10 YEARS OF UNIVERSITY RECOGNITION
20 YEARS OF ACADEMIC EXCELLENCE

REVA UNIVERSITY
Bengaluru, India

School of Applied Sciences
M.Sc. PHYSICS

HANDBOOK 2019-2021

Rukmini Knowledge Park
Kattigenahalli, Yelahanka, Bengaluru – 560064

Bengaluru, India

School of Applied Sciences

M. Sc. (Physics)

HAND BOOK

2019

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Rukmini Educational
Charitable Trust

www.reva.edu.in

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, challenge cognizance 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 ‗A University 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 REVA University to join hands in laying the foundation of your future with values, wisdom and knowledge.

Dr. P. Shyama Raju
The Founder and Hon'ble Chancellor, REVA University

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 the tremendous 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, REVA University

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 by the 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

CONTENTS

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 DivyaSree 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 a few.

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 15,000 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 dated 7th February, 2013. The University is recognised by UGC under Sec 2 (f) and empowered under Sec.22 of the UGC Act, 1956 to award degrees in any branch of knowledge. 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 27 Post Graduate Degree programs, 29 Degree and PG Degree programs in various branches of studies and has 15000+ students studying in various branches of knowledge at graduate and post graduate level and 494 Scholars pursuing research leading to PhD in 18 disciplines. It has 900+ 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, and supported 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 students. 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 Defence Dr. 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 on 6th January of every year in presence of dignitaries, faculty members and students gathering. The first ―REVA Life Time Achievement Award‖ for the year 2015 has been awarded to Shri. Kiran Kumar, Chairman ISRO, followed by Shri. Shekhar Gupta, renowned Journalist for the year 2016, Dr K J Yesudas, renowned play back singer for the year 2017. REVA also introduced **–REVA Award of**

Excellence‖ in the year 2017 and the first Awardee of this prestigious award is Shri Ramesh Aravind, Actor, Producer, Director, Screen Writer and Speaker.

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 Shubha Vidaaya, - 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.

Within short span of time, REVA University has been recoged as a fast growing university imparting quality higher education to the youth of the country ans received many awards, ranks, and accolades from various agencies, institutions at national and international level. These include: Asia‘sGreatest Brand and Leaders, by Asia One, National Award of Leadership Excellence, by Assocham India, Most promising University, by EPSI, Promising Upcoming Private University in the Country, by The Economic Times, Best University of India (South), by Dialogue India, Gold Brand by QS University Ranking, placed under 151-200 band by NIRF, 6TH Rank in the Super Excellence category by GHRDC, 6TH Rank in All India Law School Survey, ranked among Top 30 Best B Schools by Business World, India‘s Best Law Institution by Careers 360, to mention a few.

ABOUT SCHOOL OF APPLIED SCIENCES

The School of Applied Sciences offers graduate and post graduate programs in Biotechnology, Biochemistry, Chemistry, Physics and Mathematics which are incredibly fascinating. It aims to attract talented youth and train them to acquire knowledge and skills useful to industrial sectors, research laboratories, and educational institutions. The School presently offers M.Sc. degree programs in Bio-Chemistry, Bio-Technology, Chemistry, Physics, Mathematics and B Sc with various combinations viz, Physics Chemistry and Mathematics, Mathematics , Physics and Statistics, Mathematics Statistics and Computer Science, and Biology Mathematics & Computer Science and also Post Graduate Diploma in Clinical Research Management. The School also facilitates research leading to PhD in Biotechnology, Biochemistry, Physics, Chemistry, Mathematics and related areas of study.

The School of Applied Sciences is shouldered by well qualified, experienced and highly committed faculty. The state-of-the-art infrastructure digital classrooms, well equipped laboratories, conference rooms 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.

Vision

To nurture intellect, creativity, character and professionalism among students and impart contemporary knowledge in various branches of Chemical, Biological, Physical and Mathematical Sciences that are socially relevant and transform them to become global citizens.

Mission

To achieve excellence in studies and research through pedagogy and support interface between industry and academia

VALUES

- Excellence in all our academic and research endeavours
- Dedication and service to our stakeholders
- Leadership through innovation
- Accountability and transparency
- Creating conducive academic environment with service motto
- Integrity and intellectual honesty
- Ethical and moral behaviour
- Freedom of thought and expression
- Adaptability to the change
- Team-work

―The constant questioning of our values and achievements is a challenge without which neither science nor society can remain healthy‖ **— Aage Niels Bohr**

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 andresearch 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.

Eligibility for M Sc (Physics) Program

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.

M Sc (Physics) Program

Scheme of Instruction

(Effective from Academic Year 2019-20)

SEMESTER-I

Sl. No.	Course Code	Title of the Course	Course Type	Credit Pattern & Credit Value				Contact Hours
				L	T	P	Total	
1	M19PH1010	Mathematical Physics	HC	3	1	0	4	5
2	M19PH1020	Classical Mechanics	HC	3	1	0	4	5
3	M19PH1030	Electronic devices	HC	3	1	0	4	5
4	M19PH1040	Quantum Mechanics I	HC	3	1	0	4	5
5	M19PH1050	Material Science (General)	HC	3	1	0	4	5
	Practical Courses							
6	M19PH1060	General Physics lab - I	HC	0	0	3	3	5
7	M19PH1070	Electronics lab	HC	0	0	3	3	5
Total Credits				**15**	**5**	**6**	**26**	**35**

SEMESTER-II

Sl. No.	Course Code	Title of the Course	Course Type	Credit Pattern & Credit Value				Contact Hours
				L	T	P	Total	
1	M19PH2010	Quantum Mechanics II	HC	3	1	0	4	5
2	M19PH2020	Statistical Mechanics	HC	3	1	0	4	5
3	M19PH2030	Condensed matter physics (General)	HC	3	1	0	4	5
4	M19PH2040	Atomic and Molecular Physics	HC	3	1	0	4	5
5	M19PH2051	Electronics - I : Digital Electronics	SC#	2	1	0	3	4
6	M19PH2052	Condensed Matter Physics - I	SC#					
7	M19PH2053	Material Science - I	SC#					
8	M19PH2060	Music, Dance, sports, Theater, Yoga	RULO	0	0	2	2	3
9	M19PH2070	Skill development Programme	RULO	0	0	2	2	3
	Practical Courses							
10	M19PH2080	General Physics lab - II	HC	0	0	3	3	5
11	M19PH2090	Atomic and Molecular Physics	HC	0	0	3	3	5
Total Credits				**14**	**5**	**10**	**29**	**40**

Note: #Soft Core (SC): Student shall 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	Course Type	Credit Pattern & Credit Value				Contact Hours
				L	T	P	Total	
1	M19PH3010	Electrodynamics	HC	2	1	0	3	4
2	M19PH3020	Nano-science and Nanotechnology	HC	2	1	0	3	4
3	M19PH3030	Nuclear and Particle physics	HC	2	1	0	3	4
4	M19PH3041	Electronics – II: Electronic Communication Systems	SC#					
5	M19PH3042	Condensed Matter Physics - II	SC#	3	1	0	4	5
6	M19PH3043	Material Science- II	SC#					
7	M19PH3051	Electronics – III: Linear integrated circuits	SC#					
8	M19PH3052	Condensed Matter Physics - III	SC#	3	1	0	4	5
9	M19PH3053	Material Science - III	SC#					
10	M19PH3060	Astrophysics	OE#	3	1	0	4	5
	Practical Courses							
11	M19PH3070	General Physics lab - III	HC	0	0	3	3	5
12	M19PH3081	Electronics Lab						
13	M19PH3082	Condensed Matter Physics	SC#	0	0	3	3	5
14	M19PH3083	Material Science						
Total Credits				**15**	**6**	**6**	**27**	**37**

Note: i) # OE is Open Elective Course offered for students of other Schools; the students of M Sc – Physics shall take any ONE of the OE course offered by other Schools.

ii) *Soft Core (SC): Students shall have to continue the Soft Core opted during the Second Semester

SEMESTER-IV

Sl. No.	Course Code	Title of the Course	Course Type	Credit Pattern & Credit Value				Contact Hours
				L	T	P	Total	
1	M19PH4010	Major Project	HC	0	0	10	10	20
2	M19PH4020	MOOC/SWAYAM /Internship*	RULO	0	0	4	4	-
Total Credits				**0**	**0**	**14**	**14**	**20**
Total Credits of I to IV Semesters				**44**	**16**	**36**	**96**	**132**

Note: * The students shall undergo Internship during summer vacation and mid-term vacation soon after Second and Third Semester exams are completed and present the report on the Internship undergone during the Fourth Semester for evaluation.

Semester-wise Summary of Credit Distribution

Semesters	No. of Credits	No. of Hours
First Semester	26	35
Second Semester	29	40
Third Semester	27	37
Fourth Semester	14	20
Total Credits	**96**	**132**

Distribution of Credits Based on Type of Courses

Semester	HC	SC	OE	RULO	TOTAL
I	26	-	-	-	26
II	22	3	-	4	29
III	12	11	4	-	27
IV	10	-	-	4	14
Total	**70**	**14**	**4**	**8**	**96**

HC=Hard Core; SC=Soft Core; OE=Open Elective;
RULO=REVA Unique Learning Offerings

Distribution of Credits Based on L: T: P

Semester	L	T	P	Total	Total Hours
I	19	5	6	26	35
II	10	5	8	25	40
III	15	6	6	27	37
IV	0	0	14	18	20
Total	**44**	**16**	**36**	**96**	**132**

M Sc (Physics) Program

Detailed Syllabus

(Effective from Academic Year 2019-20)

FIRST SEMESTER

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH1010	MATHEMATICAL PHYSICS	HC	3	1	0	4	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 Outcomes:

On successful completion of this course, the student shall be able to:

1. Apply the mathematical skills to solve quantitative problems in the study of physics.
2. Solve the problems related to vectors and matrices for various applications.
3. The student shall be able to apply coordinate transforms to solve the physical problems expressed in tensors.
4. Apply the knowledge of Fourier transforms and Laplace transforms in solving the problems in physics.
5. Apply the suitable mathematical special function to solve the physics problems.

Course Content:

Unit-1: **12 hrs**

Review of Vector analysis and curvilinear co-ordinates Gradient, Divergence and Curl operations, Gauss‘ and Stokes‘ theorems, Curvilinear co-ordinates, tangent and normal vectors, contravarient and covariant components, Gradient, Curl, divergence and Laplacian in spherical polar and cylindrical polar co-ordinates, Definition of tensors, contravariant and covariant components of tensors, raising and lowering of tensor indices, sum, outer, inner products and contraction of tensors, Quotient law, symmetric, antisymmetric tenors, Levi civita symbol, Brief discussion on moment of inertia tensor.

Unit - 2: **12 hrs**

Linear vector spaces and operators: Vector spaces and subspaces, Linear dependence and independence, Inner product, Orthogonality, Gramm-Schmidt orthogonalization procedure, Basis and Dimensions, linear operators, Matrix representation, Similarity transformations, Characteristic polynomial of a matrix, Eigen values and eigenvectors, Self adjoint and Unitary transformations, Eigen values and eigenvectors of Hermitian and Unitary transformations, Minimal polynomial and diagonalization.

Unit - 3:

Fourier series integral transforms Fourier Series : Definition, Properties, Convergence, Application of Fourier series, Fourier Integral and Fourier transform, Convolution theorem, Parseval‘s theorem, Laplace transform and its properties, convolution theorem, inverse Laplace transforms, solution of differential equations using Laplace transforms, Fourier transform & Laplace transform of Dirac Delta function

Unit - 4: **12 hrs**

Special Functions

Ordinary differential equations and Special Functions: Linear ordinary differential equations, Separation of Poisson and Helmholtz equations in spherical polar and cylindrical polar coordinates, Series solutions – Frobenius‘method, Series solutions of the differential equations of Bessel, Legendre, Leguerre and Hermite polynomials, Generating functions, Some recurrence relations, orthogonality properties of these functions, Brief discussion of spherical Bessel functions and spherical harmonics.

Reference Books:

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).
4. Methods of Mathematical Physics, Bose H.K and Joshi M.C, Tata McGraw Hill, (1984).
5. Vector Analysis, Murray R Spiegel, Schaum's Outline Series, McGraw Hill International Book Company, Singapore (1981).
6. Tensor Analysis — Theory & Applications. Sokolnik off LS, 211: Edition, John Wiley Sons (1964).
7. Mathematical Methods in the Physical Sciences, Mary L. Boas, 2nd Edition, John Wiley & Sons (1983).
8. Matrices and Tensors in Physics, A.W. Joshi, 4th Edition, New Age International Publishers (1995).

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH1020	CLASSICAL MECHANICS	HC	3	1	0	4	5

Course Objectives:

1. To give students a solid foundation in classical mechanics.
2. To introduce general methods of studying the dynamics of particle systems.
3. To give experience in using mathematical techniques for solving practical problems.
4. To lay the foundations for further studies in physics.

Course Outcomes:

On successful completion of this course, the student shall be able to:

1. Apply the Lagrangian methods to analyze and explain the problems in classical Mechanics
2. Apply the concept of Central force problem to analyze and explain the problems Classification of orbits, Kepler's laws in planetary motion.
3. Apply the concept of Hamilton's equations to derive the expression for different principles in classical mechanics
4. Analyse the concept of mechanics of rigid bodies to demonstrate and explain the precession of rotation of earth and Rutherford's scattering in determination of structure of atoms
5. Communicate scientific information of classical mechanics.

Course Content:

Unit - 1: **12 hrs**

The Lagrangian Dynamics: Constraints and their classifications, Generalized coordinates, Virtual displacement and work, D'Alembert's principle, Lagrangian equation from D'Alembert's principle, Lagrangian equations for conservative system, Derivation of Lagrangian equations: For (I) A particle in (a) Cartesian coordinates, (b) Spherical polar coordinates and (c) Cylindrical polar coordinates, d) motion under Central force (II) Atwood's machine, III) simple pendulum, Derivation of Lagrange equation from Hamilton principle, Symmetry properties and conservation of Linear Momentum and Kinetic energy.

Unit - 2 **12 hrs**

Central force problem: Central force and Motion in plane, Equation of motion under the central force and first integrals, Differential equation for an orbit, Inverse square law of force, Kepler's laws of planetary motion and deduction, Stability and closure of orbit under central force, Artificial satellites, Scattering in a central force field, Rutherford scattering, Impact parameter, Problems.

Unit - 3: **12 hrs**

Hamilton's equations: Derivation of Hamilton's principle (Variational principle), Derivation of Hamilton's equations from the variational principle, Examples (i) the simple harmonic oscillator (ii) Hamiltonian for a free particle in plane and spherical Co-ordinates coordinates. Cyclic coordinates, Canonical Tranformations, examples of Canonical transformations, Generating functions (Four basic types), Poisson brackets, properties of Poisson brackets, angular momentum and Poisson brackets 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.

Unit – 4 **12 hrs**

Mechanics of rigid bodies: Generalized co-ordinates of a rigid body, Degrees of freedom, Angular Velocity, Angular momentum, inertia tensor, principal moments of inertia, kinetic energy of rigid body, Euler equations of motion for a rigid body, Torque free motion of a rigid body, motion of symmetrical top-rotational motion, Precession of earth's axis of rotation, Coriolis force, coriolis force acting on free fall body on earth's surface.

Special Theory of relativity: Galilean Transformation, Principle of relativity and speed of light, Lorenttz Transformations and its consequences.

References Books:

1. Classical Mechanics, J.C Upadhyaya, Himalaya Publishing house.(2005)
2. Classical mechanics, H. Goldstein, C. Poole, J. saflco. 3rd edition. Pearson Education inc. (2002).
3. Classical mechanics. K. N. Srinivasa Rao, University press (2003).
4. Classical mechanics, N. C. Rana and P.S. Joag Tata McGraw-Hill (1991).
5. Classical dynamics of particles and systems, J. B. Marion, Academic press (1970).
6. Introduction to Classical mechanics. Takwale and Puranik, Tata McGraw-hill (1983)
7. Classical mechanics, L. D. Landau and E. M. Lifshitz, 4thedition, Pergamon Press (1985).

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH1030	ELECTRONIC DEVICES	HC	3	1	0	4	5

Course Objectives:

1. To understand the basic working of Semiconducting devices and Linear Integrated Circuits.
2. To give an emphasis to the student to know the various semiconductor devices and its working.
3. To give clear understanding of various fabrication techniques of semiconducting devices.
4. To introduce the basic building blocks of linear integrated circuits.

Course Outcomes:

On successful completion of this course, the student shall be able to:

1. Analyse the BJT circuits, operation and its characteristics.
2. Design a DC bias circuitry of BJT, UJT and SCR.
3. Construct an OPAMP circuit for different applications.
4. Develop the prototypes of electronic devices.
5. Solve real time examples of BJT, UJT, SCR and OPAMP.
6. Able to describe various opto-electronic devices.

Course Content:

Unit 1: **12 hrs**

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 multi-vibtrator using transistors, Voltage regulator using transistors.

Unit 2: **12 hrs**

Field Effect Transistors (FET): JFET: Construction, working, Characteristics and parameters. MOSFET: Construction, working, Characteristics and parameters.

Thyristors: Types of thyristors, working and characteristics of Silicon Controlled Rectifier(SCR), Characteristics and application of TRIAC, Working and characteristics of Unijunction Transistor (UJT), UJT relaxation oscillator.

Unit 3: **12 hrs**

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, Active filters- First order Butterworth low pass and high pass filter, phase shift oscillator.

Unit 4: **12 hrs**

Optoelectronic devices: Photoresistor (LDR)–dark resistance, Principleand 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. LED, Plasma Display, Liquid Crystal Displays, Numeric Displays.

Reference Books:

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.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH1040	QUANTUM MECHANICS – I	HC	3	1	0	4	5

Course Objectives:

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

Course Outcomes:

On successful completion of this course, the student shall be able to:

1. Understand the mathematical representations and analysis used in quantum mechanics.
2. Postulate the basics of quantum mechanics.
3. Apply Schrodinger wave equation for one dimensional problem like, particle in a box, hormonic Oscillator etc.
4. Solve numerical based on angular momentum and spin operators.
5. Analyze the result obtained in Stern-Gerlach experiment.
6. Solve three dimensional problems in quantum mechanics.

Course Content:

Unit – 1 **12 hrs**

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, Time - dependent and independent Schrodinger's wave equation, Ehrenfest's Theorem, Continuity equation.

Unit - 2 **12 hrs**

Exactly solvable problems in one-dimension*:* free particle (Unbound state-continuous spectrum),particle in a box (bound state-Discrete spectrum)- potential barrier and wells, Tunneling, Transmission and Reflection co-efficient, Ramsauer -Townsend effect, Alpha decay, Infinite square well potentials: symmetric and asymmetricwells, finite square well potentials: scattering and bound state solutions, Simple Harmonic Oscillator: wave function and operator approach.

Unit – 3 **12 hrs**

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: Clebsch-Gordan coefficients for two particles.

Unit - 4: **12 hrs**

Exactly solvable problems in three dimensions: separation of Schrodinger equation in Cartesian coordinates, Simple harmonic oscillator in 3-dimensions, Free particle in 3-d box – Effects of the exclusion principle on non-interacting fermions in a box, central potential, Schrodinger equation in Spherical coordinates-separation of variables r, Φ, Θ. 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.

Reference Books:

1. N. Zettili, Quantum Mechanics: Concepts and Applications, 2nd edition, John Wiley (2009)
2. A Ghatak and S Lokanathan, Quantum Mechanics, Theory and Applications, Macmillan(2004).
3. Stephen Gasiorowicz, Quantum Physics, 3rd edition, John Wiley (2003).
4. E. Merzbacher, Quantum Mechanics. 3rd edition, John Wiley(1994).
5. V.K. Thankappan, Quantum Mechanics, Wiley Eastern (1985).
6. P.M. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, TMH(1977).
7. B.Bransden, C.Joachain, Quantum Mechanics, 2nd ed, Pearson/Prentice Hall, (2000).
8. R.L.Liboff, Introduction to Quantum Mechanics, Pearson Education(2003).
9. J.S.Townsend, A Modern Approach to Quantum Mechanics, 2nd ed, McGraw Hill.
10. C.Cohen-Tannoudji, B.Diu, F.Laloe, Quantum Mechanics (2 vol. set), Wiley Interscience (1996).

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH1050	MATERIAL SCIENCE (GENERAL)	HC	3	1	0	4	5

Course Objectives:

1. To introduce the basic principles underlying the behavior of materials.
2. To provide scientific foundation for understanding the relations among material properties, microstructure, and behavior of materials.
3. To make the students familiar with the vocabulary for the description of the empirical facts and theoretical ideas about the various levels of structure from atoms through defects in crystals to larger scale morphology of practical materials.

Course Outcomes:

On successful completion of this course, the student shall be able to:

1. Explain the relationship between a material's microstructure and its properties.
2. Explain how the presence and properties of defects can affect the strength of a material.
3. Distinguish between elastic and plastic behavior of materials.
4. Apply the knowledge of phase diagrams to synthesize different phases of materials.

Course Content:

Unit - 1: **12 hrs**

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.

Unit - 2: **12 hrs**

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 of ionic crystals.

Unit - 3: **12 hrs**

Elastic and Plastic Behavior of Materials

Atomic model of elastic behavior- the modulus 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.

Unit - 4: **12 hrs**

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-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.

Reference Books:

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 transformations, **V. Raghavan**, Prentice hall (1991).

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH1060	GENERAL PHYSICS LAB - I (PRACTICAL)	HC	0	0	3	3	5

Course Objectives:

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

Course Outcomes:

On successful completion of this course, the student shall be able to:

1. Verify various laws of physics related to optics.
2. Determine the physical parameters through experiments.
3. Analyze the concepts of physics through experiments.

Course Content:

LIST OF EXPERIMENTS:

1. Verification of law of intermediate metals
2. Study the thermo emf and hence to determine inversion temperature.

3. Measurement of resistivity of a semiconductor by Four probe method at different temperature and determination of energy gap.
4. Determination of grating constant and wavelength of LASER light by using grating.
5. Design and study of the frequency response of CE transistor amplifier.
6. Determination of Stefan's constant and Verification of Stefan's fourth power law by electrical method.
7. Determination of Energy band gap of two different semiconductors.
8. Determination of solar constant.
9. Thermal Conductivity of a rod by Forbe's method.
10. Determination of temperature sensitivity of a thermocouple and its Calibration.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH1070	ELECTRONICS LAB (PRACTICAL)	HC	0	0	3	3	5

Course Objectives:

- To familiarize the students with the basics of electronics.
- To enable the students to explore the concepts involved in the oscillators.
- To make the students understand the basic concepts in ICs and digital devices.
- To allow the students to understand the fundamentals of multi-vibrators.

Course Outcomes:

On successful completion of this course, the student shall be able to

1. Analyze the characteristics of MOSFET and SCR.
2. Verify the outputs of as table, monostable and VCO circuits using ICs.
3. Design and construct the Single Stage BJT and FET Amplifier circuits.
4. Design voltage regulator using Zener diode and regulated power supply using IC.

Course Content:

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 in amplifier.
6. Study of MOSFET characteristics and its applications as amplifier.

7. Characteristics and applications of SCR.
8. Monostable multivibrator using IC 74127.
9. Design of regulated power supply.
10. Solving Boolean expressions.

SECOND SEMESTER

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH2010	QUANTUM MECHANICS –II	HC	3	1	0	4	5

Course Objective:

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

Course Outcomes:

On successful completion of this course, the student shall be able to:

1. Understand Symmetry in quantum mechanics.
2. Apply approximation methods for quantum mechanical problems.
3. Understand the radiation and matter interaction
4. Understand the concepts of relativistic quantum mechanics.

Course Content:

Unit1: **12 hrs**

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 Pauli exclusion principle, Exited states of helium atom: ortho and para helium atom.

Unit 2: **12 hrs**

Approximation methods:

The variational method:-variation principle, application of variational approach to ground states of (i) Hydrogen atom and (ii) Helium atom. The WKB method: one dimensional case, approximate solutions turning points and connection formulae, tunneling through a barrier. Time independent perturbation theory: Perturbation theory for non-degenerate states, Applications. linear and quadratic stark effects in hydrogen atom. 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.

Unit 3 **12 hrs**

Interaction of radiation with matter: radiation field quantization, spontaneous emission, absorption, induced emission, dipole transitions, selection rules. Identical particles, scattering cross-section, Born approximation, partial waves, optical theorem

Unit – 4: **12 hrs**

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

Reference Books:

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.KThankappan,** 2nd Edition 2004.Pri
5. Quantum Mechanics, **E. Merzbacher,** 3rd edition, John Wiley(1994).
6. Quantum mechanics, **Stephen Gasiorowicz**, john Wiley (2003).
7. Principles of Quantum mechanics ,**R. Shankar,** 2nd Edition, Premium press, NY (1994)
8. Relativistic Quantum mechanics and Relativistic Quantum fields, **J.D. Bjorken and S.D. Drell**, Mc. Graw-hill,New York (1968).
9. Quantum mechanics, **L.I.Schiff Mc. Graw-hill**, (1955).
10. C.Cohen-Tannoudji, B.Diu, F.Laloe, Quantum Mechanics (2 vol. set), Wiley Interscience (1996).

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH2020	STATISTICAL MECHANICS	HC	3	1	0	4	5

Course Objectives:

1. To make students understand the basics of Thermodynamics and Statistical systems.
2. To make students understand the various laws of thermodynamic.
3. To acquire the knowledge of various statistical distributions.
4. To comprehend the concepts of enthalpy, phase transitions and thermodynamic functions.

Course Outcomes:

On successful completion of this course, the student shall be able to:

a) Solve day-to-day life selected problems using thermodynamics laws.
b) Analyse various distribution laws.
c) Apply the concepts to test distribution laws.
d) Apply the distribution laws to solve physical problems.

Course Content:

Unit – 1: **12 hrs**

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. thermoelectric phenomenon, Peltier effect, Seebeck effect, Thompson effect, systems far from equilibrium.

Unit – 2: **12 hrs**

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; Molecular partition function, translational and rotational and vibrational partition function and applications to solids, Chemical equilibrium.

Unit – 3: **12 hrs**

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.

Unit – 4: **12 hrs**

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

Reference Books:

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.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH2030	CONDENSED MATTER PHYSICS (General)	HC	3	1	0	4	5

Course Objectives:

1. To understand the basic knowledge on crystal structures and systems.
2. To understand the various process techniques available of X-Ray Crystallography.
3. To comprehend the concepts of superconductivity and magnetic properties of solids.

Course Outcomes:

On successful completion of this course, the students shall be able to:

1. Formulate basic models of lattice vibrations for describing the physics of crystalline materials
2. Develop a relation between band structure and the electrical/optical properties of materials
3. Analyze the concepts of superconductivity
4. Analyze of the variation of Fermi energy with temperature and impurity concentration in the case of impurity semiconductors.

Course Content:

Unit -1: **12 hrs**

X-ray Crystallography: Crystalline state, Reference axes, Lattices, two dimensional lattices, Three-dimensional lattices, equation of a plane, derivation of Miller indices, Reciprocal lattice, symmetry operations, Two and three dimensional point groups, choice of unit cell, Bravais lattices and crystal systems, Screw and glide operations, Space groups, analysis of the space group symbol. Structure and Atomic scattering factor (qualitative), Diffraction of X-rays by crystals: Bragg equations, Laue equations, Equivalence of Laue and Bragg equations,.

Unit - 2: **12 hrs**

Experimental techniques: Diffraction by single crystal, Laue, Weissenberg and Powder methods.

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

Crystal growth: Crystal growth from melt: Bridgemann and czochralski methods and zone refining techniques: any two methods.

Liquid crystals: Morphology, The smectic (A-H), nematic and cholesteric phases, Birefringence, Orientational order and its determination in the case of nematic liquid crystals.

Unit -3: **12 hrs**

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, Susceptibility below and above Neel‘s temperature.

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

Unit - 4: **12 hrs**

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.

Reference Books:

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.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH2040	ATOMIC AND MOLECULAR PHYSICS	HC	3	1	0	4	5

Course Objectives:

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

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

1. Analyze the concepts of atomic models, spectra of one and two valance electron atoms.
2. Analyze the behaviour of atoms in external applied electric and magnetic field.
3. Differentiate rotational, vibrational, electronic and Raman spectra of molecules.
4. Describe electron spin and their spectroscopic applications.
5. Formulate and solve the problems related to different spectroscopic systems.

Course Content:

Unit – 1: **12 hrs**

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).

Unit – 2: **12 hrs**

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.

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**

Reference Books:

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.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH2051	ELECTRONICS-I (DIGITAL ELECTRONICS)	SC	2	1	0	3	4

Course Objectives:

1. To understand number systems and codes and their application to digital circuits.
2. To gain knowledge of Boolean algebra, Karnaugh maps and its application to the design and characterization of digital circuits.
3. To know the mathematical characteristics of logic gates.
4. To design and analyze a given combinational or sequential circuit using Boolean Algebra as a tool to simplify and design logic circuits.
5. To understand the logic design of programmable devices, including PLDs

6. To design various synchronous & Asynchronous counters and Universal Shift Registers.

Course Outcomes:

On successful completion of this course, the student shall be able to:

1. Translate from one number system to its equivalent other number system and perform its arithmetic operations.
2. Explain TTL and CMOS construction, working, characteristics and applications.
3. Explain the use of implementation of logic circuits.
4. Draw the logic circuits by simplifying Boolean expressions using theorems, laws and K-map.
5. Analyse the operation of Combinational and Sequential logic circuits.
6. Explain DAC and ADC, types, specifications and applications.

Course Content:

Unit 1: **12hrs**

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, Application relevant information, electrical characteristics.

Unit 2: **12hrs**

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.

Unit 3: **12hrs**

Combinational and Sequential circuits: Half and full Adder – Half and full Subtractor – 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.

Unit 4: **12hrs**

A/D and D/A conversion circuits: Introduction, Digital to Analog Converters D/A converter Specifications, Types of D/A converters, Mode of Operation, BCDInput 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.

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.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH2052	CONDENSED MATTER PHYSICS - I	SC	2	1	0	3	4

Course Objectives: To familiarized students with:

1. Defects, types of defects and how defects are formed.
2. Luminescence and its mechanism.
3. Lattice formation and deformation, energy band structure and classification of materials based on energy gap.
4. Preparation of thin films and study of their structural characteristics.

Course Outcomes:

On successful completion of this course, the student shall be able to:

1. Analyse defects in crystals.
2. Illustrate Photoconductivity, Luminescence- fluorescence, Phosphorescence, Thermoluminescence, Photoluminescence, Electroluminescence; Mechanisms.
3. Analyse Short range order- Long range order.
4. Design semiconductor devices.

Course Content:

Unit -1: **12 hrs**

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.

Unit – 2: **12 hrs**

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 in amorphous semiconductors-Applications.

Unit – 3: **12 hrs**

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 Hall coefficient in intrinsic, n-type and p-type semiconductors.

Unit – 4: **12 hrs**

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 probe method, thin film resistors (Conduction in metal and non metallic films) Magnetic properties- film size effect on MS- films for memory devices.

Reference Books:

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.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH2053	MATERIAL SCIENCE –I	SC	2	1	0	3	4

Course Objectives:

1. To focus on the structural, electronic and magnetic properties of metals, alloys, super conductors, semi-conductors and dielectric materials.
2. To discuss and understand various applications of the above materials in different fields.

Course Outcomes:

On successful completion of this course, the student shall be able to:

1. Explain the Structure, types of metals and alloys.
2. Analyze the effect of doping and mobility of charge carriers in semiconductors.
3. Analyze the concept of dielectrics and magnetic materials phenomena.
4. Analyze the Properties of Magnetic Materials based on resonance and spin configurations.

Course Content:

Unit - 1: 12 hrs

Metals: Review of free electron theory and Fermi distribution function, Structure and types 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- an harmonic interactions, Galvanomagnetic effects in metals.

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.

Unit - 2: **12 hrs**

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.

SQUID. HTS superconductors - materials preparation and structure.

Unit - 3: **12 hrs**

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.

Unit - 4: **12 hrs**

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 Their application.

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, applications.

Reference Books:

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).

Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**C**	**Hrs./ Wk.**
M19PH2060	**YOGA / SPORTS / MUSIC / DANCE/ THEATRE**	RULO	0	0	2	2	3

Note: Music, Dance, and Theater courses are offered by the School of Performing Arts, whereas the Sports and Yoga courses are offered by the Department of Physical Education. The students have to choose any **ONE** of these courses.

A. YOGA FOR HEALTH

Course Objectives:

Following are the Course Objectives.

- To prepare the students for the integration of their physical, mental and spiritual faculties;
- To enable the students to maintain good health;
- To practice mental hygiene and to attain higher level of consciousness;
- To possess emotional stability, self control and concentration; and
- To inculcate among students self discipline, moral and ethical values.

Course Outcomes:

On completion of the course learners will be able to:

- Practice yoga for strength, flexibility, and relaxation.
- Learn techniques for increasing concentration and decreasing anxiety
- Become self disciplined and self-controlled
- Improve physical fitness and perform better in studies
- Gain self confidence to face the challenges in the society with commitment to serve the society

Course Contents

Unit-I:

Yoga: Introduction, Tips from Sage Patanjali's Yoga Sutras
Surya Namaskara:- 10 counts,12 counts,16 counts

Unit-II:

Asanas: Sitting- Vajrasana, Dandasana, Padmasana, Matsyasana, Ardha Matsyendrasana, Suptavajrasana, Paschimottasana, Bakasana, Simhasana, Shirasasana.
Asanas: Standing- Tadasana, Trikonasana, Parshwa konasana, Veerabadrasana, Parivrutta trikonasana.

Unit-III:

Asanas: Prone Position- Bhujangasana, Dhanurasana, Shalabhasana.
Asanas: Supine Position- Sarvangasana, Sethubandha sarvangasana, Halasana, Karnapeedasana.
Mudras- Dhyana mudra, Chinmaya mudra, Namaste mudra, Nasika mudra

Unit-IV:

Pranayams:- Ujjayi, Nadi Shodhana, Anuloma – Viloma, Basthrika, Bhramari, Sheethali
Dhyana & its types, Competition format, Rules and their interpretations

B. SPORTS (VOLLEYBALL)

Course Objectives:

1. To learn the rules, fundamental skills, and strategies of volleyball.
2. To develop skills in passing, setting, serving, spiking, and blocking.
3. To learn basic offensive and defensive patterns of play.
4. To develop a positive attitude towards volleyball as a lifetime sport and to improve physical fitness through participation in volleyball.

Course Outcomes:

On completion of the course learners will be able to:

1. Learn basic skills and knowledge associated with volleyball.
2. Apply these skills while playing volleyball and exhibit improved performance
3. Improve physical fitness and practice positive personal and lifestyle.
4. Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

Course Contents:

Unit-I

Introduction about Volleyball
Players Stance, Receiving and passing
The Volley (Overhead pass), The Dig (Underhand pass), Service Reception

Unit-II

Service- Under Arm Service, Tennis Service, Side Arm Spin Service, Round Arm Service, High spin service, Asian serve / American serve (floating)

- Setting the ball- Set for attack, Back set, Jump set

Unit-III

Smash/Spike- Straight smash, Body turn smash, Wrist outward smash, Wrist inward smash,
Block- Single block, Double block, Three-man block,
Rolls- Overhead pass & back rolling, One hand underhand pass with side rolling, Forward dive

Unit-IV

Attack Combination, Defense Systems, Libero play,
Court marking, Rules and their interpretations and Duties of officials

C. SPORTS (BASKETBALL)

Course Objectives:

1. To learn the rules, fundamental skills, and strategies of Basketball
2. To develop technical skills in passing, in ball handling, individual offense, individual defense, rebounding, screen, team offense, team defense and fast break.
3. To learn basic offensive and defensive strategies of play.
4. To develop a positive attitude towards Basketball as a lifetime sport and to improve physical fitness through participation in Basketball.
5. To develop positive understanding and appreciation of the basketball game.

Course Outcomes:

On completion of the course learners will be able to:

1. Learn basic skills and knowledge associated with basketball.
2. Apply these skills while playing basketball and exhibit improved performance
3. Improve physical fitness and practice positive personal and lifestyle.
4. Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

Course Contents:

Unit-I

- Basketball: Introduction
- Grip; Player stance- Triple threat stance and Ball handling exercises
- Passing (Two hand/one hand)- Chest pass, Bounce Pass, Over head pass, Underhand pass, Hook Pass, Behind the back pass, Baseball pass, Side arm pass and passing in running.
- Receiving-Two Hand receiving, One hand receiving, Receiving in stationary position, Receiving while jumping, Receiving while running.

Unit-II

- Dribbling- How to start dribble, How to stop dribble, High / Low dribble with variations
- Shooting- Layup shot and its variations, One hand set shot, One hand jump shot, Free throw, Hook shot, Tip-in shot.
- Stopping- Stride/Scoot, Pivoting and Faking /Feinting footwork.

Unit-III

- Rebounding- Defensive rebound, Offensive rebound, Box out, Rebound Organization.
- Individual Defensive- Guarding the man with the ball and without the ball.
- Offensive drills, Fast break drills, Team Defense/Offense, Team Tactics

Unit-IV

- Court marking, Rules and their interpretations

D. SPORTS (FOOTBALL)

Course Objectives:

1. To learn the rules, fundamental skills, and strategies of football.
2. To develop skills in passing, receiving, controlling the ball, dribbling, shielding, shooting, tackling, beating a defender and heading in football.
3. To learn basic offensive and defensive patterns of play
4. To use different parts of the body in utilizing the above skills while playing football
5. To develop a positive attitude towards football as a lifetime sport and to improve physical fitness through participation in football.

Course Outcomes:

On completion of the course learners will be able to:

1. Learn basic skills and knowledge associated with football.
2. Apply these skills while playing football and exhibit improved performance
3. Use the knowledge and understanding to perform, refine and adapt the above skills and related skills with precision, accuracy, fluency and clarity in any situation.
4. Improve physical fitness and practice positive personal and lifestyle.
5. Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

Course Content:

Unit-I

Football: Introduction

Kicks- Inside kick, Instep kick, Outer instep kick, Lofted kick, Chipping, Volley, Half Volley

Trapping- Trapping rolling the ball, Trapping bouncing ball with sole

Unit-II

- Dribbling- With instep and outer instep of the foot.
- Heading- From standing, running and jumping.
- Feinting- With the lower limb and upper part of the body.

Unit-III

- Tackling- Simple tackling, Slide tackling.
- Throw-in- Standing and Sliding
- Goal Keeping- Collection of balls, Ball clearance, throwing and deflecting.

Unit-IV

- Ground marking, Rules and their interpretations

E. SPORTS (TRACK AND FIELD)

Course Objectives:

1. To teach students the skilled techniques in sprints, relay running, hurdles, long jump, high jump, and shot put and practice them.
2. To develop competence among students in demonstrating all the techniques covered in the course.
3. To make students understand some of the scientific and empirical principles and their rationale underlying the development of skilled performance.
4. To inculcate among students the habit of team work and cooperative learning and develop competence in detecting / correcting technique errors.
5. To develop a positive attitude towards sports in general and athletics in particular and to improve physical fitness through participation in various athletic games / sports activities.

Course Outcomes:

On completion of the course learners will be able to:

1. Display competencies in executing basic techniques and skills associated with select track and field events.
2. Develop basic skills and techniques to improve one's running posture and take-off position for different jumps.
3. Learn regular practice of select track and field events and improve physical fitness
4. Appreciate track and field events by applying sports science knowledge to explain the execution of the events.

Course Content:

Unit-I

Athletics: Introduction

Track Events - Steeple Chase, Race Walking, Middle and Long distance races

Race walking - Technique, Faults and Officiating.

Middle and Long distance races – Technique and Training

Unit-II

Jumping Events - High Jump and Triple Jump: Basic Skills and techniques

High Jump - Straddle Roll & Flop Technique, Approach, Take-off, Technique in the air,

Clearance over the bar & Landing

Triple Jump – Hop, Step and Jump Technique, Approach, Take-off & Landing

Unit-III

Throwing Events - Discus Throw and Hammer Throw: Basic Skills and techniques

Discus Throw - Standing and Rotatory techniques, Grip, Stance, Rotation Technique, Power stance, Release and Reverse (Follow through)
Hammer Throw - Grip, Swings, Rotation foot work, Release and Follow through

Unit-IV
Rules, Officiating and Marking - Ground / Sector Marking, Interpretation of Rules.

Reference Books

(Athletics Part-I and Athletics Part-II)

1. Arthur E. Ellison (ed) (1994). Athletic Training and Sports Medicine.
2. Ballisteros, J.M. (1998). Hurdles Basic Coaching Manual, IAAF.
3. Bosen K.O. (1993). Teaching Athletics Skills and Technique.
4. Bosen K.O. (1990). Study Material on Hurdles for the Regular Course Students.
5. Doherty K. (1995). Track and Field Omni book.
6. Martin, David E. Peter N. Coe (1991). Training Distance Runner.
7. Howard S. (1981). Science of Track and Field Athletics.
8. Briggs Graeme (1987). ―Track and field coaching Manual‖, Australian Track and Field Coaches Association. Rothmans Foundation National Sports Division.
9. Carr, Gerry (1999). ―Fundamentals of Track and Field. Track Athletics 1 Title G.V. 1060 5.e. 368.
10. I.A.A.F. Level-II (2001). Text Book on Jumping Event.
11. Jarver, Jesse (1987). ―The Jumps‖, Track and Field Coaching Manual Australia.

F. DRAMATICS
Pre-requisites: Students with background in Theatre Arts/ Keen interest in Dramatics.
Course Objectives:

- To imbibe the acting skills.
- To understand the broader applications of theatre studies in allied arts forms.
- To be able to use body language for better communication.
- Students shall also be able to understand voice modulation and Navarasas.

Course Outcomes:

On successful completion of this course, students should be able to:

- Freely express improvisation in non-verbal communication.
- Shall hone good acting skills and be able to emote better.
- Be able to put up a theatre act and play a key role.
- Be able to differentiate good acting and understand the importance of good lyrics, stage crafting, music, dance, costume and lighting.

Course Content:

UNIT – 1

Working on Body:

Body and its analysis. Understanding physical abilities (Anga, Pratyanga and Upanga). Challenges of the body. Using body as metaphor and language. The class's bodies as a collective, an ensemble, a collaborative team.

UNIT – 2

Sound and Movement:

Awareness of creating sound patterns, voice modulations, rhythm in speech and diaologues. Understanding the rhythm and patterns of movements like walking, framing, shaping, primitive and animal movements.

UNIT – 3

Characterization and Improvisation:

Observation of people around. Getting into the role and living it. Developing a character from establishment (pace and rhythm). Improvisation techniques of body and mind.

UNIT – 4

Group work and Production:

Develop a theme, concept or a play and include all the theatre skills, stage craft, costuming and put up an act. Choosing theme and characters.

Reference Books:

1. All about Theatre – Off stage – Chris Hogget.
2. Rangadalli Anataranga – K V Subbanna
3. The Indian Theatre – Hemendranath Das Gupta.
4. A Practical handbook for an Actor – Milisa Bruder, ee Milchel Cohn, Madeleine Oliek et al, Zigler Publisher.

G. INDIAN CLASSICAL DANCE FORMS (Bharathanatyam, Kuchipudi ,Mohiniyattam)

Prerequisites: Background of classical dance training or any other dance forms.

Note: Non-classical dancers can also join.

Course Objectives:

- To develop an understanding about the Indian classical dance forms and its universal application.
- To be able to understand the fine nuances of Classical dance.
- To understand the importance of health through Indian classical dance, strengthen the body capacity.
- To understand mythology and its characters in Indian classical dance form through lessons of Abhinaya.

Course Outcomes:

- To be able to identify and appreciate the classical dance forms.
- To be able to execute basics of Adavus with finesse.
- To be able to express through abhinaya.
- To be able to perform to perform the fundamentals in the chosen dance form.

Course Content:

Unit 1

An introduction to Indian classical dance forms: Bharatanatyam, Kuchipudi, Mohiniyattam.

Unit 2

Learning of Fundamentals: Exercises and Adavus- I (Bharathanatyam , Kuchipudi, Mohiniyattam).

Unit 3

Adavus –II (Bharathanatyam , Kuchipudi, Mohiniyattam)

Unit 4

Learn a basic composition in the chosen dance form.

Reference Books:

1. Indian classical dance forms –U S Krishna Rao,U K Chandrabhaga Devi
2. Classical Dances –Sonal Mansingh, Avinash Parischa
3. Kuchipudi – Sunil Kothari
4. Bharatanatyam An in depth study- Saroja vydyanathan
5. Mohiniyattam – Bharathi Shivaji

H. PERCUSSION INSTRUMENT (TABLA AND MRIDANGAM)

Pre-requisites: Students with background in Percussion instruments and knowledge of Rhythm/ Keen interest in studying Mridagam / Tabala.

Course Objectives:

- To understand the Rhythmology.
- To understand the importance of Laya, Taala.
- To be able to understand the fine finger techniques of playing the instrument.

Course Outcomes:

On successful completion of this course, students should be able to:

- To be able to set instrument to Sruthi.
- To be able to play the fundamentals on instrument.
- To be able to learn and perform a particular taala.

Course Content:

UNIT 1

Introduction to Musical Instruments, Percussion Instruments
Mridangam and its History

UNIT 2

Introduction to Tala System, Definitions of 5 jaathis and their recitation
Adi Talam and its various forms, Definitions and recitation of different gathis

UNIT 3

Tisra Jaathi, Khanda Jaathi, Misra jaathi, Sankeerna Jaathi

UNIT 4

Learning of Jathi Formation, Basic jathis, Jathis for Dance forms
Some Basic Definitions of Korvai, Teermanam etc.,

Reference Books:

1. Mridangam- An Indian Classical Percussion Drum – Shreejayanthi Gopal
2. Theory and practice of Tabala – Sadanand Naimpally.

3. Theory and practice of Mridangam – Dharmala Rama Murthy
4. The Art of the Indian Tabala – Srdjan Beronja.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH2070	SKILL DEVELOPMENT	RULO	0	0	2	2	3

Note: The students will have to undergo Skill Development course being conducted by Training and Placement cell of the University.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M18PH2080	GENERAL PHYSICS LAB - II (PRACTICAL)	HC	0	0	3	3	5

Course Objectives:

1. 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.
2. 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 Outcomes:

On Successful completion of this course, students shall be able to:

1. Infer the result of related experiments.
2. Employ the different tools and techniques to get the data/readings related to the experiments.
3. Explore the fundamental physics behind many scientific discoveries through hands on experience.

List of Experiments:

1. Determination of wave length and 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. Determination of end point energy of half value methods or absorption energy by 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 by diffraction halos method.
8. Determination of velocity of ultrasonic waves in liquid.
9. Determination of Red berg using hydrogen spectrum.
10. Verification of photoelectric equation and determination photonic work function and Planck's constant.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH2090	ATOMIC AND MOLECULAR PHYSICS (PRACTICAL)	HC	0	0	3	3	5

Course Objectives:

1. 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.
2. 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 Outcomes:

On successful completion of this course, the student shall be able to:

1. Verify the spectroscopic phenomenon of physics through experimentation.
2. Infer results of the experiments connected with interaction of electric and magnetic fields with atoms and molecules.
3. Distinguish the band, line and Raman spectrum through the experimentation.

THIRD SEMESTER

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH3010	ELECTRODYNAMICS	HC	2	1	0	3	4

Course Objective:

1. To introduce students the principles and applications of Electrostatics, Magneto-statics, Electrodynamics and Electromagnetic waves.

Course Outcomes:

On the successful completion of this course, the student shall be able to:

1. Apply reasoning skills to model and solve problems related to electrostatics
2. Formulate problems within magnetostatics and stationary current distributions and solve.
3. Demonstrate the understanding of Faraday‘s laws and Maxwell‘s equations and physics concepts in Electrodynamics.
4. Derive expressions for the energy both for the electrostatic and magneto-static fields by using Poynting‘s theorem and Maxwell‘s equations.
5. Analysis and explain wave guides and Electromagnetic radiation by using concepts of electrostatics, magneto statics and Maxwell‘s equations.
6. Communicate scientific information in electrostatics, magneto statics, electrodynamics and electromagnetic radiation in oral, written, and graphical formats.

Course Content:

Unit -1: **12 hrs**

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.

Unit - 2: **12 hrs**

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, magneto static boundary conditions, magnetic scalar potential, Energy in the magnetic field.

Unit -3: **12 hrs**

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., frensnel‘s law

Unit 4: **12 hrs**

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-Pinch effect.

Reference Books:

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).
2. Electro magnetics: B.B. Laud. Wiley Eastern Ltd., Bangalore (1987)
3. Classical Electromagnetic Radiation: J.B. Marion, Academic press, NewYork (1968).
4. Classical Electrodynamics; S P Puri, Tata McGraw –Hill Publishing Company Ltd., New Delhi, (1990).

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH3020	NANOSCIENCE AND TECHONOLOGY	HC	2	1	0	3	4

Course Objectives:

1. To understand the fundamental concepts behind nanoscience and nanotechnology.
2. To familiarize with various processing techniques available for synthesis of nanostructure materials.
3. To acquire the knowledge of various nanomaterial characterization methods.
4. To get familiarized with the various analytical techniques.
5. To understand the properties of nanomaterials.

Course Outcomes:

On successful completion of this course, the student shall be able to:

1. Analyze the fundamental principles of nanotechnology and apply to different applications
2. Apply physics concepts to the nano-scale and non-continuum domain.
3. Demonstrate state-of-the-art nano-fabrication methods to prepare nano particles
4. Evaluate processing conditions to functional nanomaterials
5. Evaluate current constraints, such as regulatory, ethical, political, social and economical, encountered when solving problems in living systems.

Course Content:

Unit – 1: **12 hrs**

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.

Unit - 2: **12 hrs**

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.

Unit – 3 **12 hrs**

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.

Unit – 4: **12 hrs**

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.

Reference Books:

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.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH3030	NUCLEAR AND PARTICLE PHYSICS	HC	2	1	0	3	4

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:

On successful completion of this course, the student shall be able to:

- Explain various types of nuclear of reactions
- Construct nuclear and semi-conductor detectors
- Apply various models to study nuclear decay
- Apply basic laws of particle physics and macroscopic physics phenomena in determination of particle properties and properties of processes in the subatomic world

Course Content:

Unit -1: **12 hrs**

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.

Unit – 2: **12 hrs**

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.

Unit – 3: **12 hrs**

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, Potential depth.

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).

Unit – 4: **12 hrs**

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 weak 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).

Reference Books:

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.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH3041	ELECTRONICS - II (ELECTRONIC COMMUNICATION SYSTEMS)	SC	3	1	0	4	5

Course Objectives:

1. To understand the fundamental concepts of communication systems.
2. To understand and compare different analog modulation schemes.
3. To understand and compare different digital modulation schemes.
4. To understand the design tradeoffs and performance of communications systems.

Course Outcomes:

On successful completion of this course, the student shall be able to:

1. Analyze the working of amplitude and frequency modulated communication systems.
2. Analyze various modulation schemes in digital communication system
3. Distinguish between Analog and Digital Communication system and analyze various sampling methods and its reconstruction.
4. Construct various channel coding and decoding schemes such as Hadamard code, Hamming code, Cyclic Codes, Convolution coding

Course Content:

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.

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.

<u>Digital communication systems</u>

Unit 3:

Analog to Digital Conversion Noisy communications channels, 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.

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, Shannon Fano and Hoffman Codes.

Reference Books:

1. Principles of Communication Systems – H Taub & D. Schilling, Gautam Sahe. 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. Communication Systems Second Edition - R.P. Singh. SP Sapre, TMH, 2007.
6. Communication Systems by Simon Haykins John Wiley & Sons, 4th Edition.
7. Electronic Communications – Dennis Roddy and John Coolean , 4th Edition , PEA, 2004
8. Communication Systems – B.P. Lathi, BS Publication, 2004.
9. Electronics & Communication System – George Kennedy and Bernard Davis, TMH 2004.
10. Electronic Communication Systems – Modulation and Transmission - Robert J. Schoenbeck, 2nd Edition, PHI.
11. Analog and Digital Communications – Simon Haykin, John Wiley, 2005.
12. Analog and Digital Communication – K. Sam Shanmugam, Willey ,2005
13. Electronics Communication Systems-Fundamentals through Advanced-Wayne Tomasi, 5th Edition, 2009, PHI.
14. Lathi –Modern Digital and Analog Communication Systems,‖ Oxford University Press.

15. B. Sklar, ―Digital Communications: Fundamentals and Applications,‖ Pearson Education.
16. S. Haykin, ―Digital Communication,‖ John Willey.
17. R.P. Singh and S.D. Sapre, ―Communication Systems: Analog and Digital,‖ Tata McGraw-Hill.
18. T. Schilling, ―Principles of Communication Systems,‖ TMH.
19. A.B. Carlson, ―Communication Systems,‖ TMH.
20. G. Kennedy, ―Electronic Communication Systems,‖ TMH.
21. Digital Communications - John G. Proakis . Masoud salehi – 5th Edition, McGraw-Hill, 2008.
22. Digital Communication - Simon Haykin, Jon Wiley, 2005.
23. Digital Communications - Ian A. Glover, Peter M. Grant, Edition, Pearson Edu., 2008.
24. Communication Systems-B.P. Lathi, BS Publication, 2006.
25. Principles of communication systems - Herbert Taub. Donald L Schiling, Goutam Sana, 3rd Edition,Mc.Graw-Hill, 2008.
26. Digital and Analog Communicator Systems - Sam Shanmugam, John Wiley, 2005.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH3042	CONDENSED MATTER PHYSICS –II	SC	3	1	0	4	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 Outcomes:

On successful completion of this course, the student shall be able to:

1. Differentiate types of magnetic materials.
2. Analyze ESR and EPR spectral data.
3. Understand classical and quantum theory of dielectrics.
4. Classify ferroelectric crystals.

Course Content:

Unit - 1: **12 hrs**

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, magneto crystalline anisotropy energy, Bloch wall.

Ant ferromagnetism: 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.

Unit - 2: 12 hrs

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.

Unit - 3: 12 hrs

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.

Unit - 4: 12 hrs

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.

Reference Books:

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).

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH3043	MATERIAL SCIENCE - II	SC	3	1	0	4	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, the student shall be able to:

1. Synthesize the polymers, ceramics and glasses.
2. Explain the applications of composite material related to polymers, ceramics and glasses
3. Analyze the Properties of polymers, ceramics and glasses
4. Analyze the defects and inabilities of polymers, ceramics and glasses for industrial applications.

Course Content:

Unit-1: 12 hrs

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.

Unit-2: **12 hrs**

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.

Unit-3: **12 hrs**

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.

Unit-4: **12 hrs**

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.

Reference Books:

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.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH3051	ELECTRONICS - III (LINEAR INTEGRATED CIRCUITS)	SC	3	1	0	4	5

Course Objectives:

1. To analyze and design various applications using Op-amp.
2. To design and construct waveform generation circuits.
3. To design timer, analog and digital circuits using op-amps.
4. To design combinational logic circuits using digital ICs.

Course Outcomes:

On successful completion of this course, the student shall be able to:

1. Differentiate between an ideal and practical characteristics of op-amp.
2. Explain the frequency response of an opamp compensator networks.
3. Analyze linear applications of op-amp circuits such as integrator, differentiator log and antilog networks.
4. Analyze the basic function of comparators and convertors using OPAMP.

Course Content:

Unit – 1: **12 hrs**

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.

Unit - 2: **12 hrs**

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 effects in application.

Unit - 3: **12 hrs**

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.

Unit – 4: 12 hrs

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.

Reference Books:

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).

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH3052	CONDENSED MATTER PHYSICS - III	SC	3	1	0	4	5

Course Objectives:

1. Structural analysis is the first step in the characterization of any material.
2. The atomic structure of a material depends on the method of synthesis and on various parameters involved in the technique.
3. This course will introduce the fundamental concepts of crystal structure and to understand the diffraction principle and use of X-rays.
4. To understand the symmetry and space groups.
5. To know about lattice representation and reciprocal lattices.
6. To determine and analyze the crystal structure using x-ray diffraction.

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

1) Illustrate reciprocal lattice.
2) Understand the theoretical framework like symmetry and space groups.
3) Illustrate different X-ray analysis methods
4) Characterize the crystal using X-ray diffraction experiments.

Course Content:

Unit -1: **12 hrs**

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.

Unit - 2: **12 hrs**

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.

Unit - 3: **12 hrs**

Moving film methods: Weissenberg method, reciprocal lattice construction for zero level and higher levels, indexing procedure, interpretation of photographs. Single crystal diffracto-meter: Reciprocal lattice construction, parafocussing and goniometry, intensity measurements.

Unit - 4: **12 hrs**

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.

Reference Books:

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.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH3053	MATERIAL SCIENCE - III	SC	3	1	0	4	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, the student shall be able to:

1. Characterize optical and dielectric properties of metals & non-metals through the spectroscopic techniques.
2. Analyze the properties like Luminescence and photoconductivity of metals & non-metals.
3. Design the metals and non-metals having the properties of stress & strain, elasticity, Plastic deformation.
4. Explain the effect of temperature on the properties of metals and alloys.
5. Explain to use the techniques of measurements & instruments.

Course Content:

Unit-1: **12hrs**

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.

Unit -2: **12 hrs**

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 and Advantages.

Unit - 3: **12 hrs**

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, mechanism of hardening. Quenching, thermal stresses.

Unit - 4: **12 hrs**

Structure - Property correlation, Correlation of structure with physical properties of materials, application 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, load cells, LVDT Electronic instruments for measurement, Digital voltmeter, principles of electronic multimeter, digital multimeter, Q-meter, Electronic LCR meter, Frequency & time interval counters.

Reference Books:

1. Introduction to Ceramics by W. D. Kingery, H. K. Bowen and D. R. Uhlmann, John Wiley & 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.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH3060	ASTROPHYSICS	OE	3	1	0	4	5

Course Objectives:

1. To study the astrophysical universe, ranging from solar system objects through stars, to galaxies and the structure of the universe as a whole.
2. To understand the principles and methods of modern astrophysics.

Course Outcomes:

On successful completion of this course, the student shall be able to:

1. Describe the laws that govern the astrophysical phenomena.
2. Explain the nature and properties of compact astrophysical objects.
3. Elaborate astrophysical observations and measurements.
4. Discuss the principles of formation of the Planets and Comets.

Course Content:

Unit -1: **12 hrs**

Basic concepts of Astronomy:

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.

Unit – 2: **12 hrs**

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.

Unit - 3: **12 hrs**

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.

Unit – 4: **12 hrs**

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.

Reference Books:

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.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH3070	GENERAL PHYSICS LAB –III (PRACTICAL)	HC	0	0	3	3	5

Course Objectives:

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

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

1. Conduct the experiments related to different Physics laws and theories.
2. Employ the different tools and techniques to get the data/readings related to the experiments.
3. Verify the fundamental physics behind many scientific discoveries through hands on experimentation.

Course Content:

LIST OF EXPERIMENTS:

1. Hall effect experiment: Determination of Hall co-efficient and charge carrier density.
2. Divergence of laser beam
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. Fresnel's law verification
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.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH3081	ELECTRONICS LAB (PRACITICAL)	SC	0	0	3	3	5

Course Objectives:

The study of this course aims to:

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

Course Outcomes:

On successful completion of this course, the student shall be able to:

1. Analyze the functioning of basic electronic circuits of AM and FM modulation and demodulation through experimentation using discrete electronic components.
2. Verify sampling theorem by experiment.
3. Verify different modulation and demodulation techniques through experimentation.
4. Draw the outputs of various angle modulation and demodulation systems
5. Verify the outputs of ASK, FSK, PSK circuits.

Course Content:

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 generation and detection.
12. FSK generation and 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.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH3082	CONDENSED MATTER PHYSICS LAB (PRACTCAL)	SC	0	0	3	3	5

Course Objectives:

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

Course Outcomes:

On successful completion of this course, the student shall be able to:

1. Identify the phase and phase purity of the crystal.
2. Determine particle size, stress and strain using PXRD.
3. Analyse of Thermoluminescence glow curve using ORIGIN software.
4. Determine of Curie temperature using B-H curve of a Ferromagnetic material (both hard and soft).
5. Calibrate of electromagnet and magnetic susceptibility determination of magnetic salts ($MnSO_4$,

MnCl$_2$) by Quincke's method.

6. Study I-V characteristics of any given materials.

Course Content:

LIST OF EXPERIMENTS:

1. Analysing and determining the lattice parameters (h k l) values of FCC crystals by X-ray powder Diffractogram data.
2. Analysing and determining the lattice parameters (h k l) values of BCC crystals by X-ray powder Diffractogram data.
3. Determination of particle size, stress and strain using PXRD data.
4. Synthesis of metal nanoparticles by solution combustion technique.
5. Determination of Reitveld refinement parameter using full proof suit software.
6. Determination of energy gap by using absorption spectra.
7. Analysis and estimation of kinetic parameters of Thermoluminescence glow curves.
8. Determination of Curie temperature using B-H curve of a Ferromagnetic material (both hard and soft).
9. Estimation of CIE coordinates of nanophosphors samples.
10. Study of I-V characteristics of semiconducting material by using Kithely source meter.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH3083	MATERIAL SCIENCE LAB (PRACTICAL)	SC	0	0	3	3	5

Course Objectives:

1. To make the student familiarize with the basics of materials science.
2. To enable the student to explore the concepts involved in the X-ray diffraction.
3. To make the student understand the basic concepts in absorption and Infrared spectroscopy.
4. To allow the student to understand the fundamentals of Hall Effect and Hysteresis.

Course Outcomes:

On successful completion of this course, the student shall be able to:

1. Demonstrate different experimental techniques.
2. Experiment with X – ray diffractometer to determination the phase of the nano materials.
3. Analyze the thermoluminescence glow curves of different phosphor materials
4. Test I-V properties of thin films through experiment.

Course Content:

LIST OF EXPERIMENTS:

1. Synthesis of nanomaterial by solution combustion technique.
2. Synthesis of metal nanoparticles by sonochemical method.
3. Determination of particle size and lattice strain of an unknown powder specimen applying Scherer Equation.
4. Determination of energy gap by using absorption spectra (UV-visible spectrometer).
5. Analysis and estimation of kinetic parameters of Thermo luminescence glow curves.
6. B-H curve of a Ferromagnetic material (both hard and soft).
7. Study of I-V characteristics of given material by Keithley instrument.
8. Analysis of single crystal rotation photograph.
9. Study of PL spectrum and determination of CIE coordinate values of nanophosphors samples.
10. Determination of lattice parameters values of FCC crystals by X-ray powder Diffractogram data.

FOURTH SEMESTER

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH4010	MAJOR PROJECT	HC	0	0	10	10	20

Course Objective:

To carry out the research under the guidance of supervisor and in the process learn the techniques of research.

Course Outcomes:

On successful completion of the project, the student shall be able to:

1. Familiarize with literature search
2. Conduct the experiments related to research and formulate computational techniques
3. Interpret the scientific data.
4. Write report and defend the research findings.

Project:

Each student will choose the topic of research particularly from any area of soft cores studied and work under the guidance of allocated faculty member. The project shall preferably be application oriented or industry need based that could be useful to the society. In case of industry need base project the student may opt co-supervisor from the concerned industry. The student will have to make a preliminary survey of research done in broad area of his/her area of interest and decide on the topic in consultation with his/her supervisor(s). The project work floated should be completed within 16 weeks and project report has to be submitted within the stipulated date by the University/ within 18 weeks whichever is earlier. The student has to meet the concerned supervisor(s) frequently to seek guidance and also to produce the progress of the work being carried out. The student should also submit progress report during 5^{th} week and 10^{th} week of the beginning of the semester and final draft report with findings by 15^{th} week. After the completion of the project the student shall submit project report in the form of dissertation on a specified date by the School.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M19PH4020	**MOOC/SWAYAM/ INTERNSHIP**	RULO	0	0	4	4	4

Note: Students shall choose to take up any online course of four credits as guided by the school or shall have to undergo internship of four weeks duration, the details of which are provided here under.

MOOC/ SWAYAM:

Globally, MOOC (Massive Open Online Course) platforms are gaining much popularity. Considering the popularity and relevance of MOOCs, Government of India has also launched an indigenous platform, SWAYAM. SWAYAM (Study Webs of Active Learning for Young Aspiring Minds) is basically an integrated MOOCs platform for distance education that is aimed at offering all the courses from school level (Class IX) to post-graduation level. The platform has been developed collaboratively by MHRD (Ministry of Human Resource Development) and AICTE (All India Council for Technical Education) with the help of Microsoft and is capable of hosting 2,000 courses.

A student shall register and successfully complete any of the courses available on SWAYAM.
Student shall inform the MOOC/SWAYAM coordinator of the school about the course to which he/she has enrolled. The minimum duration of the course shall be not less than 40 hours and of 4 credits. The student should submit the certificate issued by the SWAYAM to the MOOC/SWAYAM coordinator of the school, the grades obtained in the course shall be forwarded to concerned authority of the University.

Internship: Minimum of four weeks duration internship should be carried out by the student either in industry or in an R&D organization, including educational institutes with excellent research culture. In case, if a student is unable to secure internship either in industry or in an R&D organization, a project may be carried out within the university. The student is expected to submit a formal report at the end of the internship programme. The student shall be awarded the marks for internship based on the (a) presentation and (b) comprehensive viva by the panel of examiners constituted by the school.

Career Development and Placement

Having a degree will open doors to the world of opportunities for you. But Employers are looking for much more than just a degree. They want graduates who stand out from the crowd and exhibit real life skills that can be applied to their organizations. Examples of such popular skills employers look for include:

1. Willingness to learn
2. Self motivation
3. Team work
4. Communication skills and application of these skills to real scenarios
5. Requirement of gathering, design and analysis, development and testing skills
6. Analytical and Technical skills
7. Computer skills
8. Internet searching skills
9. Information consolidation and presentation skills
10. Role play
11. Group discussion, and so on

REVA University therefore, has given utmost importance to develop these skills through variety of training programs and such other activities that induce the said skills among all students. A full-fledged Career Counseling and Placement division, namely Career Development Center (CDC) headed by well experienced senior Professor and Dean and supported by dynamic trainers, counselors and placement officers and other efficient supportive team does handle all aspects of Internships and placements for the students of REVA University. The prime objective of the CDC is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CDC organizes pre-placement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improve their employability. In addition, CDC forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together in a team. It also makes you to participate in various student clubs which helps in developing team culture, variety of job skills and overall personality.

The need of the hour in the field of Physics is knowledge in the subject, but also the skill to do the job proficiently, team spirit and a flavour of innovation. This kept in focus, the CDC has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, and communication skills to every student of REVA University is given with utmost care. The process involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his / her interest and march forward to make better career. The School of Applied sciences also has emphasised subject based skill training through lab practice, internship, project work, industry interaction and many such skilling techniques. The students during their day to day studies are made to practice these skill techniques as these are inbuilt in the course curriculum. Concerned teachers also continuously guide and monitor the progress of students.

The University has also established University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director to facilitate skill related training to REVA students and other unemployed students around REVA campus. The center conducts variety of skill development programs to students to suite to their career opportunities. Through this skill development centre the students shall compulsorily complete at least two skill / certification based programs before the completion of their degree. The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs. REVA University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana.

The University has also signed MOU‘s with Multi-National Companies, research institutions, and universities abroad to facilitate greater opportunities of employability, students‘ exchange programs for higher learning and for conducting certification programs.

LIST OF FACULTY MEMBERS

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