester End Practical Examination	17th & 18th Week	Entire syllabus	50	Conduct of Semester - end Practical Exams
Preparation for Semester–End Exam	17th & 18th Week	Entire Syllabus	----	Revision and preparation for semester–end exam
Semester End Theory Examination	19th and 20th Week	Entire Syllabus	50	Evaluation and Tabulation
	End of 21st Week			Notification of Final Grades

Note:

1. **As per the model making is concerned, the School shall decide about the Marks and the Number of Model Designs and as well the schedule of allocation and presentation of model design(s). If the model design carries 5 marks, there shall be two model designs; and in case of 10 marks, there shall be one model design. However, the decision of the School should be announced in the beginning of the Semester for students to avoid ambiguity and confusion.*

2. Examination and Evaluation shall take place concurrently and Final Grades shall be announced latest by 5 day after completion of the examination.

3. Practical examination wherever applicable shall be conducted after 3rd test and before semester end examination. The calendar of practical examination shall be decided by the respective School Boards and communicated well in advance to the Registrar (Evaluation) who will notify the same immediately.

14. Assessment of Performance in Practical's

The performance in the practice tasks / experiments shall be assessed on the basis of:

a) Knowledge of relevant processes;

b) Skills and operations involved;

c) Results / products including calculation and reporting

The 50 marks meant for continuous assessment of the performance in carrying out practical's Shall further be allocated as under:

i	Conduction of regular practical / experiments throughout the semester	20 marks
ii	Maintenance of lab records	10 marks
iii	Performance of mid-term test (to be conducted while conducting second test for theory courses); the performance assessments of the mid-term test includes performance in the conduction of experiment and write up about the experiment.	20 marks
	Total	**50 marks**

The 50 marks meant for Semester End (C3) Examination, shall be allocated as under:

i	Conduction of semester end practical examination	30 marks
ii	Write up about the experiment / practical conducted	10 marks
iii	Viva Voce	10 marks
	Total	**50 marks**

The duration for semester-end practical examination shall be decided by the concerned School Board.

15. Evaluation of Minor Project / Major Project / Dissertation:

Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to the regular discussion with the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation, as the case may be, for final evaluation. The components of evaluation are as follows:

i	Periodic Progress and Progress Reports (25%)
ii	Results of Work and Draft Report (25%)
iii	Final Evaluation and Viva-Voce (50%). Evaluation of the report is for 30% and the Viva-Voce examination is for 20%.

16. Requirements to Pass a Course

16.1 A candidate's performance from IA and SEE will be in terms of scores, and the sum of IA and SEE scores will be for a maximum of 100 marks (IA = 50 + SEE = 50) and have to secure a minimum of 40% to declare pass in the course. However, a candidate has to secure a minimum of 25% (12.5 marks) in Semester End Examination (SEE) which is compulsory

Eligibility to Appear for Semester - end Examination and Provision to Drop the Course.

Only those students who fulfill 75% of attendance requirement are eligible to appear for Semester end examination in that course.

In case a candidate opts to drop the course he / she has to re-register for the dropped course only in subsequent semesters whenever it is offered if it is Hard Core Course. He / she may choose alternative course if it is Soft Core Course or Open Elective course or Skill Development Course.

The details of any dropped course will not appear in the Grade Card.

Provision to Withdraw Course:

A candidate can withdraw any course within ten days from the date of notification of final results. Whenever a candidate withdraws a course, he/she has to register for the same course in case it is hard core course, the same course or an alternate course if it is soft core/open elective. **A DROPPED course is automatically considered as a course withdrawn.**

17. Provision for Make- up Examination:

Re-Registration and Re-Admission:

A candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University and is considered as dropped the semester and is not allowed to appear for end semester end examination (SEE shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

In case a candidate fails in more than 2 courses in odd and even semesters together in a given academic year, he / she may either drop all the courses and repeat the semester or reappear (SEE- semester end examination) to such of those courses where in the candidate has failed during subsequent semester / year within a stipulated period.

In such a case where in a candidate drops all the courses in semester due to personal reasons, it is considered that the candidate has dropped the semester and he / she shall seek re-admission to such dropped semester.

Requirements to Pass the Semester and Provision to Carry Forward the Failed Subjects / Courses:

Provision to Carry Forward the Failed Subjects / Courses:

A student who has failed in 2 courses in 1st and 2nd semesters together shall move to 3rd semester. And he / she shall appear for semester end examination of failed courses of the said semesters concurrently with 3rd semester end examinations (SEE) and 4th semester end examinations (SEE) of second year of study.

18. Attendance Requirement:

All students must attend every lecture, tutorial and practicalclasses.

In case a student is on approved leave of absence (e g:- representing the university in sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes taught.

Any student with less than 75% of attendance in a course in aggregate during a semester shall not be permitted to appear to the end semester (SEE) examination.

Teachers offering the courses will place the above details in the School / Department meeting during the last Wk. of the semester, before the commencement of SEE, and subsequently a notification pertaining to the above will be brought out by the Head of the School before the commencement of SEE examination. A copy of this notification shall also be sent to the office of the Registrar & Registrar (Evaluation).

Absence during mid semester examination

In case a student has been absent from a mid semester examination due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Head of the School, for make-up examination. The Head of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and permit such student to appear for make-up mid semester examination.

Absence during end semester examination:

In case a student is absent for end semester examination on medical grounds or such other exigencies, the student can submit request for make-up examination, with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Director of the School. The Director of the School may consider such request depending on the merit of the case and after consultation with class teacher, course instructor and permit such student to appear for make-up mid semester examination

19. Provisional Grade Card:

The tentative / provisional Grade Card will be issued by the Registrar (Evaluation) at the end of every Semester indicating the courses completed successfully. The provisional grade card provides **Semester Grade Point Average** (SGPA).This statement will not contain the list of DROPPED courses.

Challenge Valuation:

A student who desires to apply for challenge valuation shall obtain a Xerox copy of the answer script by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the Grade awarded to him/her by surrendering the Grade Card and by submitting an application along with the prescribed fee to the Registrar (Evaluation) within 15 days after the announcement of the results. This challenge valuation is only for Semester End Examination (SEE) component.

The answer scripts for which challenge valuation is sought for shall be sent to another external examiner. The marks awarded will be the higher of the marks obtained in the challenge valuation and in maiden valuation.

Final Grade Card: Upon successful completion of the Post Graduate Degree a Final Grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Registrar (Evaluation).

The Grade and the Grade Point: The Grade and the Grade Point earned by the candidate in the subject will be as given below.

Marks	Grade	Grade Point	Letter Grade
P	G	(GP=V x G)	
90-100	10	v*10	O
80-89	9	v*9	A
70-79	8	v*8	B
60-69	7	v*7	C
50-59	6	v*6	D
40-49	5	v*5	E
0-39	0	v*0	F

O - Outstanding; A-Excellent; B-Very Good; C-Good; D-Fair; E-Satisfactory; F - Fail;

Here, P is the percentage of marks (P=[(IA1+IA2)+M] secured by a candidate in a course which is **rounded to nearest integer**. V is the credit value of course. G is the grade and GP is the grade point.

Computation of SGPA and CGPA

The Following procedure to compute the Semester Grade Point Average (SGPA)

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

SGPA (Si) = ∑(Ci x Gi) / ∑Ci

Where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

Illustration for Computation of SGPA and CGPA
Illustration No. 1

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade)
Course 1	**4**	**A**	**9**	**4X9=36**
Course 2	**4**	**B**	**8**	**4X8=32**
Course 3	**4**	**C**	**7**	**4X7=28**
Course 4	**4**	**O**	**10**	**4X10=40**
Course 5	**4**	**D**	**6**	**4X6=24**
Course 6	**4**	**O**	**10**	**4X10=40**
	24			**200**

Thus, **SGPA = 200 ÷ 24 = 8.33**

Illustration No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	**5**	**A**	**9**	**5X9=45**
Course 2	**5**	**C**	**7**	**5X7=35**
Course 3	**5**	**A**	**9**	**5X9=45**
Course 4	**5**	**B**	**8**	**5X8=40**
Course 5	**4**	**O**	**10**	**4X10=40**
	24			**205**

Thus, **SGPA = 205 ÷ 24 = 8.54**

Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (96) for two year post graduate degree in Computer Science & Engineering is calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e

CGPA = ∑(Ci x Si) / ∑Ci Where Si is the SGPA of the i^{th} semester and Ci is the total number of credits in that semester.

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

ILLustration:
CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	24	8.33	24 x 8.33 = 199.92
2	24	8.54	24 x 8.54 =204.96
3	24	9.35	24x9.35=224.4
4	24	9.50	24x9.50=228.0
Cumulative	96		857.28

Thus, **CGPA** = 24x8.33+24x8.54+24x9.35+24x9.50 = 8.93

CONVERSION OF GRADES INTO PERCENTAGE:

Conversion formula for the conversion of CGPAinto Percentage is:

Percentage of marks scored = CGPA Earned x10

Illustration: CGPA Earned 8.93 x 10=89.30

Classification of Results

The final grade point (FGP) to be awarded to the student is based on CGPA secured by the candidate and is given as follows.

CGPA	**Numerical Index**	**FGP**
		Qualitative Index
> 4 CGPA < 5	**5**	SECOND CLASS
5 > = CGPA < 6	6	
6 >= CGPA < 7	7	FIRST CLASS
7 >= CGPA < 8	8	
8 >= CGPA < 9	9	DISTINCTION
9 >= CGPA 10	10	

Overall percentage=10*CGPA

20. Provision for Appeal

If a candidate is not satisfied with the evaluation of IA1, IA2 and IA3 components, he/she can approach the grievance cell with the written submission together with all facts, the assignments, test papers etc, which were evaluated. He/she can do so before the commencement of semester-end examination. The grievance cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the university on the candidate if his/her submission is found to be baseless and unduly motivated. This cell may recommend taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cell isfinal.

21. Grievance Cell

For every program there will be one grievance cell. The composition of the grievance cell is as follows:-

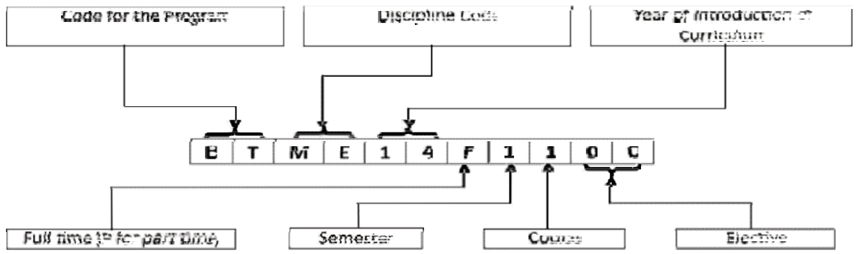
The Registrar (Evaluation) - Ex-officio Chairman / Convener

One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member.

One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

22. With regard to any specific case of ambiguity and unsolved problem, the decision of the Vice-Chancellor shall be final.

Course Numbering Scheme



List of Codes for Programs and Disciplines / Branch of Study

Program Code	Title of the Program	Discipline Code	Name of the Discipline / Branch of Study
BA	Bachelor of Arts	AE	Advanced Embedded Systems
BB	BBM (Bachelor of Business	AI	Advanced Information
BC	B.Com (Bachelor of commerce)	AP	Advanced Power Electronics
BR	B. Arch (Bachelor of Architecture)	CA	Computer Aided Structural Engineering
BS	B Sc, BS (Bachelor of Science)	CE	Civil Engineering
BT	B.Tech (Bachelor of Technology)	CH	Chemistry
BP	Bachelor of Computer Applications	CO	Commerce
BL	LLB (Bachelor of Law)	CS	Computer Science and
MA	Master of Arts	DE	Data Engineering and Cloud
MB	MBA (Master of Business Administration)	EC	Electronics and Communication Engineering
MC	M.Com (Master of Commerce)	EN	English
MS	M.Sc / MS (Master of Science)	MD	Machine Design and Dynamics
MT	M Tech (Master of Technology)	ME	Mechanical Engineering
MC	Master of Computer Applications	EE	Electrical & Electronics Engineering

M Sc in Physics: Program Overview

Physics, in general, is the study of matter, energy and their forms and mutual interaction with each other. Physicists explore the universe at its most fundamental levels and extend such knowledge to more complicated systems ranging from the subatomic to the cosmological scale. Also, Physics can be considered as the basis for all-natural sciences and the mother of any modern engineering branches and seed for the developments in technology.

The Master of Science in Physics programme at REVA University, prepares graduates for careers in research and teaching at the university level or research in industrial laboratories. Students enrolling in the two-year Master's programme will broaden their previous background in general physics and will be supported in carrying on their first independent research project.

Career Opportunities

The career opportunities for M.Sc in Physics students can be classified into the following categories:

1. Teaching Physics at High school, Graduate and post-graduate level.
2. Research opportunities at Industry / Academic institutions.
3. Eligibility to appear in jobs specialized for Physicists in public/ privatesector.

Eligibility for M.Sc. in Physics

Eligibility: Passed Bachelor's Degree of 3 years with Physics as major / optional subject with 45% marks (40% in case of candidate belonging to SC/ST category) of marks in aggregate of any recognized / institution or any other qualification recognized as equivalent there to.

Programme Educational Objectives (PEOs)

The aim of the programme is to produce postgraduates with - advanced knowledge and understanding of Physics; higher order critical, analytical, problem solving and attitudinal skills (transferable) to meet expectations of research establishments, relevant industry and academia or to take up entrepreneurial route. Hence,

The Programme Educational objectives are to prepare the students to:

1. Pursue higher education through continuous learning with effective communication skills
2. have successful professional careers in academia, industry and government
3. Start own enterprise and provide solutions to scientific research problems
4. Exhibit skills as a member of a team in national and international organizations with highest ethics through lifelong learning

Programme Outcomes (POs)

After undergoing this programme, a student will be able to:

1. **Domain knowledge**: Apply the knowledge of physics and fundamentals for the solution of complex problems in day to day life.
2. **Problem analysis**: Identify, formulate, research literature, and analyze problems to arrive at substantiated conclusions using principles of physical sciences.
3. **Design/development of solutions**: Design solutions for real time problems to meet the specifications with consideration for the public health and safety, the cultural and societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge, for analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Apply appropriate techniques, resources, and IT tools including prediction and modeling to complex activities with an understanding of the limitations.
6. **Environmental and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional practice.
7. **Environment and sustainability**: Understand the impact of the solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to ethics, and responsibilities and norms of the professional practice
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively with the professional community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.
11. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

1. Apply the fundamentals of classical mechanics, electrodynamics, Quantum mechanics and condensed matter physics to understand the energy quantization concepts.
2. Identify and compare the materials best suited for futuristic engineering applications
3. Explore the knoweledge of basic concepts of atomic, molecular, nuclear physics to analyse the spectra obtanied from various bodies.
4. Demonstrate the knowledge of fundamentals of electronic devices

Scheme of Instruction

Intake: 32

SEMESTER-I

Sl. No.	Course Code	Title of the Course	Type of Course	Credit Pattern & Credit Value				Contact Hours
				L	T	P	Total	
1	MS17PH101	Mathematical Physics	HC	3	1	0	4	5
2	MS17PH102	Classical Mechanics	HC	3	1	0	4	5
3	MS17PH103	Electronic devices	HC	3	1	0	4	5
4	MS17PH104	Condensed matter physics (General)	HC	3	1	0	4	5
5	MS17PH105	Material Science (General)	HC	3	1	0	4	5
6	MS17PH106	**Practical :** General Physics lab I	HC	0	0	3	3	3
7	MS17PH107	**Practical :** Electronics lab	HC	0	0	3	3	3
Total Credits				**15**	**5**	**6**	**26**	**31**

SEMESTER-II

Sl. No.	Course Code	Title of the Course	Type of Course	Credit Pattern & Credit Value				Contact Hours
				L	T	P	Total	
1	MS17PH201	Quantum Mechanics I	HC	3	1	0	4	5
2	MS17PH202	Statistical Mechanics	HC	3	1	0	4	5
3	MS17PH203	Electrodynamics	HC	3	1	0	4	5
4	MS17PH204	Atomic and Molecular Physics	HC	3	1	0	4	5
5	MS17PH215	Electronics I (Digital Electronics)	SC#	3	1	0	4	5
	MS17PH225	Condensed Matter Physics I						
	MS17PH235	Material Science I						
6	MS17PH206	**Practical :** General Physics lab II	HC	0	0	3	3	3
7	MS17PH207	**Practical :** Atomic and Molecular Physics	HC	0	0	3	3	3
Total Credits				**15**	**5**	**6**	**26**	**26**

Note: #Soft core (SC): Student should opt for one SC of his/her choice which will be continued in higher semesters also.

SEMESTER-III

Sl. No.	Course Code	Title of the Course	Type of Course	Credit Pattern & Credit Value				Contact Hours
				L	T	P	Total	
1	MS17PH301	Quantum Mechanics II	HC	3	1	0	4	5
2	MS17PH302	Nanoscience and Nanotechnology	HC	3	1	0	4	5

3	MS17PH303	Nuclear and Particle physics	HC	3	1	0	4	5
4	MS17PH314	Electronics II (Electronic communication systems)	SC#	3	1	0	4	5
	MS17PH324	Condensed Matter Physics II						
	MS17PH334	Material Science II						
5	MS17PH315	Electronics III (Linear integrated circuits)	SC#	3	1	0	4	5
	MS17PH325	Condensed Matter Physics III						
	MS17PH335	Material Science III						
6	MS17PH306	**Astrophysics**	OE*	3	1	0	4	5
7	MS17PH307	**Practical:** General physics lab III	HC	0	0	3	3	3
8	MS17PH318	**Practical:** Electronics Lab (Special)	SC#	0	0	3	3	3
	MS17PH328	**Practical :** Condensed Matter Physics (Special)						
	MS17PH338	**Practical :** Material science (Special)						
Total Credits				**18**	**6**	**6**	**30**	**36**

Note: *OE is open elective course offered for students of other schools; the students of MSc – physics shall take any one of the OE course offered by other schools.

#Soft core (SC): Student should opt for one SC of his/her choice which will be continued in higher semesters also.

SEMESTER-IV

Sl. No.	Course Code	Title of the Course	Type of Course	Credit Pattern & Credit Value				Contact Hours
				L	T	P	Total	
1	MS17PH401	Project/Internship	HC	0	0	14	14	-
Total Credits				**0**	**0**	**14**	**14**	
Total Credits of I to IV Semesters				**48**	**16**	**32**	**96**	

SEMESTER-I

Sub Code: MS17PH101	MATHEMATICAL PHYSICS	C	L	T	P	CH
Duration: 14 Weeks		4	3	1	0	5

Course Objectives: To make the students understand the basics of mathematical functions necessary for formulating physical systems and phenomena observed in day to day life.

Course Out comes: On successful completion of this course a student shall be able to acquire the knowledge about various mathematical tools like vectors, Matrices, Tensors and special mathematical functions that can be employed to formulate physical phenomena.

Unit 1:

Vectors: Review of Vector Algebra, Gradient, Divergence, Curl, Vector Integration, Gauss's Theorem, Stokes's Theorem, Gauss's Law, Laplace equation and Poisson's Equation, Applications of vectors.
12 hrs

Unit 2:

Matrices: Basic Definitions, Equality, and Rank, Matrix Multiplication, Addition , Inner Product, Matrix Inversion, Orthogonal, Hermitian, and unitary matrices; Diagonalization of Matrices, Matrix representation of linear operators, Eigen values and eigenvectors, characteristic equation of matrix, Cayley-Hamilton theorem, applications of matrices in physics. **12 hrs**

Unit 3:

Tensors: Curvilinear coordinates, Coordinate transformation in linear spaces, Kronecker delta, definition and types of tensors: contravariant and covariant tensors, symmetric and antisymmetric tensors, Tensor algebra: equality, addition and subtraction, tensor multiplication, outer product; contraction of indices, inner product, quotient theorem, metric tensor**,** Christoffel symbols. Tensors applications in physics**.**
12 hrs

Unit 4:

Special functions: Differential equations, Hermite and Lagaurre functions: Partial differential equations, Separation of variables- Helmholz equation in cylindrical and spherical polar coordinates. Differential equations: Regular and irregular singular points of a second order ordinary differential equation. Series solutions–Frobinius method. Linear independence of solutions-Wronskian. Hermite functions: Generating functions, Recurrence relations, Rodrigues representation, Orthogonality. Laguerre functions: Differential equation-Laguerre polynomials, Generating function, Recurrence relations, Rodrigues representation, Orthogonality, Associated Laguerre functions and its general properties. **12 hrs**

References:

1. Mathematical methods for physicists, Arfken G. B and Weber H.J, 4th Edition, Prism Books Pvt Ltd, India (1995).
2. Mathematical Physics, Sathya Prakash, Sultan Chand and Sons, (1985).

3. Mathematical Physics, Chattopadhyaya P.K, Wiley Eastern, (1980).
3. Methods of Mathematical Physics, Bose H.K and Joshi M.C, Tata McGraw Hill, (1984).
4. Vector Analysis, Murray R Spiegel, Schaum's Outline Series, McGraw Hill International Book Company, Singapore (1981).
5. Tensor Analysis — Theory & Applications. Sokolnikoff LS, 211: Edition, John Wiley Sons (1964).
6. Mathematical Methods in the Physical Sciences, Mary L. Boas, 2nd Edition, John Wiley & Sons (1983)

Sub Code: MS17PH102	CLASSICAL MECHANICS	C	L	T	P	CH
Duration: 14 Weeks		4	3	1	0	5

Course Objectives:

- To give students a solid foundation in classical mechanics.
- To introduce general methods of studying the dynamics of particlesystems.
- To give experience in using mathematical techniques for solving practical problems.
- To lay the foundations for further studies in physics and engineering.

Course Outcome:

- Know the difference between Newtonian mechanics and Analytic mechanics.
- Solve the mechanics problems using Lagrangian formalism, a different method from Newtonian mechanics
- Understand the connection between classical mechanics and quantum mechanics from Hamiltonian formalism

Unit 1:

The Lagrangian method: Constraints and their classifications. Generalized coordinates. Virtual displacement, D'Alembert's principle and Lagrangian equations of the second kind. Examples of

(I) Single particle in (a) Cartesian coordinates, (b) Spherical polar coordinates and (c) Cylindrical polar coordinates, (II) Atwood's machine. Derivation of Lagrange equation from Hamilton principle. Importance and simple applications of Lagrangian formulism, Symmetry and conservation laws, cyclic coordinates. **12 hrs**

Unit 2

Central force problem: Motion of a particle in a central force field, Conservation of energy and angular momentum, classification of orbits, stability of orbits, Kepler's laws of planetary motion. Scattering in a central potential in Laboratory and centre of mass frames, Impact parameter, Total and differential cross section, Rutherford scattering. **12 hrs**

Unit 3:

amilton's equations: Generalized momenta. Hamilton's equations. Examples (i) the simple harmonic oscillator. (ii) Hamiltonian for a free particle in different coordinates. Cyclic coordinates. Physical significance of the Hamiltonian function. Derivation of Hamilton's equations from a variational principle. Generating functions (Four basic types), examples of Canonical transformations, Poisson brackets; properties of Poisson brackets, angular momentum and Poisson bracket relations. Equation of motion in the Poisson bracket notation. The Hamilton-Jacobi equation; the example of the harmonic oscillator treated by the Hamilton-Jacobi method. **12 hrs**

Unit 4

Mechanics of rigid bodies: Degrees of freedom of a free rigid body, Angular momentum and kinetic energy of rigid body. Fixed and moving coordinates, coriolis force, coriolis force acting on falling body. Moment of inertia tensor, principal moments of inertia, products of inertia, the inertia tensor. Euler equations of motion for a rigid body. Torque free motion of a rigid body. Precession of earth's axis of rotation, motion of symmetrical top-rotational motion. **12 hrs**

References:

1. Classical mechanics, H. Goldstein, C. Poole, J. saflco. 3rd edition. Pearson Education inc. (2002).
2. Classical mechanics. K. N. Srinivasa Rao, University press(2003).
3. Classical mechanics, N. C. Rana and P.S. Joag Tata McGraw-Hill (1991).
4. Classical dynamics of particles and systems, J. B. Marion, Academic press (1970).
5. Introduction to Classical mechanics. Takwale and Puranik, Tata McGraw-hill(1983)
6. Classical mechanics, L. D. Landau and E. M. Lifshitz, 4thedition, Pergamon Press (1985).

Sub Code: MS17PH103	Electronic devices	C	L	T	P	CH
Duration: 14 Weeks		4	3	1	0	5

Course Objectives:

- To understand the basic working of Semiconducting devices and Linear Integrated Circuits.
- To give an emphasis to the student to know the various semiconductor devices and its working.
- To give clear understanding of various fabrication techniques of semiconducting devices.
- To introduce the basic building blocks of linear integratedcircuits.

Course Outcome:

- At the end of this course, students will be able to understand the fundamentals of Semiconductor Device Physics.
- Know the physical principles crucial to the functionality and operation of basic semiconductor devices.
- Enrich their knowledge in understanding the linear and non-linear applications of operational amplifiers.

Unit 1:

Transistors: Transistor configurations and characteristics, Methods of biasing-fixed bias,collector to base bias and voltage divider bias, DC and AC load line, Transistor as an amplifier-Single stage and multistage amplifier, frequency response, Push-pull amplifier, Astable multivibrator using transistors, Voltage regulator using transistors. **12 hrs**

Unit 2:

Thyristors: Types of thyristors, working and characteristics of Silicon Controlled Rectifier (SCR), SCR power controller, Characteristics and application of Triac, Working and characteristics of Uni-junction Transistor (UJT), UJTrelaxation oscillator. **12 hrs**

Unit 3:

Operational amplifier: Block diagram of an operational amplifier, Characteristics of an idealoperational amplifier, Parameters of an op-amp, Operational amplifier as a feedback amplifier: Inverting and Non-inverting amplifiers, Applications of an operational amplifier: Instrumentation amplifier, Square wave and sine wave generator, Active filters- First order Butterworth low pass and high pass filter, phaseshift oscillator. **12 hrs**

Unit 4:

Optoelectronic devices: Photoresistor (LDR)–dark resistance and material constant, Principle and working of a photodiode, Principle and working of Light emitting diode, factors affecting the efficiency of LED, Phototransistor- structure and working, Semiconductor laser- basic structure and working. **12 hrs**

References:

1. Basic Electronics and Linear Circuits, NN Bhargava, DC Kulashreshtha and SC Gupta,Tata Mc Graw Hill.
2. Electronic Devices and Circuits: An Introduction, Allen Mottershead**,** Prentice Hall of India.
3. Semiconductor Optoelectronic Devices, Pallab Bhattacharya, Pearson education, Asia.
4. Electronic Principles, A P Malvino, (Sixth Edition, 1999), Tata McGraw Hill, New Delhi.
5. A Text Book of Basic Electronics, RS Sedha, S Chand & Company Ltd.
6. Op-Amps and Linear Integrated Circuits, Remakant A Gayakwad, (Third Edition, 2004), Eastern Economy Edition.
7. Linear Integrated Circuits, D Roy Choudhury and Shail Jain, New Age International Limited.

Sub Code: MS17PH104	**CONDENSED MATTER PHYSICS (General)**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**

Course Objectives:

- The course is to understand the basic knowledge on crystal structures and systems.
- Understand the various process techniques available of X-RayCrystallography.
- To comprehend the concepts of superconductivity and magnetic properties of solids.

Course Outcome:

- At the end of this course, students will be able to Basic knowledge of crystal structures and systems.
- Understand the basic idea about the Electronic Propertiesof Solids.
- Impart the knowledge about the properties magnetic Properties of Solids.
- Understand the applications of superconductivity.

Unit 1:

X-ray crystallography: Crystalline state. Reference axes, equation of a plane, Miller indices. External symmetry of crystals; symmetry operations. Two and three dimensional point groups. Lattices; two dimensional lattices, choice of unit cell. Three-dimensional lattices; crystal systems and Bravais lattices. Screw and glide operations. Space groups; analysis of the space group symbol. Diffraction of

Xrays by crystals: Laue equations. Reciprocal lattice. Bragg equations. Equivalence of Laue and Bragg equations. Atomic scattering factor (qualitative). **12 hrs**

Unit 2:

Experimental techniques: Brief introduction to Laue, Oscillation, Weissenberg, Powder and Counter methods. Using synchrotron radiation for structure studies.

Electron and neutron diffraction: Basic principles. Differences between them and X-ray diffraction. Applications (qualitative).

Crystal growth: Crystal growth from melt and zone refining techniques. Liquid crystals: Morphology. The smectic (A-H), nematic and cholesteric phases. Birefringence, texture and X-ray studies in these phases. Orientational order and its determination in the case of nematic liquid crystals. **12 hrs**

Unit 3:

Magnetic properties of solids: Diamagnetism and its origin. Expression for diamagnetic susceptibility, Paramagnetism. Quantum theory of Paramagnetism. Brillouin function. Ferromagnetism. Curie-Weiss law. Spontaneous magnetization and its variation with temperature. Ferromagnetic domains. Antiferromagnetism. Two sub-lattice model. Susceptibility below and above Neel's temperature.

Superconductivity: Experimental facts. Type I and type II semiconductors. Phenomena logical theory. London equations. Meissner effect. High frequency behavior. Thermodynamics of superconductors. Entropy and Specific heat in the superconducting state. Qualitative ideas of the theory of superconductivity. **12 hrs**

Unit 4:

Semiconductors: Intrinsic Semiconductors. Crystal structure and bonding. Expressions for carrier concentrations. Fermi energy, electrical conductivity and energy gap in the case of intrinsic semiconductors. Extrinsic Semiconductors; impurity states and ionization energy of donors. Carrier concentrations and their temperature variation. Qualitative explanation of the variation of Fermi energy with temperature and impurity concentration in the case of impurity semiconductors.

12 hrs

References

1. Stout G.H. and Jensen L.H., X-ray structure determination, MacMillan, USA, 1989.
2. Ladd M.F.C. and Palmer R.A., Structure determination by X-ray crystallography, Plenum Press, USA, 2003.
3. Buerger M.J., Elementary crystallography, Academic Press, London.
4. Dekker A.J., Solid state physics, Prentice Hall, 1985.
5. Kittel C., Introduction to solid state physics, 7th Edn., John Wiley, New York, 1996.
6. Mckelvey J.P., Solid state and semiconductor physics, 2nd Edn., Harper and Row, USA, 1966.
7. Streetman B.G., Solid state electronic devices, 2nd Edn., Prentice-Hall of India, New Delhi, 1983.
8. De Gennes P.G. and Prost J., The physics of liquid crystals, 2nd Edn., Clarendon Press, Oxford, 1998.
9. Wahab M.A., Solid state physics, Narosa Publishing House, New Delhi, 1999.
10. Azaroff L.V., Introduction to solids, McGraw-Hill Inc, USA, 1960.
11. Pillai S.O., Solid state physics, New Age International Publications, 2002.

Sub Code: MS17PH105	MATERIAL SCIENCE (GENERAL)	C	L	T	P	CH
Duration: 14 Weeks		4	3	1	0	5

Course Objectives:

- To introduce the basic principles underlying the behavior of materials.
- This course provides the scientific foundation for understanding of the relations among material properties, microstructure, and behavior of materials.
- Students will get familiar with the vocabulary for the description of the empirical facts and theoretical ideas about the various levels of stricture, from atoms, through defects in crystals, to larger scale morphology of practical materials.

Course Outcomes:

On successful completion of this course a student shall be able to

- Acquire the knowledge that will provide you with a foundation for understanding the relationship between a material's microstructure and itsproperties.
- Understand the crystallographic principles, defects and diffusion in materials and explain how the presence and properties of defects can increase or decrease the strength of a material.

Unit 1:

Formation and structure of materials

Introduction to material science- engineering materials- structure - property relationship. Review of ionic, covalent and molecular bindings- bond angle, bond length and bond energy. Lattice energy – Jones potential. Closed pack structures- packing efficiency and density of materials.

Crystal morphology - symmetry elements - crystal systems. Point group symmetry- derivation of point groups- elementary ideas on space groups. Principles of X-ray powder diffraction method, interpretation of powder photographs and powder metallurgy. **12 hrs**

Unit 2:

Crystal imperfections and diffusion in solids:

Review of crystalline imperfections- schottky and Frenkel defects- equilibrium concentrations. Line imperfections- edge and screw dislocations-interactions of dislocations. Surface imperfections- grain boundary- tilt and twin boundaries- volume imperfections.

Diffusions in solids - Fick’s law of diffusion- Solution to Ficks law - error function. Determination of diffusion co efficients- diffusion couple. Applications based on second law Atomic model of diffusion- electrical conductivity ofionic crystals. **12 hrs**

Unit 3:

Elastic and plastic behavior of materials

Atomic model of elastic behavior- the model as a parameter in design- rubber like elasticity-anelastic behavior – viscosity behavior. Fracture of materials – ductile and brittle fracture – ductile brittle transition- protection against fracture.

Plastic deformation by slip – the shear strength of perfect and real crystals- CRSS- the stress to move a dislocation – work hardening and dynamic recovery. Methods of strengthening crystalline materials against plastic deformation- strain hardening, grain refinement, solid solution strengthening, precipitation strengthening. **12 hrs**

Unit 4:

Phase diagrams and phase transformations

Phase diagrams- the phase rule and it's applications to binary alloy systems- isomorphous, eutectic and peritectic - the lever rule. Typical phase diagrams-Cu-Zn, Ag-Pb, Pb-Sn, Fe-C systems. Heat treatment processes- annealing, hardening and tempering.

Phase transformations- Nucleation and growth- nucleation kinetics – transformations in steel. Solidification and crystallization- recovery, recrystallization and gain growth. Microstructure-single phase materials, phase distribution precipitates and eutectoid decomposition- examples of modifications of microstructure. **12 hrs**

References:

1. Elements of material science and engineering, **Lawrence H. Van Vlack Addison Wesley** (1975).
2. Material science and engineering, **V. Raghavan**, Prentice Hall (1993)
3. Nature of chemical Bond, **L Pauling**, Oxford and IBH (1960)
4. An introduction to crystallography, **F.C. Phillips**, Longman (1970)
5. Crystallography applied to solid state physics, **Verma and srivastava** New age international (2005)
6. Introduction to solid Solid state physics**, C. kittel,** Wiley Eastern (1993)
7. The structure and properties of Materials vol I- IV- **Rose, Shepard** and wulff (1987)
8. Introduction to solids**, L. V Azaroff, Mc Graw** Hill (1977)
9. Foundation of material science and engineering, William **F. Smith,Mc** Graw Hill international Editions (1988)
10. Solid state Physics Source Book- **Sybil P Parker** (Ed), Mc Graw Hill (1987).
11. Solid state phase trasformations, **V. Raghavan**, Prentice hall (1991).

Sub Code: MS17PH106	GENERAL PHYSICS LAB I	C	L	T	P	CH
Duration: 14 Weeks		3	0	0	3	3

Course Objectives:

- To make the student familiarize with the basics of experimental physics.
- To enable the student to explore the concepts involved in the thermodynamics and heat.
- To make the student understand the basic concepts in modern optics.
- To allow the student to understand the fundamentals of instruments involved.

Course Outcome:

- At the end of the course, the student should have had a knowledge on the different experimental techniques.
- The student should have understood the basics of physics involved in experiments.
- The student should be able to apply the concepts of physics and do the interpretation and acquire the result.

LIST OF EXPERIMENTS

1. Determination of rigidity modulus and moment of inertia using Torsional pendulum for two different materials.
2. Measurement of resistivity of a semiconductor by Four probe method at different temperature and determination of energy gap.
3. Determination of grating constant and wavelength of LASER light by using grating.
4. Design of CE transistor amplifier.
5. Deter,ination of Stefanc's constant and Verification of Stefan's fourth power law by electrical method.
6. Determination of Energy band gap of two different semiconductor.
7. Determination of solar constant.
8. Thermal Conductivity of a rod by Forbe's method.
9. Determination of temperature sensitivity of a thermocouple and its Calibration.
10. Determination of wavelength of sodium light by Michelson's interferometer.

Sub Code: MS17PH107	**Practical: Electronics lab**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**3**	**0**	**0**	**3**	**3**

Course Objectives:

- To make the student familiarize with the basics of electronics.
- To enable the student to explore the concepts involved in the oscillators.
- To make the student understand the basic concepts in Ic's and digitaldevices.
- To allow the student to understand the fundamentals of multivibrators.

Course Outcome:

- At the end of the course, the student should have had knowledge on the different experimental techniques involved in electronics.
- The student should be able to independently construct thecircuits.
- The student should be able to apply the concepts of electronics and do the interpretation and acquire the result.

List of Experiments

1. Experiment on UJT and its applications.
2. Astable, monostable and bistable multivibrator using IC 555 timer.
3. Voltage controlled oscillator using IC741 and 555.
4. Zener diode characteristics and voltage regulation.
5. Study of FET characteristics and its applications inamplifier.
6. Study of MOSFET characteristics and its applications asamplifier.
7. Characteristics and applications of SCR.
8. Monostable multivibrator using IC 74127.

9. Design of regulated power supply.
10. Solving Boolean expressions.

SEMESTER-II

Sub Code: MS17PH201	QUANTUM MECHANICS – I	C	L	T	P	CH
Duration: 14 Weeks		4	3	1	0	5

Course Objectives

- To illustrate the inadequacy of classical theories and the need for a quantum theory.
- To explain the basic principles of quantum mechanics.
- To develop solid and systematic problem solving skills.
- To apply quantum mechanics to simple systems occurring in atomic and solid state physics.

Course Outcome:

- To have a working knowledge of the foundations, techniques and key results of quantum mechanics.
- To comprehend basic quantum mechanical applications at the researchlevel.
- Gain an ability to competently explain/teach quantum physics to others.

Unit 1

Introduction: Dual nature of matter and waves, Double-slit experiment for photons and electrons as an illustration. Fundamental Postulates of Quantum Mechanics. Review of Linear vector spaces in Dirac Bra-Ket notation. Position and momentum representations. Wavefunctions. Superposition principle. probability densities, probability current. Expectation values. Commutators. Eigenvalues and eigenvectors of a complete set of mutually commuting operators. Waves, wave packets, phase velocity and group velocity. Canonically conjugate variables, General uncertainty principle. Hamiltonian, Schrodinger's equation. Ehrenfest's Theorem. Continuity equation. **12 hrs**

Unit 2

Exactly solvable problems in one-dimension*:* Bound states, examples of particle in a box, rectangular potential wells, Simple Harmonic Oscillator: wave function and operator approach. particle in a spherically symmetric potential, Rigid rotator, hydrogen atom.

Unbound states, Scattering in one-dimension. Examples of scattering from a one-dimensional rectangular potential well and barrier, Tunneling, Transmission and Reflection co-efficients. Ramsauer -Townsend effect, Alpha decay, cold emission of electron in a metal. **12 hrs**

Unit 3

Angular Momentum and spin*:* Angular momentum operators and their Algebra. Eigen functions and Eigen values of $\mathbf{L^2}$ and $\mathbf{L_z}$ using Schrodinger wave mechanics and matrix mechanics. angular momentum operators.

Uncertainty relations. Stern-Gerlach experiment and the concept of spin, Pauli-spin matrices. Addition of angular momentum of two or more particles. **12 hrs**

Unit 4:

Exactly solvable problems in three dimensions*:* Wave function of a free particle in Cartesian, cylindrical and spherical coordinates. Bound state problems. Examples of a particle confined in a box, cylindrical and spherical well. Simple harmonic oscillator in 3-dimensions. Two-particle bound state problems. Reduction to a one-particle problem. Schrodinger's equation for the hydrogen atom and its solution, properties of its wave functions. **12 hrs**

References:

1. E. Merzbacher, Quantum Mechanics. 3rd edition, John Wiley(1994).
2. V.K. Thankappan, Quantum Mechanics, Wiley Eastern (1985).
3. P.M. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, TMH(1977).
4. R.L.Liboff, Introduction to Quantum Mechanics,Pearson Education(2003).
5. R. Shankar,Principles of Quantum Mechanics,2nd edition, Plenum US (1994).
6. A Ghatak and S Lokanathan, Quantum Mechanics, Theory and Applications, Macmillan(2004).
7. LI Schiff, Quantum Mechanics, 3rd ed. McGraw-Hill(1968).
8. .J. Sakurai, Modern Quantum Mechanics, Addison Wesley (1985).
9. B.Bransden,C.Joachain, Quantum Mechanics, 2nd ed, Pearson/Prentice Hall, (2000).
10. J.S.Townsend,A Modern Approach to Quantum Mechanics, 2nd ed, McGraw Hill.
11. C.Cohen-Tannoudji, B.Diu, F.Laloe,Quantum Mechanics (2 vol. set), Wiley Interscience (1996).

Sub Code: MS17PH202	**STATISTICAL MECHANICS**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**

Course Objectives:

- The course is to understand the basics of Thermodynamics and Statistical systems.
- Understand the various laws of thermodynamic.
- Acquire the knowledge of various statistical distributions.
- To comprehend the concepts of Enthalpy, phase transitions and thermodynamic functions.

Course Outcome:

- At the end of this course, students will be able to basic knowledge of thermodynamic systems.
- Understand the basic idea about statistical distributions.
- Impart the knowledge about the phase transitions andpotentials.
- Understand the applications of statistical laws.

Unit 1

Thermodynamics preliminaries: A brief overview of thermodynamics, Maxwell's relations, specific heats from thermodynamic relations, the third law of thermodynamics. Applications of thermodynamics: Thermodynamic description of phase transitions, Surface effects in condensation. Phase equilibria; Equilibrium conditions; Classification of phase transitions; phase diagrams; Clausius-Clapeyron equation, applications. Van der Wall's equation of state. Irreversible thermodynamics—Onsager's reciprocal relation, thermoelectric phenomenon, Peltier effect, Seebeck effect, Thompson effect, systems far from equilibrium. **12 hrs**

Unit 2

Classical statistical mechanics: The postulate of equal a priori probability; The Liouville theorem; the microcanonical ensemble, canonical ensemble, Grand canonical ensemble, mean value and fluctuations, Entropy and thermodynamic probability, Reduction of Gibbs distribution to Maxwell and Boltzmann distribution, Entropy of an ideal gas; Gibbs paradox; Law of the equipartition theorem; Sackur-Tetrode formula, Molecular partition function, translational and rotational and vibrational partition function and applications to solids. Chemical equilibrium. **12 hrs**

Unit 3

Quantum statistical mechanics: The postulates of quantum statistical mechanics. Symmetry of wave functions. The Liouville theorem in quantum statistical mechanics; condition for statistical equilibrium; Ensembles in quantum mechanics; The quantum distribution functions (BE and FD); the Boltzmann limit of Boson and Fermion gases; the derivation of the corresponding distribution functions. **12 hrs**

Unit 4

Applications of quantum statistics: Equation of state of an ideal Fermi gas (derivation not expected), application of Fermi-Dirac statistics to the theory of free electrons in metals, degeneracy and magnetic susceptibility. Application of Bose statistics to the photon gas, derivation of Planck's law, comments on the rest mass of photons, Thermodynamics of Black body radiation. Bose-Einstein condensation. **12 hrs**

References

1. Agarwal B.K. and Eisner M., Statistical mechanics, New Age International Publishers, 2000.
2. Roy S.K., Thermal physics and statistical mechanics, New Age International Pub., 2000.
3. Huang K., Statistical mechanics, Wiley-Eastern, 1975.
4. Laud B.B., Fundamentals of statistical mechanics, New Age International Pub.,2000.
5. Schroeder D.V., An introduction to thermal physics, Pearson Education New Delhi, 2008
6. Salinas S.R.A., Introduction to statistical physics, Springer,2004.

Sub Code: MS17PH203	**ELECTRODYNAMICS**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**

Course Objective: This module introduces the students to the principles and applications of Electrostatics, Magneto statics, Electrodynamics and Electromagnetic waves.

Course Outcome: The theory of electrodynamics is helpful to realize various applications.

Unit 1:

Electrostatics: Divergence and curl of electrostatic field, Gauss law in integral and differential forms, Poisson and Laplace equations, Boundary conditions and uniqueness theorem, electrostatic potential energy and energy density of a continuous charge distribution. Multipole expansion of the potential and energy of a localized charge distribution, monopole and dipole terms, electric field of a dipole,

dipole-dipole interaction. Electrostatic fields in matter, polarization, macroscopic field equations, electrostatic energy in dielectric media. **12 hrs**

Unit 2:

Magnetostatics: Current density, continuity equation, magnetic field of a steady current, the divergence and curl of **B**, Ampere's law, magnetic vector potential, multipole expansion of vector potential of a localized current distribution, magnetic moment. Torques and forces on magnetic dipoles, effect of a magnetic field on atomic orbits. Magnetic fields in matter, macroscopic equations, magnetostatic boundary conditions, magnetic scalar potential. Energy in the magnetic field. **12 hrs**

Unit 3:

Electrodynamics: Faraday law of induction, displacement current, Maxwell's equations. Vector and scalar potentials. Gauge transformations, Lorentz gauge, Coulomb gauge. Poynting's theorem and conservation of energy and momentum for a system of charged particles and electromagnetic fields.

Electromagnetic Waves: Plane waves in non-conducting and conducting medium, skin depth. Linear and circular polarizations. Reflection and refraction of plane waves at a plane interface, total internal reflection, reflection from a surface of a metal. **12 hrs**

Unit 4:

Wave guides: Fields at the surface and within a conductor, cylindrical cavities and wave guides, modes in rectangular wave guide.

Electromagnetic radiation: Retarded Potentials. Radiation from an oscillating dipole, liner antenna. Lenard-Wiechert potentials, potentials for a charge in uniform motion, power radiated by an accelerated charge at low velocities, Larmor's formula , radiation from a charged particle with collinear velocity and acceleration, Bremsstrahlung radiation, radiation from a charged particle moving in a circular orbit, cyclotron and synchrotron radiation.

Plasma Physics: Plasma behavior in magnetic field, plasma as a conducting fluid-magneto hydrodynamics, magnetic confinement-Pincheffect. **12 hrs**

References:

1. Classical Electrodynamics: J.D.Jackson , Wiley Eastern Ltd., Bangalore (1978)
2. Introduction to Electrodynamics: D.J.Griffiths, Prentice Hall of India, Ltd., New Delhi (1995).
3. Electromagnetics: B.B. Laud. Wiley Eastern Ltd., Bangalore(1987)
4. Classical Electromagnetic Radiation: J.B. Marion, Academic press, NewYork (1968).
5. Classical Electrodynamics; S P Puri, Tata McGraw –Hill Publishing Company Ltd., New Delhi, (1990).

Sub Code: MS17PH204	ATOMIC AND MOLECULAR PHYSICS	C	L	T	P	CH
Duration: 14 Weeks		4	3	1	0	5

Course Objectives:

- To develop a basic understanding of physics of atoms and molecules: definitions, units, laws and rules.
- to gain an ability of basic problems analyzing and solving in physics of atoms and molecules
- to realize a role and practical application of physics of atoms and molecules in the modern world

Course Outcomes:

- Discuss the relativistic corrections for the energy levels of the hydrogen atom and their effect on optical spectra.
- Derive the energy shifts due to these corrections using first order perturbation theory. state and explain the key properties of many electron atoms and the importance of the Pauli exclusion principle.
- Explain the observed dependence of atomic spectral lines on externally applied electric and magnetic fields.
- Discuss the importance of group theory in molecular physics. Demonstrate a grasp of bonding types in molecules.
- State the formal properties of groups, characters and irreducible representations state and justify the selection rules for various optical spectroscopies in terms of the symmetries of molecular vibrations.

Unit 1

Atomic Physics: Brief review of early atomic models of Bohr and Sommerfeld. One electron atom: Quantum states, Atomic orbitals, spectrum of hydrogen, Rydberg Atoms (brief treatment), Relativistic corrections to spectra of alkali atoms: Spin-orbit interaction and fine structure in alkali spectra. Lamb shift in hydrogen (qualitative Discussion only). **12 hrs**

Unit 2

Two electron atom: Ortho and Para states and role of Pauli principle, level schemes of two electron atoms. Perturbations in the spectra of one and two electron atoms: Zeeman effect, Paschen- Back effect, Stark effect in hydrogen spectra. Hyperfine interactions and 21cm line of hydrogen. Many electron atoms: Central field approximation. LS and JJ coupling schemes, Multiplet splitting and Lande interval rule. **12 hrs**

Unit 3

Molecular Physics A: Brief treatment of chemical bonds: covalent, ionic, Vanderwaal's interactions. The Born-Oppenheimer approximation (qualitative treatment), diatomic molecule as a rigid rotator, rotational spectra of rigid and non-rigid rotator, intensities of rotational lines. Microwave spectroscopy- principle and technique Types of rotors: Eigen values of Linear, Symmetric top, Asymmetric top and Spherical top molecules. Raman spectroscopy: Theory of Raman effect, experimental techniques, rotational Raman spectra of diatomic and linear polyatomic molecules.

12 hrs

Unit 4

Molecular Physics B: Diatomic molecule as a simple harmonic oscillator, anharmonicity, Morse potential curves, vibrating rotator: energy levels and vibration spectra, PQR branches in rovibronic spectra, experimental technique and IR spectrometer. Comparison of vibration and Raman spectra.

Electronic spectra of diatomic molecules: Vibrational structure, rotational structure in electronic spectra, intensity of vibrational lines in electronic spectra, Frank-Condon principle, dissociation and pre-dissociation, fluorescence and phosphorescence. **12hrs**

References:

1. Introduction to Atomic spectra- H.E.White.
2. Fundamentals of molecular spectroscopy, C B Banwell.
3. Spectroscopy Vol I, II & III, Walkere and Straughen.
4. Physics of atoms and molecules, Bransden and Joachain, (2nd Edition) Pearson Education, 2004.
5. Fundamentals of Molecular Spectroscopy, Banwell and Mccash, Tata McGraw Hill, 1998.
6. Modern Spectroscopy, J.M. Hollas, John Wiley, 1998.
7. Molecular Quantum Mechanics, P.W. Atkins and R.S. Friedman. Third Edition, Oxford Press(Indian Edition), 2004.

Sub Code: MS17PH215	Electronics I (Digital Electronics)	C	L	T	P	CH
Duration: 14 Weeks		4	3	1	0	5

Course objectives: Students undergoing this course are expected to:

- Understand number systems and codes and their application to digital circuits.
- Understand Boolean algebra, Karnaugh maps and its application to the design and characterization of digital circuits.
- Understand the mathematical characteristics of logic gates.
- Able to Design and analyze a given combinational or sequential circuit using Boolean algebra as a tool to simplify and design logic circuits.
- Understand the logic design of programmable devices, including PLDs
- Able to design various synchronous & Asynchronous counters and Universal Shift Registers. Consider alternatives to traditional design techniques to simplify the design process to yield innovative designs

Course outcomes: After undergoing the course students will be able to:

- Differentiate between analog and digital representations.
- Convert a number from one number system to its equivalent in of the other Number system.
- Realize and Implement logic circuits by using Universal gates.
- Use Boolean algebra and K-map as tool to simplify and design logic circuits.
- Construct and analyze the operation of Combinational and Sequential Circuits.
- Design various types of sequential circuits like counters and universal Shift Registers

- Able to Differentiate between Mealy and Moore machines.
- Able to Modify traditional design techniques to yield innovativedesigns

Unit 1:

Number Systems and Logic families: Decimal, Binary, octal, and hexa-decimal number systems, binary arithmetic. Number base conversion, Complements Codes: Binary code, excess-3 code, gray code, error detection and correction codes.

Positive logic and Negative Logic, AND, OR, NOT,NAND,NOR, X-OR GATE, INHIBIT CIRCUIT, Significance and type like TTL, CMOS, interface with different logic families, application relevant information, electrical characteristics. **12hrs**

Unit 2:

Boolean operations and expressions: Introduction, Logic Operators, Postulates and theorems, properties –Product of Sums and Sum of Products– Karnaugh Map method – Two, three, four, five variable K-maps, Converting Boolean expressions to Logic and Vice versa, NAND and NOR implementation – Don't-Care conditions – The tabulation method. **12hrs**

Unit 3:

Combinational and Sequential circuits: Half and full Adder – Half and full Subtracter – Binary parallel adder – BCD Adder, Decimal adder – Magnitude comparator – Encoders & Decoders – Multiplexers– De-multiplexer Latches, Flip-flops, SR, JK- Flip-flop, JK Master-Slave, D, T flip-flops, counters, synchronous and asynchronous counters, ripple counters, registers, shift registers, timing sequences.

12hrs

Unit 4:

A/D and D/A conversion circuits: Introduction, Digital to Analog Converters D/A converter Specifications, Types of D/A converters, Mode of Operation, BCD Input D/A converter, Integrated Circuit D/A Converters, D/A converter Applications, A/D converters, A/D Converter Specifications, A/D Converter Technology, Types of A/D converters, Integrated Circuit A/D Converters, A/D converter Applications

Basics of microprocessor and microcontroller: Architecture of 8085, Architecture of 8051. **12hrs**

Reference Books:

1. John F. Wakerly, "Digital Design" 4 thedition,Pearson/PHI,2008.
2. John, M Yarbrough, "Digital Logic application and design", Thomson Learning,2006.
3. Charles H, Roth, "Fundamentals of Logic Design", Thomson Learning, 2013.
4. Donald P, Leach and Albert Paul Malvino, " Digital Principles and Applications", 6th edition, TMH,2006.
5. Thomas L. Floyd, " Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011
6. Donald D, Givone, "Digital Principles and Design', TMH, 2003.

Sub Code: MS17PH225	CONDENSED MATTER PHYSICS –I	C	L	T	P	CH

Duration: 14 Weeks	(SPECIAL)	4	3	1	0	5

Course Objectives:

The course is to understand the basic knowledge on magnetic, dielectric and electric properties of material. Types of magnetic and dielectric materials and their applications.

Course Outcome: At the end of this course, students will be able to

- Understand how magnetic, dielectric and electric materials works.
- Know the properties of magnetic, dielectric and electric materials.
- Impart the knowledge and properties of these materials for various applications.

Unit 1:

Ferromagnetism : Review of Weiss theory of ferromagnetism, its successes and failures, Heisenberg exchange interaction, exchange integral, exchange energy, Ising model, Spin waves (one dimensional case only), quantization of spin waves and magnons, density of modes, thermal excitation of magnons and Bloch $T^{3/2}$ law, specific heat using spin wave theory. Band theory of ferromagnetism. Ferromagnetic domains, hysteresis curve, magnetocrystalline anisotropy energy, Bloch wall.

Antiferromagnetism : Characteristic property of anti ferromagnetic substance, Neutron diffraction experiment. Two sub-lattice model molecular field theory of anti ferromagnetism, Neel temperature, Susceptibility below and above Neel temperature.

Ferrimagnetism: Ferrimagnetic order, ferrites, Curie temperature and susceptibility of ferrimagnets.

12 hrs

Unit 2:

Magnetic Resonance : Basic principles of paramagnetic resonance, spin-spin and spin–lattice relaxation, susceptibility in a.c. magnetic field power absorption, equations of Bloch, steady state solutions, determination of g-factor, line width and spin –lattice relaxation time, paramagnetic resonance and nuclear magnetic resonance. Effect of crystal field on energy levels of magnetic ions (qualitative). Spin- Hamiltonian, zero field splitting. **12 hrs**

Unit 3:

Dielectrics: Review of basic formulae, dielectric constant and polarizability, local field, Clausius-Mossotti relation, polarization catastrophe. Sources of polarizability, Dipolar polarizability: dipolar dispersion, Debye's equations, dielectric loss, dipolar polarization in solids, dielectric relaxation. Ionic polarizability. Electronic polarizability: classical treatment, quantum theory, interband transitions in solids. **12 hrs**

Unit 4:

Ferroelectrics: General properties of ferroelectrics, classification and properties of representative ferroelectric crystals, dipole theory of ferroelectricity, dielectric constant near Curie temperature, microscopic source of ferroelectricity, Lydane –Sachs-Teller relation and its implications, thermodynamics of ferroelectric phase transition, ferroelectric domains, Piezoelectricity and its applications. **12 hrs**

References:

1. The Physical Principles of Magnetism : A. H. Morrish, John Wiley & sons, New York (1965)
2. Solid State Physics : A. J. Dekker, Macmillan India Ltd., Bangalore(1981)
3. Introduction to Solid State Physics : 5th Edn C. Kittel, Wiley Eastern Ltd., Bangalore (1976)
4. Elementary Solid State Physics : M. A. Omar, Addison-Wesley Pvt. Ltd., New Delhi (2000)
5. Introduction to Magnetic Resonance: A. Carrington and A. D. Mclachlan, Harper & Row, New York, (1967).
6. Elements of Solid State Physics (2nd Ed): J.P. Srivastava, PHI Learning Pvt. Ltd., New Delhi (2009).

Sub Code: MS17PH235	MATERIAL SCIENCE –I	C	L	T	P	CH
Duration: 14 Weeks		4	3	1	0	5

Course Objectives:

This course focuses on the structural, electronic and magnetic properties of metals, alloys, super conductors, semi-conductors and dielectric materials. Various applications of these materials in different fields are also discussed.

Outcomes: On successful completion of this course a student shall be able to

- Explain the reasons for electrical and thermal conductivity in metals, alloys, semiconductors and superconductors.
- Classify the dielectrics and magnetic materials.
- Explain the different applications of ferroelectrics and magnetic materials.

Unit 1:

Metals: Review of free electron theory and Fermi distribution function, Structure andtypes of metals, Electronic properties of metals- electrical and thermal conductivity, Widemann- Franz law, temperature and impurity effects. Heat capacity of metals- debye‘s model of specific heat- contribution of free electrons to heat capacity- dispersion relation- acoustic and optical modes- thermal expansion- anharmonic interactions, Galvanomagnetic effects inmetals.

Alloys: Solid solutions - substitutional and interstitial. Hume Rothery rules. Super lattice- long range order theory. Diffusion in alloys- Darkens equation. Some special alloys-ferrous and nonferrous, super alloys. **12 hrs**

Unit 2:

Semiconductors: Review of band theory of solids, direct and indirect band gaps, charge carrier in intrinsic semiconductor. Extrinsic semiconductor- effect of doping and mobility of charge carriers.

Methods of doping- alloying, diffusion and ion implantation. Preparation of semiconductor single crystals.

Superconductivity: Superconducting tunneling phenomena. AC and DC Josephson effect. Applications- Superconducting magnets, super density switches.

SQUID. HTS superconductors - materials preparation and structure. **12 hrs**

Unit 3:

Dielectrics and Ferroelectrics

Dielectrics: Review of dielectric polarization- internal field and macroscopic field. The Complex dielectric constant-dielectric losses and relaxation time-Debye equations- Theory of electronic polarization and optical absorption. Dielectric function» LST Relationship, dielectric breakdown- general applications of dielectric materials. Ferroelectrics Piezoelectric, pyroelectric and ferroelectric materials- transducer and detector applications, Classification of ferroelectrics.

Ferro electricity in KDP and barium titanate- order—disorder and displacement theories. Thermodynamics of ferroelectric phase transitions. **12 hrsUnit 4:**

Magnetic Materials and Magnetic Resonance:

Magnetic Materials: Review of dia, para and ferro- magnetic materials, Spontaneous Magnetization— temperature dependence- gyromagnetic experiments. Origin of Ferromagnetic domains- anisotropy of magnetostriction and Bloch wait energies. Antiferromagnetic and ferrimagnetism- Subiattice mode|~ Neel's theory. Neutron Diffraction in magnetic structure analysis. Hard and soft magnetic materials- areas of Theirapplication.

Magnetic Resonance: Elements of theory of nuclear magnetic resonance (NMR)-rate of energy absorption- spin lattice and spin-spin relaxation- Bloch equations, Principles of ESR, NOR and Mossbauer techniques, typical areas of application. **12 hrs**

References:

1. Introduction to Properties of Materials — D. Rosenthal and R M Asirnov, East West (1974).
2. Elements of Materials Science and Engineering- L H Van Vlack, Addison Wesley (1975).
3. Introduction to solid state Physics,C. Kittle, Wiley Eastern (1993).
4. Solid State Physics, A. J. Dekker, Mc Milan India (2005).
5. Introduction to solids, L V Azaroff , Mc Graw Hill (1977).
6. Electronic Materials, S. Muraka , Academic Press(1989).
7. Superconductivity and Superconducting Materials- A. V. Narlikar and S. N. Ekbote , South Asian Publications (1983).
8. Semiconductor Physics- P S Kireev, Mir Publishers (1975).
9. Solid State and semiconductor Physics, John Mckelvey, Harper and Low (1969).
10. Modern Magnetism- L F Bates, Cambridge University Press(1963).
11. Electronic Properties of Materials Ver, Hummel, Springer lag(1985).
12. Physics of dielectric Materials- *13* Tareev, Mir Publishers(1979).
13. Magnetic Resonance- C P Slichter , Harper and Row(1985).
14. NQR Spectroscopy, SSP Suppl. I T P Das and E. L. Hahn, Academic Press (1957).
15. Mossbauer Effect and its Applications, V G Bhide , Tata McGraw Hill (1973).

Sub Code: MS17PH206	Practical: General Physics lab II	C	L	T	P	CH
Duration: 14 Weeks		3	0	0	3	3

Course Objectives:

- To achieve perfectness in experimental skills and the study of practical applications will bring more confidence and ability to develop and fabricate engineering and technical equipments.
- Design of circuits using new technology and latest components and to develop practical applications of engineering materials and use of principle in the right way to implement the modern technology.

Course Objectives:

- Develop skills to impart practical knowledge in real time solution.
- Understand principle, concept, working and application of new technology and comparison of results with theoretical calculations.
- Design new instruments which can be used to verify laws of Physics.
- Gain knowledge of new concept in the solution of practical oriented problems and to understand more deep knowledge about the solution to theoreticalproblems.
- Understand measurement technology, usage of new instruments and real time applications.

List of Experiments:

1. Determination of difference in wavelengths of D_1 and D_2 lines using Michelson interferometer.
2. Active low pass and high pass filter using op-amp.
3. Determination of Fermi Energy of given conductor/semiconductor.
4. Experiment with GM counter.
5. Determination of Ferroelectric phase transition and verification Curie Weis law.
6. Measurement of thickness of thin wire using Laser source.
7. Determination of size of the particles using Laser.
8. Determination of velocity of ultrasonic waves in liquid.
9. Determination of Redberg constant.
10. Verification of photoelectric equation and determination photonic work function and Planck's constant.

Sub Code: MS17PH207	Practical : Atomic and Molecular Physics (General)	C	L	T	P	CH
Duration: 14 Weeks		3	0	0	3	3

Course Objectives:

- To achieve perfectness in experimental skills and the study of practical applications will bring more confidence and ability to develop and fabricate engineering and technical equipments.

- Design of circuits using new technology and latest components and to develop practical applications of engineering materials and use of principle in the right way to implement the modern technology.

Course Objectives:

- Develop skills to impart practical knowledge in real time solution.
- Understand principle, concept, working and application of new technology and comparison of results with theoretical calculations.
- Design new instruments which can be used to verify laws of Physics.
- Gain knowledge of new concept in the solution of practical oriented problems and to understand more deep knowledge about the solution to theoreticalproblems.
- Understand measurement technology, usage of new instruments and real time applications.

List of Experiments

1. CCD spectrometer to record absorption bands of Iodinemolecule.
2. CCD spectrometer to record band spectrum of AlO.
3. Analysis of band spectrum of PN molecule.
4. Analysis of Rotational Raman spectrum of a molecule.
5. Determination of separationbetweenetalonplates using Fabry-Perot interferometer experiments.
6. Zeeman effect.
7. Determination of e/m ratio of an electron by Millikan's oil drop experiment.
8. Study of intensity distribution of elliptically polarized light.
9. Study of elliptically polarized light using Babinet compensator.
10. Determination of thickness of mica sheet using Edser Butler Fringes.

SEMESTER-III

Sub Code: MS17PH301	**QUANTUM MECHANICS –II**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**5**	**3**	**1**	**0**	**5**

Course Objective

- To familiarize students with the advanced quantum mechanical concepts for better understanding of behavior of sub-atomic particles.

Course Outcome

- On successful completion of this course, students should be able to: Connect the historical development of quantum mechanics with previous knowledge and learn the basic properties of quantum world with development aspects of quantummechanics.
- understand and explain the differences between classical and quantum mechanics

- understand the idea of wave function, Schrödinger representation, spot, identify and relate the eigen value problems for energy, momentum, angular momentum and central potentials explain the idea of spin.

Unit 1

The Schrodinger equation in three dimensions: separation of Schrodinger equation in Cartesian coordinates. Free particle in 3-d box – Effects of the exclusion principle on non-interacting fermions in a box. central potential and consequences of rotational invariance – separation of variables r,Φ,Θ; radial equation.

The hydrogen atom – radial equation; energy spectrum; degeneracy of the spectrum; radial wave functions and probability density P(r) for finding the electron at a distance from the center; evaluation of expectation values of r^n. **12 hrs**

Unit 2

Symmetry in quantum mechanics: Spatial transition and conservation of linear momentum**.** Discrete symmetries: parity and time reversal. Permutation symmetry: symmetric and anti symmetric wave functions for two identical particles, slater determinant and pouli exclusion principle. Exited states of helium atom: ortho and para helium atom.

Approximation methods – I: The variational method: variation theorem, application of variation theorem, application of variational approach to ground states of (i) Hydrogen atom and (ii) Helium atom. The WKB method: one dimensional case, approximate solutions turning pints and connection formulae, Tunneling through a barrier. **12 hrs**

Unit 3

Approximation methods -II:

Time independent perturbation theory: Perturbation theory for non degenerate states, examples: linear and quadratic stark effects (i) in hydrogen atom, (ii) a particle moving in a 1-d harmonic oscillator. Degenerate perturbation theory, examples: linear stark effect, Normal Zeeman effect.

Time dependent perturbation theory: Time dependent perturbation series. Harmonic perturbation; transition probability, Fermi golden rule, example: sinusoidal perturbation on 1-d simple harmonic oscillator.

Scattering experiments and cross sections: potential scattering, Born approximation, validity of born approximation, Scattering in a central potential, examples: screened coulomb field. **12 hrs**

Unit 4

Relativistic quantum mechanics: Klein Gordan equation for a free particle and its drawbacks; probability density. Dirac equation for free particle, properties of Dirac matrices, solutions of free particle Dirac equation- ortho normality and completeness, spin of the Dirac particle, negative energy sea, covariant form of Dirac equation. Velocity operator of a free Dirac particle and Zitterbeagung.

Non relativistic limit of Dirac equation for a free particle moving in a central potential – spin – orbit energy. Dirac particle under the influence of a uniform external magnetic field – magnetic moment for the Dirac particle. **12 hrs**

References:

1. Quantum mechanics, **B.H. Bransden and Joachain,** 2nd Edition Pearson Education (2004).
2. Introduction to Quantum mechanics, **David J. Griffiths**, 2nd Edition, Parson Education (2005).
3. Modern Quantum mechanics**, J.J. Sakurai**, Pearson Education, (2000).
4. Quantum mechanics, V.K Thankappan, 2nd Edition 2004.
5. Quantum mechanics, **Stephen Gasiorowicz**, john Wiley (2003).
6. Relativistic Quantum mechanics and Relativistic Quantum fields, J.D. Bjorken and S.D. Drell, Mc. Graw-hill,New York (1968).
7. Quantum mechanics, **L.ISciff,Mc. Graw-hill**, (1955).

Sub Code: MS17PH302	**NANOSCIENCE AND TECHONOLOGY**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**5**	**3**	**1**	**0**	**5**

Course Objectives:

- The course is to understand the fundamental concepts behind nanoscience and nanotechnology.
- Understand the various processing techniques available for synthesis of nanostructure materials.
- Acquire the knowledge of various nanomaterial characterization methods.
- To get familiarized with the various analytical techniques to understand the nano properties and characteristics of nano materials.

Course Outcome:

- At the end of this course, students will be able to explain the fundamentals of Nanoscience, nanotechnology and the characterization techniques of nanomaterials.
- Understand the properties and applications of nanomaterials.

UNIT 1

NANOSCALE SYSTEMS: Length, energy, and time scales - Quantum confinement of electrons in semiconductor nanostructures: Quantum confinement in 3D, 2D, 1D and zero dimensional structures -Size effect and properties of nanostructures- Landauer Buttiker formalism for conduction in confined geometries - Top down and Bottom up approach. **12 hrs**

UNIT 2

QUANTUM DOTS: Excitons and excitonic Bohr radius – difference between nanoparticles and quantum dots - Preparation through colloidal methods - Epitaxial methods- MOCVD and MBE growth of quantum dots - current-voltage characteristics - magneto tunneling measurements - spectroscopy of Quantum Dots: Absorption and emission spectra - photo luminescence spectrum - optical spectroscopy - linear and nonlinear optical spectroscopy. **12 hrs**

UNIT 3

SYNTHESIS OF NANOSTRUCTURE MATERIALS:

Gas phase condensation – Vacuum deposition -Physical vapor deposition (PVD) - chemical vapor deposition (CVD) – laser ablation- Sol-Gel- Ball milling –Electro deposition- electroless deposition – spray pyrolysis – plasma based synthesis process (PSP) - hydrothermal synthesis. **12 hrs**

UNIT 4

NANOTECHNOLOGY APPLICATIONS: Applications of nanoparticles, quantum dots, nanotubes and nanowires for nanodevice fabrication – Single electron transistors, coulomb blockade effects in ultrasmall metallic tunnel junctions - nanoparticles based solar cells and quantum dots based white LEDs – CNT based transistors – principle of dip pen lithography. **12 hrs**

REFERENCES:

1. "Nanotechnology" G. Timp. Editor, AIP press, Springer-Verlag, New York,1999

2. "Nanostructured materials and nanotechnology'', Concise Edition, Editor:- Hari Singh Nalwa; Academic Press, USA (2002).

3. "Hand book of Nanostructured Materials and Technology'', Vol.1-5, Editor:- Hari Singh Nalwa; Academic Press, USA (2000).

4. "Hand book of Nanoscience, Engineering and Technology (The Electrical Engineering handbook series), Kluwer Publishers, 2002.

5. "Sol-Gel Science", C.J. Brinker and G.W. Scherrer, Academic Press, Boston(1994).

6. Nanoscale characterization of surfaces & interfaces, N John Dinardo, Weinheim Cambridge: Wiley-VCH, 2nd ed., 2000.

Sub Code: MS17PH303	NUCLEAR AND PARTICLE PHYSICS	C	L	T	P	CH
Duration: 14 Weeks		5	3	1	0	5

Course Objectives:

- To study the general properties of nucleus.
- To study the nuclear forces and nuclear reactions.
- To introduce the concept of elementary particles.

Course Outcomes:

- At the end of the course, the students shall be able to acquire basic knowledge about nuclear and particle physics.
- Understand the nuclear decay, nuclear fission and fusion reactions and their usage in technology.
- Impart the knowledge about the nuclear forces and elementaryparticles.

Unit 1

Interaction of charged particles: energy loss of heavy charged particles in matter, Bethe-Bloch formula, energy loss of fast electrons, Bremstrahlung.

Interaction of gamma rays: photo electric, Compton, and pair production processes. Gamma ray attenuation- attenuation coefficients, absorber, mass thickness, cross sections.
Nuclear reactions: cross section for a nuclear reaction, Differential cross section, Q-value of reaction, threshold energy, Direct and compound nuclear mechanisms, Bhor's independence hypothesis and experimental verification.
Nuclear fission: energy released in fission, neutron cycle in a thermal reactor and four factor formula. **12 hrs**

Unit 2

Nuclear forces: characteristics of nuclear forces, short range, saturation, chare independence and exchange characteristics ,Ground state of deuteron, Relation between the range and the depth of the potential using square well potential, Yukawa's theory of nuclear forces (qualitative only)
Nuclear detectors: scintillation detectors- Nal(Tl), plastic scintillation- scintillation spectrometer.
Semiconductor detectors: Surface barrier detectors, Li ion drift detectors, relation between applied voltage and the depletion region in junction detectors, counter telescopes, particle identification, and position sensitive detector. **12 hrs**

Unit 3

Nuclear models and nuclear decay:

Liquid drop model: Semiemphirical mass formula, stability of nuclei against beta decay, mass parabola.
Fermi gas model: Kinetic energy for the ground state, asymmetry energy.
Shell model: evidence for magic numbers, prediction of energy levels in an infinite square well potential, spin orbit interaction, prediction of ground state spin parity and magnetic moment of odd nuclei, Schmidt limit.
Beta decay: Fermi's theory of beta decay, curie plots and ft values, selection rules.
Gamma decay: Multi polarity of gamma rays, selection rules, internal conversion (qualitative only). **12 hrs**

Unit 4

Elementary particle physics: types of interactions between elementary particles, hadrons and leptons, detection of neutrinos.
Symmetries and conservation laws: conservation of energy, momentum, angular momentum, charge and isospin, parity symmetry, violation of parity in week interactions, lepton number conservation, lepton family and three generations of neutrinos. Conjugation symmetry, CP violation in week interactions.

Strange particles, conservation of strangeness in strong interactions, Baryon number conservation, Gell-Mann Nishijima formula, eight fold way (qualitative only), Quark model, quark content of baryons and mesons, color degree of freedom, standard model (qualitative only). **12 hrs**

References:

1. Introduction to Nuclear Physics H.Enge: Addison Wesley, 1971.
2. Atomic and Nuclear Physics, S. N. Goshal vol II 2000.
3. Introductory Nuclear Physics Kenneth S. Krane: John Wiely and Sons, 1987.
4. The Atomic Nuclease Evans R.D. : Tata Mc. Graw hill, 1955.
5. Nuclear Physics, R R Roy and Nigam: Wiley-eastern Ltd 1983.

6. Nuclear physics an introduction, S.B. Patel: New age international (P) limited 2000.
7. Radiation Detection and Measurements, G.F. Knoll: 3rd edition, John Wiely and sons, 2000.
8. Nuclear Radiation Detectors, S.S. Kapoor and V.S Ramamurthy: Wiley and sons. Introduction to High Energy Physics D.H. Perkins: Addison Wesley, London, 2000.
9. Introduction to Elementary Particles, D.Griffiths: John Wiley1984.
10. Nuclear Interactions, S.de Benedetti: John Wiley, New York, 1964.

Sub Code: MS17PH314	**ELECTRONICS II (ELECTRONIC COMMUNICATION SYSTEMS)**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**5**	**3**	**1**	**0**	**5**

Course objectives:

- Understand the fundamental concepts of communication systems.
- The course objectives are to enable the students to:
- Understand and compare different analog modulation schemes.
- Understand and compare different digital modulation schemes.
- Understand the design tradeoffs and performance of communications systems

Course Outcomes:

Students will be familiar with the techniques involved in the transfer of information in the field of Radio communication Students will be able to detect and correct the errors that occur due to noise during transmission Students will be able to understand the concepts of Facsimile, Television, Cellular and Satellite Communication

Analog communication systems

Unit 1:

AM Transmitters and Receivers: Generation of AM, low level and high level modulation, comparison of levels, AM transmitter block diagram, DSB S/C modulator. AM Receiver: Tuned radio frequency (TRF) receiver. Super heterodyne receiver, RF section and characteristics, mixers, frequency changing and tracking, IF rejection and IF amplifiers. Detection and automatic gain control (AGC), AM receiver characteristics. **12 hrs**

Unit 2:

FM Transmitters and Receivers FM Transmitters: Basic requirements and generation of FM, FM Modulation methods: Direct methods, Variable capacitor Modulator, Varactor Diode Modulator, FET Reactance Modulator, Transistor Reactance Modulator, Pre-emphasis, Direct FM modulator, FM Receivers: Limiters, single and double-tuned demodulators, balanced slope detector, Foster-Seely or Phase Discriminator, De-emphasis, ratio Detector, Block diagram of FM Receivers, RF Amplifiers, FM Receiver characteristics. **12 hrs**

Digitalcommunicationsystems

Unit 3:

Analog to Digital Conversion Noisy communications channels, The sampling Theorem, low pass signals and band pass signals, pulse Amplitude modulation, channel bandwidth for a PAM signal, Natural sampling, Flat top sampling, signal recovery & holding, Quantization of signal, Quantization error, pulse code modulation (PCM), Delta Modulation, adaptive delta modulation. Digital Modulation Techniques: Binary phase shift keying, differential phase shift keying, differential encoded PSK, QPSK, Quadrate Amplitude shift keying (QASK) Binary frequency shift keying. **12 hrs**

Unit 4:

Information Coding and Decoding: Coding for error detection and correction, Block coding – coding, anticoding, Hadamard code, Hamming code, Cyclic Codes, Convolution coding and decoding, Viterbi algorithm, Shannon Fano and Hoffman Codes. **12 hrs**

References:

1. Principles of Communication Systems – H Taub& D. Schilling, GautamSahe. TMH, 2007 3rd Edition.
2. Principles of Communication Systems - Simon Haykin. John Wiley, 2r" Edition,
3. Electronics & Communication System - George Kennedy and Bernard Davis, 4th Edition TMH 2009
4. Analog Communications- KN Hari Bhat & Ganesh Rao, Pearson Publications, 2nd Edition 2008.
5. Analog and Digital Communication – K. Sam Shanmugam, Willey ,2005
6. Electronics Communication Systems-Fundamentals through Advanced-Wayne Tomasi, 5th Edition, 2009, PHI.
7. Lathi “Modern Digital and Analog Communication Systems,” Oxford University Press.
8. B. Sklar, “Digital Communications: Fundamentals and Applications,” Pearson Education.
9. S. Haykin, “Digital Communication,” John Willey.
10. R.P. Singh and S.D. Sapre, “Communication Systems: Analog and Digital,” Tata McGraw-Hill.
11. Digital Communications - John G. Proakis .Masoudsalehi – 5th Edition, McGraw-Hill, 2008.
12. Digital Communication - Simon Haykin, Jon Wiley, 2005.
13. Digital Communications - Ian A. Glover, Peter M. Grant, Edition, Pearson Edu., 2008.
14. Communication Systems-B.P. Lathi, BS Publication, 2006.
15. Principles of communication systems - Herbert Taub. Donald L Schiling, Goutam Sana, 3rd Edition,Mc.Graw-Hill, 2008.
16. Digital and Analog Communicator Systems - Sam Shanmugam, John Wiley, 2005.

Sub Code: MS17PH324	**CONDENSED MATTER PHYSICS II**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**5**	**3**	**1**	**0**	**5**

Course Objective: Student will be familiarized with

- Defects, types of defects and how defects areformed.
- Luminescence and its mechanism.
- Lattice formation and deformation, energy band structure and classification of materials based on energy gap.
- Preparation of thin films and study of their structuralcharacteristics.

Course Outcome: Student will be able to tell

- The formation of color centers their characteristics, models andapplications.
- Types of disorder and variation of conductivity with defects.
- Different techniques for preparation of films, surface characterization, electrical properties and applications of thin films.

Unit1

Disordered systems: Point defects-shallow impurity states in semiconductors-Localized lattice vibrational states in solids-Vacancies, interstitials in ionic crystals- Color centers in ionic crystals-Types of Color centers- methods of production-mechanism - Characteristic absorption bands, Properties of Color centers- Models and Applications.

Photoconductivity, Luminescence- fluorescence, Phosphorescence- Thermoluminescence, Photoluminescence, Electroluminescence; Mechanisms. Imperfections in crystals, Mechanism of plastic deformation in solids, Stress and strain fields of screw and edge dislocations, Elastic energy of dislocations. **12 hrs**

Unit 2

Disorder in Condensed Matter : Introduction- Short range order- Long range order- Ordered lattice-Disordered lattice- Compositional. disorder- Topological disorder-Magnetic disorder-Localized states-Anderson Model- Density of states. Concept of glass- Glass transition- Atomic correlation function and structural description of glasses and liquids. Amorphous semiconductors: Classification, band structure- electronic conduction- Optical absorption-Switching. Transport in disordered lattices-Transport in extended states, Fixed range and variable range hopping- conductivity in impurity bands and inamorphous semiconductors-Applications. **12 hrs**

Unit 3

Semiconductors: Structure of typical semiconductors- Fermi energy expression in Intrinsic and extrinsic semiconductors- its variation with temperature and impurity concentration- Law of mass action- Charge neutrality equation- mobility- diffusion- generation- recombination of Carriers in Semiconductors- Conductivity equation- carrier Life time- Haynes-Shockley experiment- Hall effect in semiconductors- Determination of dell coefficient in intrinsic, n-type and p-type semiconductors.

12 hrs

Unit 4

Films and Surfaces: Thin films Methods of preparation: Thermal evaporation- sputtering- DC, AC, diode, triode, magneton, ion beam sputtering, Laser and electron beam evaporation technique. Chemical vapor deposition. Characterization of thin films- film thickness: optical methods-interferometry- Fizeau fringes- FECO Method. Mechanical techniques- Stylus method-weight measurement and crystal oscillators. Structural characterization Scanning electron microscopy, Transmission Electron microscopy and Atomic Force Microscopy. Mechanical properties- Internal stress and strain analysis. Electrical properties of thin films- Measurement of resistivity by four frobe method, thin film resistors (Conduction in metal and non metallic films) Magnetic properties- film size effect on MS- films for memory devices. **12 hrs**

References:

1. Solid State Physics, A. J. Dekker, McMillan India Ltd, 2003.
2. Luminescence of Solids, D. R. Vij, Plenum Press, 1998.
3. Elementary dislocation theory, J. Weertman and J.R. Weertman, New York ; Macmillan 1964
4. Crystallography Applied to Solid State Physics, Verma and Srivasthava, 2nd Edition. New age International publishers, 2001.
5. Introduction to Solid State Physics, C. Kittel, 7"' Edition, John Wiley and Sons 1996.
6. Thin Film phenomenon, K.L. Chopra, McGraw Hill Book Company, 1969.
7. Introduction to solid state theory**,** Otfried Madelung, Springer series. 1996.

Sub Code: MS17PH334	MATERIAL SCIENCE II	C	L	T	P	CH
Duration: 14 Weeks		5	3	1	0	5

Course Objectives: This course provides the knowledge about the processing, characterization and testing of Polymers, ceramics and glass materials.

Course Outcomes: On successful completion of this course a student shall be able to

- Synthesize polymers, ceramics and glasses.
- Explain the applications of composite materials.
- Test the polymers, ceramics and glasses and analyze the test results.

Unit 1:

Elements of Polymer Science: Monomers- Polymers- Classification of polymers Synthesis of polymers- chain polymerization, step Polymerization, industrial polymerization methods. Average molecular weight-weight, number and viscosity, size of polymer molecule. Microstructure of polymers- chemical, geometric, random alternating, block and graft polymers, stereo regular polymers. Phase transition- polymer melting and glass transition; polymer crystallinity- degree of crystallinity, crystallization and stereo isomerism. Processing of Plastic Materials- inoculating-compression, injection blow, extrusion, spinning. **12 hrs**

Unit 2:

Ceramics and Glasses: Ceramics and their structure- Silicate structure, Preparation-Forming and thermal treatments, Classification of ceramics- traditional and engineering. Dielectric, ferroelectric and piezoelectric properties of ceramics with specific examples, Ceramic magnets, Mechanical properties- strength, toughness. Fatigue failure, abrasion. Basic refractory materials.

Glasses: Preparation and structure, Types of glasses- borates silicate, oxide, metallic and semiconducting glasses; tempered glass and cnernically strengthened glass. **12 hrs**

Unit 3:

Composite Materials: General Introduction, matrix Materials- polymer, metals, ceramics, Reinforcing materials- fibers, particles. Concrete-concrete making materials, structure, composition. properties and applications. Polymer-concrete composites, fabrication, structure, interface, properties, applications of polymer matrix composites, metal matrix composites, ceramic matrix composites and carbon fiber composites, wood-plastic composites, dispersion strengthened. Particle reinforced, fiber and laminate reinforced composites with fabrication, interface, properties and applications. **12 hrs**

Unit 4: Testing of Materials: Mechanical Testing - Universal Testing Machine. Hardness- Brinnel, Vicker and Rockwell, impact testing and Fatigue Testing. Optical Microscopy- Metallurgical Microscopes-sample preparation and grain size Measurements. Electron microscopy-Transmission microscopy (TEM), scanning microscopy (SEM)- principle, sample preparation techniques and applications. non Destructive Testing- Ultrasonic Testing, X-ray radiography. Neutron radiography.

12 hrs

References:

1. Textbook of Polymer Science**. Fred. W. Billmeyer** John Wiley 8. Sons, Inc. (1984)
2. Polymer Science, **V.R. Gowariker, N. V. Vistrwanathan, Jayadev Shreedhar**, Wiley Eastern (1937)
3. Electronic properties of Materials- **Rolf E. Hummel, Springer Verlag**, Springer Verlag (1985)
4. Foundations of Materials Science and Engineering- **William F. Smith**, McGraw Hill international Editions, (1988)
5. Elements of Materials Science and Engineering. Lawrence **H. Van Vlack,** Addison Wesley (1975)
6. Introduction to Ceramics**- W D Kingery, H K Bower and U R Uhlman,** John Wiley (1960)
7. Ultrasonic **B. Carlin** , Mc. Graw Hill (1950).
8. Principles of Neutron Radiography- **N D Tyufyakav and A S Shtan**, Amerind Publishers (1979)
9. Applied X-rays- **George L Clark**, Mc. Graw Hill, (1955)
10. Testing of Metallic Materials**— AVK Suryanarayan** , Prentice Hall India, (1990)
11. Physical Metallurgy Part I, **R W Cahn and P Haasen** (Ed), North.

Sub Code: MS17PH315	**ELECTRONICS III (LINEAR INTEGRATED CIRCUITS)**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**5**	**3**	**1**	**0**	**5**

Course Objectives:

- Analyze and design various applications using Op-amp.
- Design and construct waveform generation circuits.
- Design timer, analog and digital circuits using op-amps.
- Design combinational logic circuits using digital ICs.

Course Outcomes

- This course provides the foundation education in electric circuit analysis and design.

- Design basic application circuits using op-amp.
- Understand and implement the working of basic digital circuits.

Unit 1

THE PRACTICAL OP-AMP (741): Input offset voltage, input bias current, input offset current. Total output offset voltage, thermal drift, error voltage, variation of OP-AMP parameter with temperature & supply voltage. Supply voltage rejection ration (SVRR), CMRR-Measurement of OP-AMP parameters. **12 hrs**

Unit 2

FREQUENCY RESPONSE OF AN OP-AMP: Frequency response compensator networks. Frequency response of internally compensated OP-AMP & non-compensated OP-AMP. High frequency OP-AMP equivalent circuit, open loop voltage gain as a function of frequency. Slew rate, causes of slew rates and its effectsin application. **12 hrs**

Unit 3

OPERATIONAL AMPLIFIER CONFIGURATIONS & LINEAR APPLICATION:

Open loop OP-AMP configurations- The differential amplifier, inverting amplifier, non-inverting amplifier, negative feedback configurations - inverting and non-inverting amplifiers, voltage followers & high input impedance configuration, differential amplifiers, closed loop frequency response & circuit stability, single supply operation of OP-AMP, summing, scaling and averaging amplifier, voltage to current & current to voltage converters, integrators & differentiators, logarithmic & anti logarithmic amplifiers. **12 hrs**

Unit 4

COMPARATORS & CONVERTERS: Basic comparator & its characteristics, zero crossing detector, voltage limiters, clippers & clampers, small signal half wave & full wave rectifiers, absolute value detectors, sample and hold circuit. **12 hrs**

References:

1. OP-AMP and linear integrated circuits 2nd edition, PLHI by Ramakant A. Gayakwad.
2. Design with operation amplifiers and Analog Integrated circuits by Sergei Franco.
3. Integrated Electronics: Analog and Digital circuits & system by Millman&Halkias.
4. Linear Integrated Circuits by D.R.Chaudhary (WEL).

Sub Code: MS17PH325	**CONDENSED MATTER PHYSICS III**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**5**	**3**	**1**	**0**	**5**

Course objectives:

- Structural analysis is the first step in the characterization of any material.

- The atomic structure of a material depends on the method of synthesis and on various parameters involved in the technique.
- This course will introduce the fundamental concepts of crystal structure and to understand the diffraction principle and use of X-rays.
- To understand the symmetry and space groups.
- To know about lattice representation and reciprocal lattices.
- To determine and analyze the crystal structure using x-raydiffraction.

Course outcomes:

- Student would have understood the structure of various crystals.
- Know the theoretical framework like symmetry and space groups.
- Know to characterize the crystal using X-ray diffraction experiments and also would be able analyze the collected experimental data.

Unit 1:

Reciprocal lattice: Elementary considerations, graphical construction, vector algebraic discussion, relation between direct and reciprocal cells, interpretation of Bragg's law using reciprocal lattice concept, general spacing formula, transformation equations and their importance. **12 hrs**

Unit 2:

The Laue method: Reciprocal lattice construction, instrumentation, flat plate cameras, front reflection region, appearance of photographs, back reflection region, appearance of photographs. Rotating crystal methods: Reciprocal lattice construction, instrumentation, cylindrical camera, mounting and adjustment of crystal, interpretation of photographs, unit cell determination, indexing procedure. **12 hrs**

Unit 3:

Moving film methods: Weissenberg method, reciprocal lattice construction for zero level and higher levels, indexing procedure, interpretation of photographs. Single crystal diffractometer: Rciprocal lattice construction, parafocussing and goniometry, intensity measurements. **12 hrs**

Unit 4:

Powder method: X-ray powder photographic methods, instrumentation, diffraction geometry, measurement of Bragg angles and interplanar spacings, index of power patterns, analytical and graphical methods, precise lattice parameter determination, characteristics of powder pattern lines, application to identification of solid solution and phase changes, line broadening and particle size measurements, interpretation of powder photographs of unknown system, powder diffractometer and applications. **12 hrs**

References:

1. Elements of X-ray Crystallography, L.V. Azaroff: McGraw Hill, New York, 1968.
2. An introduction to Crystallography, Michael M Wooffen: Cam bridege University Press, 1997
3. Crystal growth Processes and methods, Santhana Raghavan and Ramaswamy: KRU Publications, Kumbakonam.
4. Crystallography for solid state physics, Verma and Srivastava: New age international Ltd. 1997.
5. Solid State Physics, Charles Kittel: Wiley Eastern, 1984.

6. X-ray crystallography, M.J.Burger: John Wiley, New York, 1952.
7. Crystalline Solids, Duncan M and C. Mike: Nelson, London, 1973.
8. The powder method in X-ray cryst. L.V. Azaroff and M.J.Burger: McGraw Hi11s, 1958.

Sub Code: MS17PH335	MATERIAL SCIENCE III	C	L	T	P	CH
Duration: 14 Weeks		5	3	1	0	5

Course Objectives: This course provides the knowledge about the optical, dielectric and mechanical properties of materials. Effect of structure of materials on the properties is also discussed in detail.

Course Outcomes: On successful completion of this course a student shall be able to

- Explain the spectroscopic techniques to characterize optical and dielectric properties.
- Explain the electrical and mechanical properties of crystalline and polymeric materials.
- Explain the effect of temperature on the properties of metals and alloys.

Unit 1:

Optical and dielectric properties of materials: Theory of electronic polarization and optical absorption, ionic polarization, orientationl polarization. Optical phonon model in an ionic crystal; Interaction of electromagnetic waves with optical modes, polarization, Dispersion curves of transverse optical (TO) phonon and optical photon in a diatomic ionic crystal, LST relation; Metal-insulator transition. UV-VIS, IR, FTIR and Raman spectroscopy. Optical properties of metals & nonmetals- Luminescence, photoconductivity. **12hrs**

Unit 2:

Electrical properties of crystalline, nanocrystalline and polymeric materials: Resistivity variation in metals, alloys, semiconductors and nanocrystalline materials, electrical conduction in ionic ceramics, clay materials and conducting polymers. Two-probe and four probe techniques, DC and AC conductivity measurements.

Mechanical Properties of metals and ceramics: Concepts of stress & strain, stress-strain behavior, elasticity, Plastic deformation, Hardness-Knoop & Vicker's hardness test. **12 hrs**

Unit 3:

Thermal properties of metals & alloys: Temperature effects on the intensities of Bragg reflections. Influence of temperature on diffraction of X-rays: Normal coordinates of lattice vibration and X-ray scattering from a vibrating lattice and origin of thermal diffuse spots. First order TDS. Debye-Waller factor' Debye's method of calculating isotropic temperature factor for a cubic crystal. DTA, TGA, DSC (Outline only). Annealing processes, Heat treatment of steels, mechanism of hardening. Quenching, thermal stresses. **12 hrs**

Unit 4:

Structure - Property correlation, Correlation of structure with physical properties of materials, application prospects of materials in different areas.

Basic concepts of measurements & instruments: Static characteristics of instruments, accuracy & precision, sensitivity, reproducibility, errors, Transducers, classification & selection criteria, principles of piezoelectric, photoelectric, thermoelectric transducers, resistance temperature transducers (RTD), Thermister, strain gauge, load cells, LVDT Electronic instruments for measurement, Digital voltmeter, principles of electronic multimeter, digital multimeter, Q-meter, Electronic LCR meter, Frequency & timeinterval counters. **12 hrs**

References:

1. Introduction to Ceramics by W. D. Kingery, H. K. Bowen and D. R. Uhlmann, John Wiley
    a. Sons
2. Diffraction analysis of the microstructure of materials by E. J. Mittemeijere and P. Scardi, Springer
3. Materials Science & Engineering by William D. Callister, John Wiley & Sons, Inc.
4. Modern techniques of surface science by D. P. Woodruff & T. A. Delchar, Cambridge University Press
5. X-ray spectroscopy by B. K. Agarwal, Springer-Verlag.

Sub Code: MS17PH306	ASTROPHYSICS (OPEN ELECTIVE)	C	L	T	P	CH
Duration: 14 Weeks		4	3	1	0	5

Course Objectives

- Astrophysics involves the observational and theoretical study of the astrophysical universe, ranging from solar system objects through stars, to galaxies and the structure of the universe as a whole.
- In this course we aim to give the student an in-depth understanding of the principles and methods of modern astrophysics, and the skills to apply this understanding to a range of theoretical, observational and practical problems.

Course Outcomes

- To present an in-depth integrated course of study that describes, analyses and relates the principles of modern astrophysics.

- To develop the student's competence in the application of methods of mathematics and physics in an astrophysical context
- To provide the opportunity to apply measurement, problem-solving and critical assessment, and communication skills in performing and writing a report on an extended and demanding project

Unit 1

Basic concepts of Astronomy: Co-ordinate system, Time system-Solar and Sidereal times, Apparent and Absolute magnitudes, Trigonometric Parallax, Atmospheric extinction, Optical telescopes and their characteristics, Modern Optical telescopes, Astronomical Instruments – Photometer, Photographic plates, Spectrographs, Charge Coupled Detector. 12 hrs

Unit 2

Stellar properties: Observational properties of stars – spectral and luminosity classification of stars- H-R Diagram, Saha Equation, , Star Formation - Jeans mass, Jeans Length and Free fall timescale, Main Sequence Evolution, Mass- luminosity relation, White Dwarfs – Chandrasekhar's Limit, Neutron Stars, Pulsars, Supernovae, Stellar Black holes. 12 hrs

Unit 3

Solar system: Overview of Sun, Solar Interior structure- Core, Radiative zone and Convective Zone, solar atmosphere-photosphere, Chromospheres, Properties of Interior planets and exterior planets satellites of planets, Kuiper Belt objects, Oort Cloud, Theories of formation of the solar system.

12 hrs

Unit 4

Stellar structure: Hydrostatic Equilibrium, Mass conservation, Luminosity gradient equation, Temperature gradient Equations, Lane – Emden equation for polytrophic stars and its physical solution, estimates of central pressure and temperature, Radiation pressure, equation for generation and luminosity, equation of temperature gradient for radiative and convective equilibrium, Schwarzschild criterion, gas pressure and radiation pressure, Linear Model and its properties, Volt – Russell theorem, Zero age main sequence, Mass – Luminosity relation. 12 hrs

References

1. Ostlie and Carroll: Introduction to Modern Astrophysics, Addison Wesley (II Edition), 1997

2. Kristian Rohlf : Tools of Radio Astronomy, Springer

3. John D. Krauss : Radio Astronomy, II Edition, Signet.

4. F. Shu : The Physical Universe, University So Press, 1987.

5. M. Schwarzschild : Structure and Evolution of Stars, Dover.

6. R. Kippenhahn and Weigert A.: Stellar Structure and Evolution, Spinger Verlag, 1990.

7. C.J. Hansen and Kawaler S.D.: Stellar Interiors: Physical Principles, Structure and Evolution, Spinger Verlag, 1994.

8. M. S. Longair : High Energy Astrophysics, CUP.

9. Kitchin C R : Stars, Nebulae and the Interstellar Medium, Taylor and Francis Group, 1987.

Sub Code: MS17PH307	PRACTICAL: GENERAL PHYSICS LAB III	C	L	T	P	CH
Duration: 14 Weeks		3	0	0	3	3

Course Objectives: To introduce the basic concepts of physics through hands on experience and impart experimental skill to students.

Course Outcomes: The student will be able to understand the fundamental physics behind many scientific discoveries through hands on experience.

LIST OF EXPERIMENTS

1. Hall effect experiment:- Determination of charge carrier density.
2. Spatial and temporal coherence of He-Ne laser.
3. Verification of Mallu's law.
4. Experiments with lasers and reflection grating.
5. To photograph the spectra of Fe (standard) and Cu arc using CDS spectrograph and to determine the wavelengths of Cu spectrum using Hartman formula.
6. Determination of laser light wavelength using Lloyd's mirror.
7. Determination of Numerical aperture in an optical cable.
8. Laser light attenuation in an optical cable.
9. Refractive index of liquids/solids using laser light.
10. Diffraction of laser light through two closely spaced circular apertures.

Sub Code: MS17PH318	PRACITICAL: ELECTRONICS LAB (SPECIAL)	C	L	T	P	CH
Duration: 14 Weeks		3	0	0	3	3

Course Objectives: On completion of this Subject/Course the student shall be able to

- Provide a strong foundation on Linear Circuits.
- Familiarize students with applications of various IC's.
- Have a broad coverage in the field that is relevant for engineers to design Linear circuits using Op-amps.
- Familiarize the conversion of data from Analog to Digital and Digital to Analog.

Course outcomes: At the end of the course student will have ability to

- Define significance of Op Amps and their importance.
- Build circuits using Analog IC's.
- In-depth knowledge of applying the concepts in real timeapplications.
- Ability to use OP Amp as Summer, Subtractor, Multiplier and Divider.
- Able to use OP Amp to generate sine waveform, Square wave form, Triangular wave forms.
- Able to use OP Amp to as analog to digital and digital to analog converter.
- Design and explain the Analog to Digital conversion operation and vice versa.

List of Experiments

Analog and Digital communication lab

1. Amplitude modulation and demodulation.
2. DSB SC modulation and demodulation.
3. SSB SC modulation and demodulation.
4. Frequency modulation and demodulation.
5. Pre Emphasis-De Emphasis circuits.
6. Verification of sampling theorem.
7. PAM generation and reconstruction.
8. PWM AND PPM: generation and reconstruction
9. Delta and Adaptive delta modulation.
10. TDM of two band limited signals.
11. ASK generationand detection.
12. FSK generationand detection.
13. PSK generation and detection.
14. Line coding and decoding.

LIC Lab

1. OP-AMP as square wave generator.
2. Schmitt trigger.
3. Voltage regulator
4. UJT relaxation oscillator
5. OP-AMP as active integrator and differentiator.
6. Design and test the operation of 4 Bit DAC using R-2R ladder network and OP-AMP MA741.
7. Design a second order Butterworth active low pass filter and high pass filter.
8. Design Schmitt trigger and test the circuit for the given values of UTP and LTP using OP-AMP MA741.

Sub Code: MS17PH328	CONDENSED MATTER PHYSICS LAB (SPECIAL)	C	L	T	P	CH
Duration: 14 Weeks		3	0	0	3	3

Course Objectives:

- To make the student familiarize with the basics of materials.
- To enable the student to explore the concepts involved in the X-ray diffraction.
- To make the student understand the basic concepts in absorption and Infrared spectroscopy.
- To allow the student to understand the fundamentals of Hystersis.

Course Outcomes:

- At the end of the course: The student should have had a knowledge on the different experimental techniques.
- The student should be able to perform the phase determination using X – ray diffraction.
- The student should be able to determine the energy gap of the material.

LIST OF EXPERIMENTS

1. Analysis of X-ray powder Diffractogram (NaCl).
2. Analysis of X-ray powder Diffractogram (KCl).
3. Determination of particle size, stress and strain using PXRD.
4. Analysis of single crystal rotation photograph.
5. Determination of Reitveld refinement parameter using full proof suit software.
6. Determination of energy gap by using absorption spectra.
7. Analysis of Thermoluminescence glow curve using ORIGIN software.
8. Determination of Curie temperature using B-H curve of a Ferromagnetic material (both hard and soft).
9. Calibration of electromagnet and magnetic susceptibility determination of magnetic salts ($MnSO_4$, $MnCl_2$) by Quincke's method.
10. Study of I-V characteristics of given materials.

Sub Code: MS17PH338	MATERIAL SCIENCE (SPECIAL)	C	L	T	P	CH
Duration: 14 Weeks		3	0	0	3	3

Course Objectives:

- To make the student familiarize with the basics of materials science.
- To enable the student to explore the concepts involved in the X-ray diffraction.
- To make the student understand the basic concepts in absorption and Infrared spectroscopy.
- To allow the student to understand the fundamentals of Hall effect and Hystersis.

Course Outcomes:

- At the end of the course: The student should have had a knowledge on the different experimental techniques.
- The student should be able to perform the phase determination using X – ray diffraction.
- The student should be able deposit thin films by spin coating technique.

LIST OF EXPERIMENTS

1. Synthesis of nanomaterial by solution combustion technique.
2. Synthesis of nanomaterial by hydrothermal technique.
3. Synthesis of material by solid state synthesis technique.
4. Analysis of X-ray powder Diffractogram.
5. Determination of energy gap by using absorption spectra (UV-visible spectrometer).
6. Analysis of Thermoluminescence glow curve using Origin software.
7. B-H curve of a Ferromagnetic material (both hard and soft).
8. Calibration of electromagnet and magnetic susceptibility determination of magnetic salts ($MnSO_4$, $MnCl_2$) by Quincke's method.
9. Study of I-V characteristics of given material.
10. Analysis of single crystal rotation photograph.

SEMESTER-IV

Sub Code: MS17PH401	PROJECT/INTERSHIP	C	L	T	P	CH
Duration: 14 Weeks		14	0	0	14	14

Project and Dissertation

This course will be based on preliminary research oriented topics both in theory and experiment. The teachers who will act as supervisors for the projects will float projects and any one of them will be allocated to the student at the completion of the project by the semester end the student will submit project report in the form of dissertation which will be examined by the examiners. Examination shall consist of (a) presentation and (b) compressive viva.

Internship

Student should go to industry and get trained certificate for 6 months.

FACULTY PROFILE:

 Prof. S. Bharathi Devi Associate Professor	Prof. S. Bharathi Devi, Associate Professor, School of Applied Sciences, holds M.Sc degree in" Physics" from Andhra University & M. Phil degree in Materials Science and currently pursuing Ph. D at REVA University in the field of Photovoltaics. She has 25 years of teaching experience, teaching various subjects like Engg. Physics, Material Science & Advanced Physics. (Mobile :9886189024; Email ID : bharathidevi@reva.edu.in)
 Dr. M. Madesh Kumar Associate Professor	Dr. M. Madesh Kumar, Associate Professor in School of Applied Sciences, holds Ph.D degree in 'Nanophosphor Materials' from Jawaharlal Nehru Technological University, M.Phil and M.Sc degrees in 'Physics' from Allagappa University, Bangalore University respectively. Dr. M. Madesh kumar, has more than 18 years of teaching experience and 7 years of research work experience. His specialization area of research is Nanomaterials luminescence properties. He has taught various subjects in Undergraduate level viz. Engineering Physics, Modern Physics, Quantum, Classical Physics and Advanced materials. He has published 12 research papers in reputed journals and international/ national conferences, he participated 10 workshops on various concepts of physics. (Mobile :9341271290 Email ID :madeshkumar@reva.edu.in)
 Dr. Jayadev Pattar Assistant Professor	Dr. Jayadev Pattar, Assistant Professor, School of Applied Sciences, holds Ph.D. degree in "Semiconductor thin films" and M.Sc. in Electronics with 1st rank and Gold medal" from Kuvempu University. He has 10 years of teaching experience, teaching various subjects like Engineering Physics, Engineering Physics Lab and some M.Sc. & B.Sc. Physics subjects. He is interested in semiconductor thin films and device research. (Mobile :09620305750 Email ID :jayadevpattar@reva.edu.in)

 Prof. Usha S K Senior Assistant Professor	Prof. Usha S K, Senior Assistant Professor, School of Applied Sciences, holds M.Sc degree in" Physics" from KUVEMPU University. She has 20 years of teaching experience, teaching various subjects like Engg. Physics, Nuclear Physics & Solid State Physics. (Mobile :9481033638 Email ID :ushask@reva.edu.in)
 Dr. D. V. Sunitha Associate Professor	Dr. D. V. Sunitha, Associate Professor, School of Applied Sciences, holds M. Sc, degree in "Physics" and awarded gold medal for securing I Rank in 2009 at Tumkur University, Tumkur. Secured Ph.D. degree in Material science from Tumkur University, Karnataka. She is having 5 years of teaching experience for UG and PG courses (B.Sc, M.Sc, and B.Tech,). Research experience of 6 years and published 38 papers in peer reviewed international journals. Presented and published 25 papers in national and international conferences and secured two best poster and one oral presentation award. Her area of research is nanomaterials synthesis and characterization, study of radiation (ion, electron, gamma and UV) induced effect on luminescence properties (iono, photo and thermoluminescence), etc (Mobile :7760884884 Email ID :sunithadv@reva.edu.in)
 Dr. Prakash Babu D Assistant Professor	Dr. Prakash Babu. D, Asst. Professor in the School of Applied Sciences. He has done M.Sc, M.Phil and PhD in physics. He has got 12 years of teaching experiences. His research interests are in the areas of Spectroscopic properties of phosphors. (Mobile :9916322600 Email ID :Prakashdebabu@gmail.com)
 Dr. S. Naresh Kumar Assistant Professor	Dr. S. Naresh Kumar has been conferred 'Doctor of Philosophy' by National Institute of Technology Rourkela, for his thesis entitled "Synthesis and Characterization of $Sr_{0.53}Ba_{0.47}Nb_2O_6$ based Ferroelectric Composites for Pyro-electric Applications" in 2012. He has ten years of teaching and research experience. He has six research publications in reputed international journals having good impact factor. He has participated and attended in nine national and international conferences and workshops. His research areas include Ferroelectrics, Multiferroics, Composites and Photo-voltaics. (Mobile :8867445995 Email ID :s.nareshkumar@reva.edu.in)

 Dr. Ponnam Anjaneyulu Assistant Professor	Dr. Ponnam Anjaneyulu, Assistant Professor, School of Physical Sciences, did his Ph.D. at Indian Institute of Science, Bangalore. His Research interests are charge transport studies and optical properties of polymers and nanomaterials. He has 04 years of teaching experience, teaching various subjects like Engineering Physics, Engineering Physics Lab and some M.Sc. & B.Sc. Physics subjects. (Mobile :9741965325 Email ID :p.njaneyulu@reva.edu.in)
 Dr. K. Munirathnam Assistant Professor	Dr. K. Munirathnam, Asst. Professor in the School of Applied Sciences. He has done M.Sc, M.Phil in physics, in additional B.Ed in Physical Sciences. At present he pursuing Ph.D from Sri Venkateswara University and he is at verge of submission of his thesis. He has published 5 international and 1 national journals. He was awarded seed money for young scientist research work by VGST. He has got 10 years of teaching experiences. His research interests are in the areas of Spectroscopic properties of phosphors, preparation and characterization of thin films for solar application.
 MR. G RANJITH KUMAR Assistant Professor	Prof.G Ranjith Kumar, Assistant Professor, School of Applied Sciences, pursuing Ph.D. degree in "Spectroscopic studies on Interstellar Diatomic Molecules" from Rayalaseema University, Kurnool and M.Phil from Sri Krishnadevaraya University, Ananthapur. He has 09 years of teaching experience, teaching various subjects like Engineering Physics, Engineering Physics Lab and some M.Sc. & B.Sc. Physics subjects. He is interested in Spectroscopy Studies on Diatomic molecules. (Mobile :09449441201 Email ID :ranjithk@reva.edu.in)
 MR. DEEPAK.K Assistant Professor	Mr. Deepak.K, Assistant Professor, School of Applied Sciences, REVA University, holds M.Sc degree from Kuvempu University. He has Five year of teaching experience and 2 year of research experience. Prior to venturing into the field of academia, he has experience of working in the MEMS field and he is working towards his Ph.D on Semiconducting Polymer Devices. His teaching experience includes, teaching subjects like Engineering Physics, Semiconductor Physics, Quantum Mechanics, Modern Physics and Digital Electronics at the undergraduate level. His area of interest is MEMS, Polymer Electronics. (Mobile :8892926677 Email ID :Deepak@reva.edu.in)

 Dr. Hareesh K Assistant Professor	Dr. Hareesh K, Assistant Professor, School of Applied Sciences completed his M.Sc. degree with Nuclear Physics as specialization from Bangalore University in the year 2008. He worked as Junior Research Fellow at Microtron Centre, Mangalore University and obtained his Ph.D. degree in Physics from Mangalore University, Karnataka. He did his first post doctoral fellowship as **Dr. D. S. Kothari Post Doctoral Fellow** at Department of Physics, Savitribai Phule Pune University, Pune and second post doctoral fellowship as **Endeavour Australia India Education Council (AIEC) Research Fellow** at ARC Centre for Antimatter and Matter Studies, School of Physics, University of Western Australia, Perth, Australia. He is having 31 publications in peer reviewed international journals and presented 18 papers in international/national conferences. He is having total 4 years (excluding Ph.D. duration) of research experience. His areas of research includes graphene based nanocomposites for supercapacitor, field emission, pollutants degradation and Hydrogen generation applications. Also he is working on polymer-nanoparticles matrix/nanocomposite synthesis by radiation assisted method. He is also serving as reviewer in many journals published by Elsevier and Institute of Physics. (Mobile:9986996834 E-mail ID:hareesh.k@reva.edu.in)