REVA UNIVERSITY
Bengaluru, India

SCHOOL OF APPLIED SCIENCES

HANDBOOK

M.Sc

Physics

2021-23

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

RUKMINI EDUCATIONAL
Charitable Trust

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Chancellor's Message

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

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

It is deemed virtuous to serve seekers of knowledge and as educators it is in the ethos at REVA University to empower every learner who chooses to enter our portals. Driven by our founding philosophy of 'Knowledge is Power', we believe in building a community of perpetual learners by enabling them to look beyond their abilities and achieve what they assumed impossible. India has always been beheld as a brewing pot of unbelievable talent, acute intellect and immense potential. All it takes to turn those qualities into power is a spark of opportunity. Being at a University is an exciting and rewarding experience with opportunities to nurture abilities, 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.

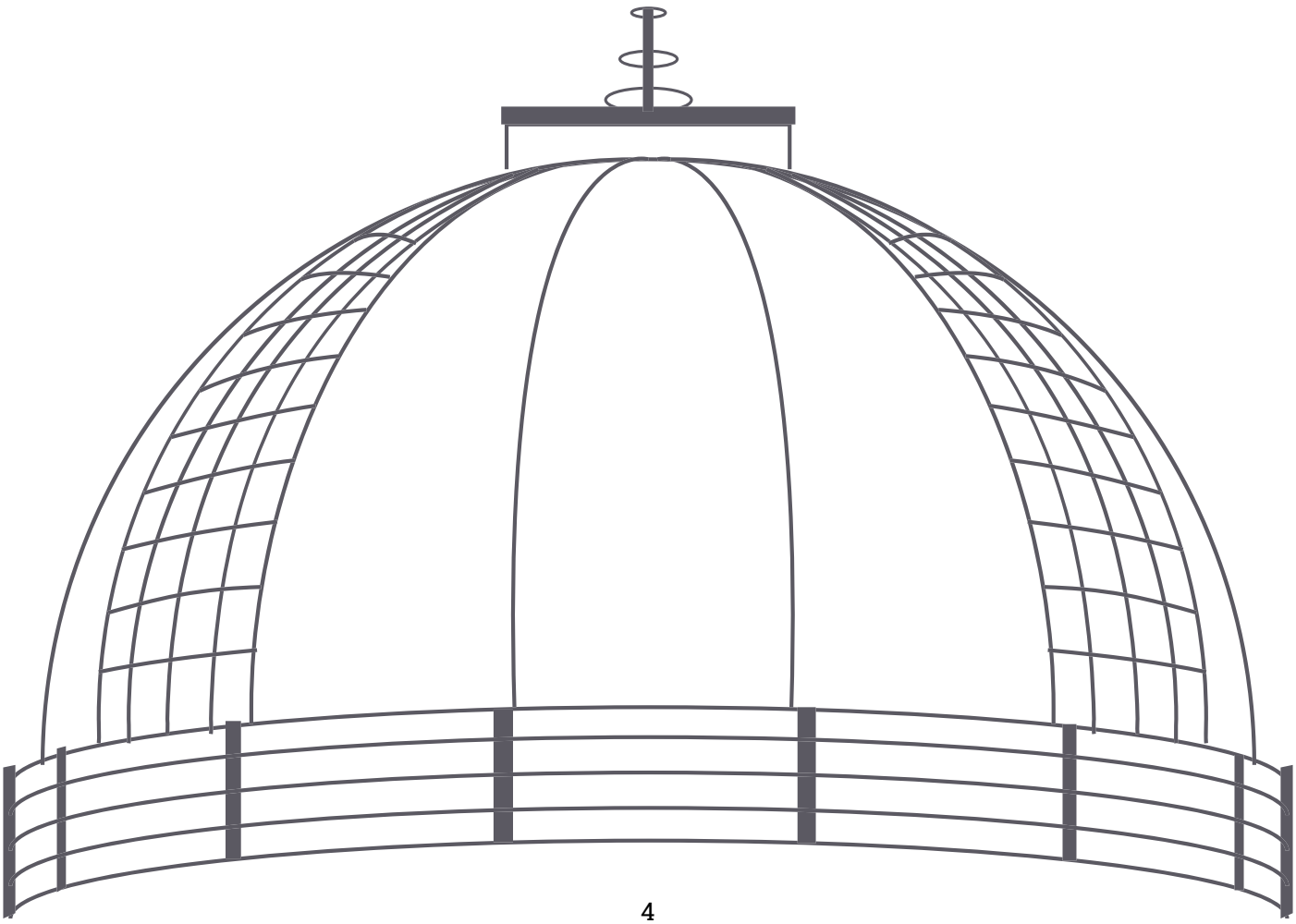
REVA University has entered into collaboration with many prominent industries to bridge the gap between Industry and University. Regular visits to industries and mandatory internship with industries have helped our students become skilled with relevant to industry requirements. Structured training programs 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. Dhanamjaya M
Vice-Chancellor, REVA University



Director's Message

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

Indian economy is experiencing an upward growth right from the beginning of 21st century necessitating well qualified science graduates to work as scientists, teachers, algorithm developers, computer programmers, professionals and often administrators. At present more than 400 million youth are below 18 years of age and government is committed to increase the GER to 30% by 2020, further necessitating a greater number of teachers and professors to work in schools and colleges. Research has also been given equal importance. Pivate sector and Corporates are also looking for smart science graduaes in a big way. The B.Sc. (CMG) degree program of REVA University is designed to prepare biotechnologist, biochemists, Microbiologist, genetists, scientists, teachers, professionals & administrators who are motivated, enthuastics & creative thinkers to meet the challenges of growing economy as well as to fulfill the growing aspirations of the youth.

The program has been developed with an emphasis on knowledge assimilation, application, national and international job market and its social relevance. The outcome-based curriculum designed and followed imbibes required theoretical concepts and practical skills in the domain. By undergoing this program, you will develop critical, analytical thinking and problem-solving abilities for a smooth transition from academic to real-life work environment. The L: T: P structure of teaching and learning under Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) would certainly help our students learn and build competencies needed in this knowledge-based society.

This handy document containing brief information about B.Sc. (CMG) program, scheme of instruction and detailed course content will serve as a guiding path to you to move forward in a right direction.

I am sure you will enjoythe curriculum, teaching and learning environment, the vast infrastructure and the experienced teachers' involvement and guidance. We will strive to provide all needed comfort andcongenial environment for your studies. I wish you and allstudents' pleasant stay in REVA and grand success in your career.

Prof.Shilpa BR.

Deputy Director, SoAS

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

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

REVA consistently ranked as one of the top universities in various categories because of the diverse community of international students and its teaching excellence in both theoretical and technical education in the fields of Engineering, Management, Law, Science, Commerce, Arts, Performing Arts, and Research Studies. REVA offers 28 Undergraduate Programmes, 22 Full-time and 2 Part-time Postgraduate Programmes, 18 Ph. D Programmes, and other Certificate/ Diploma/Postgraduate Diploma Programmes in various disciplines. The curriculum of each programme is designed with a keen eye for detail by giving emphasis on hands-on training, industry relevance, social significance, and practical applications. The University offers world-class facilities and education that meets global standards.

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, Nana 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.

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, Counsellors 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, Oklahoma 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 facilitate 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 RatnaProf. 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 IISc., and noted Scientist, Dr. V S Ramamurthy, Former Secretary, DST, Government of India, Dr. V K Aatre, noted Scientist and former head of the DRDO and Scientific Advisor to the Ministry of DefenceDr.Sathish Reddy, Scientific Advisor, Ministry of Defence, New Delhi and many others have accepted our invitation and blessed our students and faculty members by their inspiring addresses and interaction.

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 recognised 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 class's everyday to students, faculty members, administrative staff and their family members and organizes yoga camps for villagers around.

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 create excellent infrastructure facilities and state-of-the-art laboratories and incubation centres
- To provide student-centric learning environment through innovative pedagogy and education reforms
- To encourage research and entrepreneurship through collaborations and extension activities
- To promote industry-institute partnerships and share knowledge for innovation and development
- To organize society development programs for knowledge enhancement in thrust areas
- To enhance leadership qualities among the youth and enrich personality traits, promote patriotism and moral values.

Objectives

- Creation, preservation and dissemination of knowledge and attainment of excellence in different disciplines
- Smooth transition from teacher - centric focus to learner - centric processes and activities
- Performing all the functions of interest to its major constituents like faculty, staff, students and the society to reach leadership position
- Developing a sense of ethics in the University and Community, making it conscious of its obligations to the society and the nation
- Accepting the challenges of globalization to offer high quality education and other services in a competitive manner

ABOUT THE 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

To create intellectual curiosity, academic excellence, and integrity through multidimensional exposure

To establish state of the art laboratories to support research and innovation and promote mastery of science.

To inculcate an ethical attitude and make students competitive to serve the society and nation.

Members of Board of Studies

Board of Studies in Physics (PG)

Sl. No.	Name of Members	Designation
1.	**Dr. D V Sunitha** Associate Professor& Coordinator, Asst.Director School of Physical Sciences (Physics) REVA University Ph: +91-7760884884 E-mail:sunithadv@reva.edu.in	Chairperson
2.	**Prof. Chandrabhas Narayana,**FRSC FNAScFASc Dean R&D Chemistry and Physics of Materials Unit Jawaharlal Nehru Centre for Advanced Scientific Research Jakkur P.O., Bangalore 560064 INDIA Phone: +91 80 22082810 Mob: +91 9448682721 Email: cbhas@jncasr.ac.in or cbhasi@gmail.com	External Member
3.	**Dr.Manohar Rao** Principal Product specialist PerkinElmer India Pvt Ltd No. 33, Swayam Prabhe North Park Road, Kumara Park East Bangalore 560001 Ph:+91-9886012556 E-mail: manohar.jnc@gmail.com	External Member
4.	**Dr.K.M. Eshwarappa** Associate Professor Davengere University,Davangere, Karnataka Ph:+91-9036830242 E-mail:km.eshwarappa@gmail.com	External Member
5.	**Dr J B Prasanna Kumar** Assistant Professor Government First grade college, Tumkur Ph:+91-9964521358 E-mail: prassanakumarjb39@gmail.com	External Member
6.	**Dr.J. Malleshappa** Assistant Professor Department of Physics, University College of Science Tumkur University, Tumkur 560004 Ph: +91- 9448759073 Email: jmallesh.phy@gmail.com	External Member

7.	**Dr. Madeshkumar** Professor Ph:+91-9341271290 E-mail: madeshkumar@reva.edu.in	Internal Member
8.	**Dr. JaydevPattar** Associate Professor Ph: +91-9341271290 Email: jaydevpattar@rev.edu.in	Internal Member
9.	**Dr. P Anjaneyulu** Associate Professor Ph: +91-9989036960 E-mail: p.ajaneyulu@reva.edu.in	Internal Member
10.	**Dr. K Upendra kumar** Associate Professor Ph:+91-8374589647 E-mail:upendrakumar.k@reva.edu.in	Internal Member
11.	**Dr. K.Munirathnam** Assistant professor Ph: 9035286246 E-mail: munirathnam.k@reva.edu.in	Internal Member

PREFACE

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

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

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

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

M. Sc. (Physics) Program

Programme Overview

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

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

1. Physics is an exciting intellectual adventure that inspires the young people and expands the frontiers of our knowledge about Nature.
2. Physics generates fundamental knowledge needed for the future technological advances that will continue to drive the economic engines of the world.
3. Physics contributes to the technological infrastructure and provides trained personnel needed to take advantage of scientific advances and discoveries.
4. 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.
5. 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.
6. 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 highest in 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:

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

PROGRAMME OUTCOMES (POS)

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

1. **Domain knowledge**: Apply the knowledge of physics and fundamentals for the solution of complex problems in day to day life.
2. **Problem analysis**: Identify, formulate, research literature, and analyze problems to arrive at substantiated conclusions using principles of physical sciences.
3. **Design/development of solutions**: Design solutions for real time problems to meet the specifications with consideration for the public health and safety, the cultural and societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge, for analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Apply appropriate techniques, resources, and IT tools including prediction and modeling to complex activities with an understanding of the limitations.
6. **Environmental and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional practice.
7. **Environment and sustainability**: Understand the impact of the solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to ethics, and responsibilities and norms of the professional practice
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively with the professional community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.
11. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. Apply the fundamentals of mathematical physics, classical mechanics, electrodynamics, Quantum mechanics, statistical mechanics and astrophysics to arrive at substantiated conclusions of physical phenomena and the energy quantization concepts.
2. Identify , compare and and synthesis of materials of the materials best suited for futuristic scientific applications
3. Explore the knoweledge of basic concepts of atomic, molecular, nuclear physics to analyse the spectra obtanied from various bodies.
4. Demonstrate the knowledge of fundamentals of electronic devices and photonics

Regulations –Master Degree (2 Years) Programs
(MA, M Com, MPA & M Sc Programs)
Academic Year 2021-23 Batch

(Framed as per the provisions under Section 35 (ii), Section 7 (x) and Section 8 (xvi) & (xxi) of the REVA University Act, 2012)

1. Title and Commencement:

1.1 These Regulations shall be called **"REVA University Academic Regulations – 2 years Masters Degree Programs2021-23Batch subject to amendments from time to time by the Academic Council on recommendation of respective Board of Studies and approval of Board of Management**

1.2 These Regulations shall come into force from the date of assent of the Chancellor.

2. The Programs:

These regulations cover the following 2 years Masters Degree Programs of REVA University offered during 2021-23:

MA in English
MA in Journalism & Mass Communications
M Com
M. Sc. In Psychology
M.Sc. in Computer Science
M.Sc. in Biotechnology
M.Sc. in Biochemistry
M.Sc. in Chemistry
M.Sc. in Physics
M.Sc. in Mathematics
MPA

3. Duration and Medium of Instructions:

3.1 Duration: The Two Year Masters Degree program is of 4Semesters duration. A candidate can avail a maximum of 8 semesters - 4 years as per double duration norm, in one stretch to complete the Two Year Masters Degree, including blank semesters, if any. Whenever a candidate opts for blank semester, s/he has to study the prevailing courses offered by the School when s/he resumes his/her studies.

3.2 The medium of instruction shall be English.

4. Definitions:

4.1 Course: "Course" means a subject, either theory or practical or both, listed under a programme; Example: "Documentary & New Production" in MA in Journalism &Communication Program, "Immunology" in M.Sc. in Biochemistry program are examples of courses to be studied under respective programs.

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

L	**Lecture**
T	**Tutorial**
P	**Practice**

Where:

L stands for **Lecture** session consisting of classroom instruction.

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

P stands for **Practice** session and it consists of Hands on Experience / Laboratory Experiments / Field Studies / Case Studies / Project Based Learning or Course end Project/Self Study/ Online courses from listed portals that equip students to acquire the much required skill component.

4.2 **Classification of Courses**

Courses offered are classified as: Core Courses, Hard Core Courses, Soft Core Courses, Open Elective Courses, Project work/Dissertation

4.2.1 **Core Course:** A course which should compulsorily be studied by a candidate choosing a particular program of study

4.2.2 **Hard Core Course (HC) simply core course:** The **Hard Core Course** is a Core Course in the main branch of study and related branch(es) of study, if any, that the candidates have to complete compulsorily

4.2.3 **Soft Core Course (SC) (also known as Professional Elective Course)**

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

4.2.4 **Open Elective Course (OE):**

An elective course chosen generally from other discipline / subject, with an intention to seek exposure to the basics of subjects other than the main discipline the student is studying is called an **Open Elective Course.**

4.2.5 **Project Work / Dissertation:**

School can offer project work/dissertation as a course. Depending on the duration required for completing the project/dissertation work, credits can be assigned. Normally, a minor project carries 4-6 credits and a major project carries double the number of credits of a minor project.

4.2.6 **"Program"** means the academic program leading to a Degree, Post Graduate Degree, Post Graduate Diploma or such other degrees instituted and introduced in REVA University.

5. Eligibility for Admission:

5.1. The eligibility criteria for admission to **Two YearsMaster DegreeProgram** (4 Semesters) is given below:

Sl. No.	Program	Duration	Eligibility
1	Masters of Commerce	4 Semesters (2 years)	B.Com. /BBM /BBA /BBS with 45% (40% in case of candidates belonging to SC/ST) of Semesters marks in aggregate of any recognized University /Institution or any other qualification recognized as equivalent there to.
2	Masters of Arts in English	4 Semesters (2 years)	i) Bachelors Degree of 3 years duration in Arts with English as a major / optional subject with a minimum 45% (40% in case of candidates belonging to SC/ST) marks in aggregate from any recognized University/ Institution; OR ii) Any Degree of 3 years duration with minimum50% (45% in case of candidates belonging to SC/ST)of marks in English language or English minor from any recognized University or Institution or any other qualification recognized as equivalent there to.
3	Masters of Artsin Journalism & Mass Communications	4 Semesters (2 years)	Bachelors degree of three years in any stream or BE / B.Tech. with 50% (45% in case of candidates belonging to SC/ST) marks in aggregate from any recognized University / institution or any other qualification recognized as equivalent there to.
4	Masters of Science in Computer Science	4 Semesters (2 years)	B E / B.Tech. in ECE / IT / EEE / CSE / ISE / TE / BCA/ M.Sc. or B.Sc. in Computer Science / Mathematics/ Information Science / Information Technology with a minimum of 50% (45% in case

			of SC/ST) marks in aggregate of any recognized University / Institution or AMIE or any other qualification recognized as equivalent there to.
5	Masters of Science in Psychology	4 Semesters (2 years)	55% or equivalent CGPA in B.A/B.Sc. degree with Psychology as one of the core papers.
6	Masters of Science in Biotechnology	4 Semesters (2 years)	B.Sc. graduates with any Life Science subjects securing at least 45% (40% in case of candidates belonging to SC/ST) marks in aggregate of all optional subjects from any recognized University/Institute or any other qualification recognized as equivalent there to.
7	Masters of Sciencein Biochemistry	4 Semesters (2 years)	Bachelors Degree of 3 years with Biochemistry, Chemistry, Microbiology, Agricultural Sciences, Animal Sciences or Life Sciences as biochemistry as principal or subsidiary subjects with 45% (40% incase of SC / ST) of marks in aggregate from any recognized University/ Institution or any other qualification recognized as equivalent there to.
8	Masters of Science. in Physics	4 Semesters (2 years)	Three years Bachelor's Degree in Science with Physics as one of the major / optional Subjects with45% (40% in case of SC / ST) of marks in aggregate from any recognized University / Institution or anyother qualification recognized as equivalent there to.
9	Masters of Science in Chemistry	4 Semesters (2 years)	Bachelors Degree of 3 years with Chemistry as one of the major / optional Subjects with 45% (40% incase of SC / ST) of marks in aggregate from any recognized University / Institution or any other qualification recognized as equivalent there to.
10	Masters of Science in Mathematics	4 Semesters (2 years)	Bachelors Degree of 3 years with Mathematics as one of the major / optional subjects with 45% (40% incase of SC / ST) marks in aggregate from any recognized University / Institution or any other qualification recognized as equivalent there to.
11	Masters in Performing Arts	4 Semesters (2 years)	A graduate in any degree from a recognized University along with any Govt. conducted Examination certificate in Karnataka (or an equivalent body from other States). A minimum of 5years of learning experience from a reputed dance institution or guru/ an under graduate in Dance

5.2 Provided further that the eligibility criteria are subject to revision by the Government Statutory Bodies, such asUGC from time to time.

6. Courses of Study and Credits

6.1 Each course of study is assigned with certain credit value

6.2 Each semester is for a total duration of 20 weeks out of which 16 weeks dedicated for teaching and learning and the remaining 4 weeks for IAs and final examination, evaluation and announcement of results.

6.3 The credit hours defined as below:

In terms of credits, every one hour session of L amounts to 1 credit per Semester and a minimum of two hour session of T or P amounts to 1 credit per Semester or a three hour session of T / P amounts to 2 credits over a period of one Semester of 16 weeks for teaching-learning process.

1 credit = 13 credit hours spread over 16 weeks or spread over the semester

The total duration of a semester is 20 weeks inclusive of semester-end examination.

7. Different C**ourses of Study**:

Different C**ourses of Study** are labeled as follows:

a. Core Course (CC)
b. Hard Core Course (HC)
c. Soft Core course (SC)
d. Open Elective Course (OE)
e. Project Work / Dissertation: School can offer project work/dissertation as a course. Depending on the duration required for completing the project/dissertation work, credits can be assigned. Normally, a minor project carries 4-6 credits and a major project carries double the number of credits of a minor project

8. Credits and Credit Distribution

Registered candidates are required to earn the credits stated in the below table for the award of degree in the respective programs:

Credits	**Programs**
90 credits	M Com and M Sc in Computer Science
90 credits	MA English, MA in Journal & Mass Communication and M Sc in Psychology, M.Sc. in Biotechnology, M.Sc. in Biochemistry, M.Sc. in Chemistry, M.Sc. in Physics and M.Sc. in Mathematics
120 credits	Masters of Performing Arts

8.2. The concerned BoS based on the credits distribution pattern given above shall prescribe the credits to various types of courses and shall assign title to every course including project work, practical work, field work, self-study elective, as **Hard Core (HC) or Soft Core (SC), Open Elective (OE).**

8.3. Every course including project work, practical work, field work, self-study elective should be entitled **Hard Core (HC) or Soft Core (SC) or Open Elective (OE)** or **Core Course** (**CC**) by the BoS concerned.

8.4**.** The concerned BoS shall specify the desired Program Educational Objectives, Program Outcomes, Program Specific Outcomes and Course Outcomes while preparing the curriculum of a particular program.

8.5. A candidate can enrol during each semester for credits as prescribed in the scheme of the program.

8.6. Only such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to VI semester and complete successfully prescribed number of credits for the award of the degree for three year program in 6 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities.

9 Assessment and Evaluation

9.1 The Scheme of Assessment will have two parts, namely;

i. Internal Assessment (IA); and
ii. Semester End Examination (SEE)

9.2 Assessment and Evaluation of each Course shall be for 100 marks. The Internal Assessment (IA) and Semester End Examination (SEE) of for 2 year Masters degree programs shall carry 50:50 marks respectively (i.e., 50 marks internal assessment; 50 marks semester end examination).

9.3 There shall be **two Internal Tests** conducted as per the schedule announced below. **The Students' shall attend both the Tests compulsorily.**

- 1st test is conducted for 15 marks during **8th week** of the Semester;
- 2nd test is conducted for 15 marks during **16th week** of the of the Semester;
- Suitable number of Assignments/quizzes/presentations are set to assess the remaining 20 marks of IA at appropriate times during the semester

9.4 The coverage of syllabus for the said tests shall be as under:

- Question paper of the **1st test should be based on first 50%of the total syllabus**;
- Question paper of the **2nd test should be based on second 50%of the total syllabus**;

9.5 The Semester End Examination for 50 marks shall be held in the 18th and 19th week of the beginning of the semester and the syllabus for the semester end examination shall be entire syllabus.

9.6 A test paper is set for a maximum of 30 marks to be answered as per the pre-set time duration (1 hr / 1 hr 15 minutes / 1 hr 30 minutes). Test paper must be designed with School faculty members agreed pattern and students are assessed as per the instructions provided in the question paper. Questions must be set using Bloom's verbs. The questions must be set to assess the students outcomes described in the course document.

9.7 The question papers for internal test shall be set by the internal teachers who have taught the course. If the course is taught by more than one teacher all the teachers together shall devise a common question paper(s). However, these question papers shall be scrutinized by School specific Question Paper Scrutiny Committee formed by the respective School Head /Director to bring in the uniformity in the question paper pattern and as well to maintain the necessary standards.The evaluation of the answer scripts shall be done by the internal teachers who have taught the course and set the test paper.

9.8 The evaluation of the answer scripts shall be done by the internal teachers who have taught the course and set the test paper.

9.9 Assignment/seminar/Project based learning/simulation based problem solving/field work should be set in such a way students be able to apply the concepts learnt to a real life situation and students should be able to do some amount self-study and creative thinking. While setting assignment care should be taken such that the students will not be able to plagiarise the answer from web or any other resources. An IA1 and IA2 assignment / Quiz can be set each for a maximum of 5 marks, totals to 10 marks. Course instructor at his/her discretion can design the questions as a small group exercise or individual exercise. This should encourage collaborative learning and team learning and also self-study.

9.10 Internal assessment marks must be decided well before the commencement of Semester End examinations

9.11 Semester End Examination: The Semester End Examination is for 50 marks shall be held in the 19th and20th week of thesemester and the entire course syllabus must be covered while setting the question paper.

9.12 Semester End Examination paper is set for a maximum of 100 marks to be answered in 3 hours duration. Question paper must be prepared as per the respective School set format.

9.13 Each question is set using Bloom's verbs. The questions must be set to assess the students outcomes described in the course document. (Please note question papers have to be set to test the course outcomes)

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

9.15 There shall be double evaluation, viz, first valuation by the internal evaluator who has taught the course and second evaluation shall be an external examiner who is familiar with the course. The average marks of the two evaluations (internal examiner & external examiner) shall be the marks to be considered for declaration of results

9.16 Board of Examiners, question paper setters and any member of the staff connected with the examination are required to maintain integrity of the examination system and the quality of the question papers

9.17 There shall also be an **Program Assessment Committee (PAC)** comprising at-least 3 faculty members having subject expertise who shall after completion of examination process and declaration of results review the results sheets, assess the performance level of the students, measure the attainment of course outcomes, program outcomes and assess whether the program educational objectives are achieved and report to the Director of the School. **Program Assessment Committee (PAC)** shall also review the question papers of both Internal Tests as well as Semester End Examinations and submit to the Director of the respective School about the scope of curriculum covered and quality of the questions.

9.18 The report provided by the **Program Assessment committee (PAC)** shall be the input to the Board of Studies to review and revise the scheme of instruction and curriculum of respective program

9.19 During unforeseen situation , the tests and examination schedules, pattern of question papers and weightage distribution may be designed as per the convenience and suggestions of the board of examiners in consultation with COE and VC

9.20 University may decide to use available modern technologies for writing the tests and SEE by the students instead of traditional pen and paper

9.21 Any deviations required to the above guidelines can be made with the written consent of the Vice Chancellor

9.22 Online courses may be offered as per UGC norms.

For online course assessment guidelines would be as follows:

1. If the assessment is done by the course provider, then the School can accept the marks awarded by the course provider and assign the grade as per REVA University norms.
2. If the assessment is not done by the course provider then the assessment is organized by the concerned school and the procedure explained in the regulation will apply
3. In case a student fails in an online course, s/he may be allowed to repeat the course and earn the required credits

9.23 The online platforms identified could be SWAYAM, NPTEL, Coursera, Edx.org, Udemy, Udacity and any other internationally recognized platforms like MIT online, Harvard online etc.

9.24 Utilization of one or two credit online courses would be:

4 week online course – 1 credit – 15 hours
8 week online course / MOOC – 2 credits – 30 hours
12 week online course / MOOC – 3 credits – 45 hours

9.25 **Summary of Internal Assessment, Semester End Examination and Evaluation** Schedule is provided in the table given below.

Summary of Internal Assessment and Evaluation Schedule

Sl. No.	Type of Assessment	when	Syllabus Covered	Max Marks	Reduced to	Date by which the process must be completed
1	Test-1	During 8th week	First 50%	30	15	8th week
2	Assignment 1	On or before 8th week (5 marks)				
3	Presentations 1	On or before 8th week (5 marks)				
4	Test -2	During 16th Week	Second 50%	30	15	16th Week
5	Assignment 2	On or before 16th Week (5 marks)				
6	Presentations 2	On or before 16th Week (5 marks)				
7	SEE	19/20th Week	100%	100	50	20th Week

Note: 1. Examination and Evaluation shall take place concurrently and Final Grades shall be announced as per notification from the Controller of Examination.

2. Practical examination wherever applicable shall be conducted after 2nd test and before semester end examination. The calendar of practical examination shall be decided by the respective School Boards and communicated well in advance to the Controller of Examination who will notify the same immediately

10 Assessment of Students Performance in Practical Courses

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

a) Knowledge of relevant processes;

b) Skills and operations involved;

c) Results / products including calculation and reporting.

10.1 The 50 marks meant for Internal Assessment (IA) of the performance in carrying out Practical shall further be allocated as under:

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

10.2 The50 marks meant for Semester End Examination (SEE), shall be allocated as under:

10.3

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

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

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

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

Component – I	Progress Report 1 (25%)
Component – II	Progress Report 2(25%)
Component – III	Evaluation of Report and final viva voce (50%)

All assessments must be done by the respective Schools as per the guidelines issued by the Controller of Examinations. However, the responsibility of announcing final examination results and issuing official transcripts to the students lies with the office of the Controller of Examinations.

12. Requirements to Pass a Course:

A candidate's performance from all 3 components will be in terms of scores, and the sum of all three scores will be for a maximum of 100 marks (25 + 25 + 50). A candidate who secures a minimum of 40% in the SEE and an overall 40% (IA1+IA2+SEE) in a course is said to be successful.

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

Marks, P	Grade, G	Grade Point (GP=V x G)	Letter Grade
90-100	10	v*10	O
80-89	9	v*9	A+
70-79	8	v*8	A

60-69	7	v*7	B+
55-59	6	v*6	B
50-54	5.5	v*5.5	C+
40-49	5	v*5	C
0-39	0	v*0	F
ABSENT			AB

O - Outstanding; A+-Excellent; A-Very Good; B+-Good; B-Above Average; C+-Average; C-Satisfactory; F – Unsatisfactory.

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

a. Computation of SGPA and CGPA

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

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in a given semester, i.e :**SGPA (Si) = ∑(Ci x Gi) / ∑Ci** where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Examples on how SGPA and CGPA are computed

Example No. 1

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course 1	4	A+	9	4x9=36
Course 2	4	A	8	4x8=32
Course 3	4	B+	7	4x7=28
Course 4	3	O	10	3x10=30
Course 5	3	C	5	3x5=15
Course 6	3	B	6	3x6=18
	21			**159**

Thus, **SGPA = 159 ÷ 21 = 7.57**

Example No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	A	8	4x8=32
Course 2	4	B+	7	4x7=28
Course 3	4	A+	9	4x9=36
Course 4	4	B+	7	4x7=28
Course 5	4	B	6	4x6=24
	20			**148**

Thus, **SGPA = 148 ÷ 20 = 7.4**

b. Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits for the respective programs are calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e :**CGPA = ∑(Ci x Si) / ∑Ci**Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

Example:
CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	21	7.57	21 x 7.57 = 158.97
2	20	7.4	20 x 7.4 = 148.00
3	23	8.11	23 x 8.11 = 186.53
4	26	7.40	26 x 7.40 = 192.40
Cumulative	**90**		**685.90**

Thus, CGPA = 685.90/90 = 7.62

c. Conversion of grades into percentage:

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Example: CGPA Earned 7.62 x 10=76.2

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

13. Classification of Results

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

CGPA	Grade (Numerical Index)	Letter Grade	Performance	FGP
	G			Qualitative Index
9 >= CGPA 10	10	O	Outstanding	Distinction
8 >= CGPA < 9	9	A+	Excellent	
7 >= CGPA < 8	8	A	Very Good	First Class

6 >= CGPA < 7	7	B+	Good	
5.5> = CGPA < 6	6	B	Above average	Second Class
> 5 CGPA < 5.5	5.5	C+	Average	
> 4 CGPA <5	5	C	Satisfactory	Pass
< 4 CGPA	0	F	Unsatisfactory	Unsuccessful

Overall percentage=10*CGPA

a. **Provisional Grade Card**: The tentative / provisional grade card will be issued by the Controller of Examinations at the end of every semester indicating the courses completed successfully. The provisional grade card provides **Semester Grade Point Average (SGPA).**

b. **Final Grade Card:** Upon successful completion of two year Degree a Final Grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Controller of Examinations.

14. Attendance Requirement:

14.1 All students must attend every lecture, tutorial and practical classes.

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

14.3 Any student with less than 75% of attendance in aggregate of all the courses including practical courses / field visits etc., during a semester shall not be permitted to appear to the end semester examination and such student shall seek re-admission

15. Re-Registration and Re-Admission:

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

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

16. Absence during Internal Test:

In case a student has been absent from an internal tests due to the illness or other contingencies s/he may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Director of the School, for conducting a separate internal test. The Director of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and arrange to conduct a special internal test for such candidate(s) well in advance before the Semester End Examination of that respective semester. Under no circumstances internal tests shall be held / assignments are accepted after Semester End Examination.

17. Provision for Appeal

If a candidate is not satisfied with the evaluation of Internal Assessment components (Internal Tests and Assignments), s/he can approach the Grievance Cell with the written submission together with all facts, the assignments, and test papers, which were evaluated. S/he can do so before the commencement of respective semester-end examination. The Grievance Cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the University on the candidate if his/her submission is found to be baseless and unduly motivated. This Cell may recommend for taking disciplinary/corrective action on an evaluator if s/he is found guilty. The decision taken by the Grievance committee is final.

18. Grievance Committee:

In case of students having any grievances regarding the conduct of examination, evaluation and announcement of results, such students can approach Grievance Committee for redressal of grievances. Grievance committees will be formed by CoE in consultation with VC

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

- The Controller of Examinations - Ex-officio Chairman / Convener
- One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member.
- One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

19. Eligibility to Appear for Semester End Examination (SEE)

Only those students who fulfil a minimum of 75% attendance in aggregate of all the courses including practical courses / field visits etc., as part of the program shall be eligible to appear for Semester End Examination

20. Provision for Supplementary Examination

In casea candidate fails to secure a minimum of 40% (20 marks) in Semester End Examination (SEE) and a minimum of 40% marks together with IA and SEE to declare pass in the course, such candidate shall seek supplementary examination of only such course(s) wherein his / her performance is declared unsuccessful. The supplementary examinations are conducted after the announcement of even semester examination results. The candidate who is unsuccessful in a given course(s) shall appear for supplementary examination of odd and even semester course(s) to seek for improvement of the performance.

21. Provision to Carry Forward the Failed Subjects / Courses:

A student who has failed in a given number of courses in odd and even semesters shall move to next semester of immediate succeeding year and final year of the study. However, s/he shall have to clear all courses of all semesters within the double duration, i.e., with four years of admission of the first semester failing which the student has to re-register to the entire program.

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

Mapping of PEOS with Respect to PoS

	PO1	P2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
PEO1	**2**	**1**	**1**	**1**	**1**			**1**			**3**	**1**		**2**	
PEO2	**1**		**2**			**1**			**3**			**3**		**2**	
PEO3			**3**		**2**		**2**			**1**			**3**		**1**
PEO4	**1**		**1**		**1**				**3**		**2**	**1**			**3**

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
M21SP0101	1	3	3		1	1	1			2	3	2				
	2	3	3		1	1	1			2	3	2				
	3	3	3		1	1	1			2	3	2				
	4	3	3		1	1	1			2	3	2				
M21SP0102	1	2	3	1	2	2			1			2	1	3	1	1
	2	3	2	2	2	2			1				1	3	2	
	3	2	3	2	3	2	1	1	1			2	1	3		2
	4	2	2	1	1	1			1			2	1	3	1	1
M21SP0103	1	2	3							2		1		3		3
	2	2	3	2	1	2						2		3		3
	3	2	3	2								2		3		3
	4	2	3	2	1	2						2		3		3
M21SP0104	1	1	3	3									3	1		
	2	2	2	2										1		
	3	3	2	2										1		
	4	4	2	2										1		
	5	5	2	2	2									1		
	6	6	3	3									3	1		3
M21SP0105	1	1	2	2	2	2	1	1	1			1	2	2	2	1
	2	2	2	2	2	2	1	1	1			1	1	3	2	1
	3	1	2	2	2	2	1	1	1			1	1	2	2	1
	4	1	2	3	3	3	1	1	1			1	1	2	2	1
M21SPM101	1	3	3	1	3	2						2	3	2	2	1
	2	3	3	1	2	1						1	3	2	2	1
M21SP0201	3	2	3	2	3	3						2	3	3	3	1
	4	3	2	1	2	2						2	3	3	3	1
	3	3	3									3	1		3	3
	4	3	3									3	1		3	3
M21SP0202	1	3	3	1	3	2						2	3	2	2	1
	2	3	3	1	2	1						1	3	2	2	1
	3	2	3	2	3	3						2	3	3	3	1
	4	3	2	1	2	2						2	3	3	3	1
M21SP0203	1	1	2	2	2	2	1	1	1			1	2	2	2	1
	2	2	2	2	2	2	1	1	1			1	1	3	2	1
	3	1	2	2	2	2	1	1	1			1	1	2	2	1
	4	1	2	3	3	3	1	1	1			1	1	2	2	1
M21SP0204	1	3	2	1	2	2			1			2	2	1	3	1

	2	3	2	2	2	2			1				2	1	3	2
	3	3	3	3	3	3	1	1	1			2	1	1	3	
	4	2	2	1	1	1			1			2	3	1	3	1
M21SPS211	1	2	3							2		1		3		3
	2	2	3	2	1	2						2		3		3
	3	2	3	2								2		3		3
	4	2	3	2	1	2						2		3		3
M21SPS212	1	3	2	1	2	2			1			2	2	1	3	1
	2	3	3	3	3	3	1	1	1			2	1	1	3	
	3	3	2	2	2	2			1				2	1	3	2
	4	2	2	1	1	1			1			2	3	1	3	1
M21SPS213	1	1	3		1	1	1						1	2	2	1
	2	3	2	2	2	2			1				2	1	3	2
	3	3	2	1	2	2	1		1				2	1	3	2
	4	3	2	2	2	2			1				2	1	3	2
M21SP0205	1	2	3							2		1		3		3
	2	2	3	2	1	2						2		3		3
	3	2	3	2								2		3		3
	4	2	3	2	1	2						2		3		3
M21SP0206	1	3	2	1	2	2			1			2	2	1	3	1
	2	3	2	2	2	2			1				2	1	3	2
	3	3	3	3	3	3	1	1	1			2	1	1	3	
	4	2	2	1	1	1			1			2	3	1	3	1
M21SP0301	1	3	3	2	1	3					2	1	3	2	3	2
	2	3	3	1	3	3						3	3	2	3	2
M21SP0302	1	1	2	2	2	2	1	1	1			1	2	2	2	1
	2	1	2	2	2	2	1	1	1			1	1	2	2	1
	3	1	2	2	2	2	1	1	1			1	1	2	2	1
	4	1	2	3	3	3	1	1	1			1	1	2	2	1
M21SP0303	1	3	3	2	3	2	1					2	3	2	3	1
	2	3	3	2	3	2						2	3	3	3	1
	3	3	3	1	3	3						2	3	1	3	1
M21SPS311	1	2	3							2		1		3		3
	2	2	3	2	1	2						2		3		3
	3	2	3	2								2		3		3
	4	2	3	2	1	2						2		3		3
M21SPS312	1	3	2	1	2	2			1			2	2	1	3	1
	2	3	2	2	2	2			1				2	1	3	2
	3	3	3	3	3	3	1	1	1			2	1	1	3	
	4	2	2	1	1	1			1			2	3	1	3	1
M21SPS313	1	1	2	2	2	2	1	1	1			1	2	2	2	1
	2	2	2	2	2	2	1	1	1			1	1	3	2	1
	3	1	2	2	2	2	1	1	1			1	1	2	2	1
	4	1	2	3	3	3	1	1	1			1	1	2	2	1

M21SPS321	**2**	**3**							**2**		**1**		**3**		**3**	**2**
	2	**3**	**2**	**1**	**2**						**2**		**3**		**3**	**2**
	2	**3**	**2**								**2**		**3**		**3**	**2**
	2	**3**	**2**	**1**	**2**						**2**		**3**		**3**	**2**
M21SPS322	**1**	**3**	**3**	**1**	**3**					**1**	**1**	**1**	**1**	**3**	**3**	**2**
	2	**3**	**3**	**1**	**3**					**1**	**1**	**1**	**1**	**3**	**3**	**2**
	3	**3**	**3**	**1**	**3**					**1**	**1**	**1**	**1**	**3**	**3**	**1**
	4	**3**	**3**	**1**	**3**	**3**				**1**	**1**	**1**	**1**	**3**	**3**	**1**
M21SPS323	**1**	**2**	**2**	**2**	**2**	**1**	**1**	**1**			**1**	**2**	**2**	**2**	**1**	**1**
	2	**2**	**2**	**2**	**2**	**1**	**1**	**1**			**1**	**1**	**3**	**2**	**1**	**2**
	1	**2**	**2**	**2**	**2**	**1**	**1**	**1**			**1**	**1**	**2**	**2**	**1**	**1**
	1	**2**	**3**	**3**	**3**	**1**	**1**	**1**			**1**	**1**	**2**	**2**	**1**	**1**
M21SP0304	**2**	**3**							**2**		**1**		**3**		**3**	**2**
	2	**3**	**2**	**1**	**2**						**2**		**3**		**3**	**2**
	2	**3**	**2**								**2**		**3**		**3**	**2**
	2	**3**	**2**	**1**	**2**						**2**		**3**		**3**	**2**
M21SPS331	**1**			**2**		**3**			**1**			**3**	**1**			
	2	**1**					**2**				**3**				**2**	
	3			**2**		**2**							**3**		**2**	
	4		**3**							**1**		**2**			**3**	

M Sc (Physics) Program
Scheme of Instruction
(Effective from Academic Year 2021-23)

SEMESTER-I

Sl. No.	Course Code	Title of the Course	Course Type	Credit Pattern & Credit Value				Contact Hours
				L	T	P	Total	
1	M21SP0101	Mathematical Physics	HC	4	0	0	4	4
2	M21SP0102	Classical Mechanics	HC	4	0	0	4	4
3	M21SP0103	Electronic devices	HC	4	0	0	4	4
4	M21SP0104	Quantum Mechanics I	HC	4	0	0	4	4
5	M21SP0105	Solid state physics	HC	4	0	0	4	4
6	M21SPM101	C and Python program	MC	0	0	0	0	3
	Practical Courses							
6	M21SP0106	General Physics lab - I	HC	0	0	2	2	4
7	M21SP0107	Electronics lab	HC	0	0	2	2	4
Total Credits				**21**	**0**	**5**	**24**	**31**

SEMESTER-II

Sl. No.	Course Code	Title of the Course	Course Type	Credit Pattern & Credit Value				Contact Hours
				L	T	P	Total	
1	M21SP0201	Quantum Mechanics II	HC	4	0	0	4	4
2	M21SP0202	Statistical Mechanics	HC	4	0	0	4	4
3	M21SP0203	Electrodynamics	HC	4	0	0	4	4
4	M21SP0204	Atomic and Molecular Physics	HC	4	0	0	4	4
5	M21SPS211	Electronics - I :Digital electronics	SC#	4	0	0	4	4
6	M21SPS212	Condensed Matter Physics - I	SC#					
7	M21SPS213	Photonics-I	SC#					
8	M21SPM201	Lab View introduction and interfacing	MC	0	0	0	0	2
	Practical Courses							
9	M21SP0205	General Physics lab - II	HC	0	0	2	2	4
10	M21SP0206	Atomic and Molecular Physics Lab	HC	0	0	2	2	4
Total Credits				**20**	**0**	**4**	**24**	**32**

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	M21SP0301	Astrophysics	HC	4	0	0	4	4
2	M21SP0302	Nanoscience and Nanotechnology	HC	4	0	0	4	4
3	M21SP0303	Nuclear and Particle physics	HC	4	0	0	4	4
4	M21SPS311	Electronics – II: Digital Electronics and Communication Systems	SC#	4	0	0	4	4
5	M21SPS312	Condensed Matter Physics – II	SC#					
6	M21SPS313	Photonics-II	SC#					
7	M21SPS321	Electronics – III: Linear integrated circuits	SC#	4	0	0	4	4
8	M21SPS322	Condensed Matter Physics - III	SC#					
9	M21SPS323	Photonics-III	SC#					
10	M21SPO301	Astrobiology and Extraterrestrial Life	OE	4	0	0	4	4
11	M21PTM301	Soft skill training	MC	0	0	0	0	2
12	M21SP0304	General Physics lab - III	HC	0	0	2	2	4
13	M21SPS331	Electronics Lab	SC#	0	0	2	2	4
14	M21SPS332	Condensed Matter Physics Lab						
15	M21SPS333	Photonics Lab						
Total Credits				**24**	**0**	**4**	**28**	**32**

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

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	M21SP0401	Research methodology	HC	2	0	0	2	2
2	M21SP0402	Major Project	HC	0	0	8	8	16
3	M21SPON01	MOOC/SWAYAM /Internship*	SC	4	0	0	4	-
Total Credits				**6**	**0**	**8**	**14**	**18**
Total Credits of I to IV Semesters				**70**	**0**	**20**	**90**	**113**

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	24	31
Second Semester	24	32
Third Semester	28	32
Fourth Semester	14	18
Total Credits	**90**	**113**

Distribution of Credits Based on Type of Courses

Semester	HC	SC	OE	MC	TOTAL
I	24	-	-	-	24
II	20	4	-	0	24
III	20	8	4	-	28
IV	10	4	-	4	14
Total	**70**	**14**	**4**	**8**	**90**

HC=Hard Core; SC=Soft Core; OE=Open Elective

Distribution of Credits Based on L: T: P

Semester	L	T	P	Total	Total Hours
I	20	0	4	24	31
II	20	0	4	24	32
III	24	0	4	28	32
IV	6	0	8	14	18
Total	**70**	**0**	**20**	**90**	**113**

M Sc (Physics) Program

Detailed Syllabus

(Effective from Academic Year 2020-21)

FIRST SEMESTER

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SP0101	MATHEMATICAL PHYSICS	HC	4	0	0	4	4

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, Laplace transforms and mathematical special function in solving the problems in physics.

Course Content:

Unit-1: **12 hrs**

Vectors & Tensors:

Review of Vector analysis, Gradient, Divergence and Curl operations, Gauss' and Stokes' theorems, applications, 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, Tensor application: moment of inertia.

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, Hermitian and Unitary transformations, diagonalization, application of matrices.

Unit - 3: **12hrs**

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.

Unit - 4: **12hrs**

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 Besseland Legendrepolynomials, Generating functions, Some recurrence relations, orthogonality properties of these functions.

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. Sokolnikoff 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.
M21SP0102	CLASSICAL MECHANICS	HC	4	0	0	4	4

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. Analyse the Central force problemsto explain the 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. Solve problems related to the mechanics of rigid bodies, the precession of rotation of earth and Rutherford's scatteringand Communicate scientific information of classical mechanics.
5.

Course Content:

Unit - 1: 12 hrs

The Lagrangian Dynamics: Constraints and their classifications, Generalized coordinates, Virtualdisplacement 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,applications of Hamilton principle,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,Derivation of Hamilton's equations from the variational principle, Examples (i) the simpleharmonic oscillator (ii) Hamiltonian for a free particle in plane and spherical Co-ordinates. 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.

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.
M21SP0103	ELECTRONIC DEVICES	HC	4	0	0	4	4

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 and develop the prototypes of electronic devices
4. Solve real time examples of BJT, UJT, SCR and OPAMP, and able to describe various opto-electronic devices
5.

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 SCGupta,Tata Mc Graw Hill.1983.
2. Electronic Devices and Circuits: An Introduction, Allen Mottershead**,** Prentice Hall of India, 1973.
3. Semiconductor Optoelectronic Devices, Pallab Bhattacharya,Pearson Education Taiwan Limited, 2003.
4. Electronic Principles, A P Malvino, (Sixth Edition, 1999), Tata McGraw Hill, New Delhi.
5. A Textbook of Electronic Circuits, RS Sedha, S Chand & Company Ltd.2014.

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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.2003.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SP0104	QUANTUM MECHANICS – I	HC	4	0	0	4	4

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, harmonic Oscillator etc and three dimensional problems in quantum mechanics.
4. Solve numerical based on angular momentum and spin operators and analyze the result obtained in Stern-Gerlach experiment.

Course Content:

Unit – 1 **12 hrs**

Introduction: Dual nature of matter and waves, Double-slit experiment for photons andelectrons 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 independentSchrodinger'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 Cartesiancoordinates, 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 publishers, 2012.
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.
M21SP0105	Solid state Physics	HC	4	0	0	4	4

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. Distinguish the relationship between a material's microstructure and its properties.
2. Analyze the properties of defects can affect the strength of a material.
3. Compare the elastic and plastic behavior of materials.
4. Analyze the phase diagrams to synthesize different phases of materials.

Course Content:

Unit - 1: 12 hrs

Structural properties: Classification of solids: crystalline, non-crystalline, nanophase solids, liquids. Crystalline solids:Periodic arrays of atoms: lattice translation vectors, basis and the crystal structure primitive lattice cell, fundamental types of lattices two-dimensional lattice types three-dimensional lattice types, index system for crystal planes, simple crystal structures (hexagonal close-packed diamond and cubic zinc sulfide structure). Bragg's law in direct and reciprocal lattice, Diffraction of waves by crystals: X-rays. Brillouin zones, Brillouin zones reciprocal lattice to sc, bcc, fcc lattice, structure factor of the bcc and fcc lattice, atomic form factor.

Unit - 2: Lattice dynamics 12 hrs

vibrations of crystals with monatomic basis, first brillouin zone, group velocity, long wavelength limit, derivation of force constants from experiment, two atoms per primitive basis, quantization of elastic waves, Phonons and phonon momentum, inelastic scattering by phonons, phonon heat capacity, Planck distribution, normal mode enumeration density of states in one dimension and three dimensions, Debye model for density of states, Debye T^3 law, anharmonic crystal interactions, thermal resistivity of phonon gas, Phase diagrams- the phase rule and it’s applications to binary alloy systems.

Unit - 3: **12 hrs**

Electrical and optical properties

Electron motion in a periodic potential, Kroning penny model, band theory of solids: nearly free electron and tight binding models; metals, semiconductors and insulators; conductivity, mobility, Energy levels in one dimension, effect of temperature on the Fermi-Dirac distribution, free electron gas in three dimensions, heavy fermions, Effective mass and concept of holes. Fermi surface,Fermi energy, experimental electrical resistivity of metals, Semiconductors: Carrier concentrations in intrinsic and extrinsic semiconductors, Excitons (qualitatively).

Unit - 4: **12 hrs**

Magnetism and superconductivity

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, BCS theory of superconductivity, Type I and type II superconductors, London equations, Thermodynamics of superconductors, Entropy and Specific heat in the superconducting state, Application-SQUID.

Reference Books:

1. Elements of material science and engineering, **Lawrence H. Van VlackAddisonWesley**(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).
12. Material science and engineering,William D. Callister, Jr.Callister, John Wiley &Sons,Inc(1997).

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SPM101	**C and Python programming**	MC	0	0	0	0	3

Course Objectives

1. To understand the various steps in C and Python Program development.
2. To understand the basic concepts in C and Python Programming Language.
3. To learn to write programs (using structured programming approach) in C and Python programs to solve problems.

Out comes:

The students will be able to

1. Solve and the various steps in Program development.
2. Analysis the basic concepts in C Programming Language.
3. Write programs (using structured programming approach) in C to solve problems.

UNIT 1: **6 hrs**

Standard I/O in "C", Fundamental Data Types and Storage Classes: Character types, Integer, short, long, unsigned, single and double-precision floating point, storage classes, automatic, register, static and external.

Operators and Expressions: Using numeric and relational operators, mixed operands and type conversion, Logical operators, Bit operations, Operator precedence and associativity.

UNIT 2: **6 hrs**

Conditional Program Execution: Applying if and switch statements, nesting if and else, restrictions on switch values, use of break and default with switch, Program Loops and Iteration: Uses of while, do and for loops, multiple loop variables, assignment operators, using break and continue,

Python programming

Unit 3 **6 hrs**

Introduction to Python: Overview – History of Python – Python features – Environment - Environment setup – Getting Python – Install Python – Setting up Path – Running Python – Basic Syntax –Interactive mode programming – Script mode Programming – A simple Python example. Input, processing, and output. Editing saving and running a script.

Unit 4 **6 hrs**

Programming Basics of Python: Python Keywords –Identifiers – Rules for writing Identifiers – Reserved words – Lines and Indentation – Multiline statements – Python Variable – Variable Assignment – Multiple Assignment - Standard Data Types: Numbers: int, float and decimal – Basic Operators: Arithmetic Operators – Comparison (Relational) Operators – Assignment Operators – Logical Operators – Bitwise Operators – Membership Operators – Identity Operators

– Loops: Types of loops – while – for Loops – Control statements: if …else – for loop – break and continue.

Text Books :

1. Let us C- by Yashwant kanetkar, BPB publications, 2016.
2. Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson Addison-Wesley, 2006.
3. Programming in ANSI C, 8/e, by E Balagurusamy , Mc Graw Hill, 2019.
4. Learning with Python, by Allen Downey , Jeffrey Elkner, et al. Green tree Press, 2015
5. Core Python Programming by R. Nageswara Rao, Dreamtech Press, 2nd Edition, 2018

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SP0106	GENERAL PHYSICS LAB - I (PRACTICAL)	HC	0	0	2	2	4

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 concets 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. Design and study of the frequency response of CE transistor amplifier.
5. Determination of Stefan’s constant and Verification of Stefan’s fourth power law by electrical method.
6. Determination of Energy band gap of two different semiconductors.
7. Determination of solar constant.
8. Thermal Conductivity of a rod by Forbe’s method.
9. Determination of temperature sensitivity of a thermocouple and its Calibration.
10. Determination of work function of filament of a directly heated diode and hence verify the Richardson and Dushman equation .

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SP0107	ELECTRONICS LAB (PRACTICAL)	HC	0	0	2	2	4

Course Objectives:

1. To familiarize the students with the basics of electronics.
2. To enable the students to explore the concepts involved in the oscillators.
3. To make the students understand the basic concepts in ICs and digital devices.
4. 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 astable, 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 bistablemultivibrator 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 741.
9. Design and implementation of regulated power supply.
10. Solving Boolean expressions.

SECOND SEMESTER

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SP0201	QUANTUM MECHANICS –II	HC	4	0	0	4	4

Course Objective:

1. 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: Symmetry in quantum mechanics **12 hrs**

Symmetry transformation, Spatial transition -conservation of linear momentum**,** Translation in time-Conservation of energy, Rotation in space- conservation of angular 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: Approximation methods: **12 hrs**

The WKB method: one dimensional case, approximate solutions turning points and connection formulae, tunneling through a barrier.

The variational method:variation principle, application of vibrational approach to ground states of (i) Hydrogen atom and (ii) Helium atom.

Time independent perturbation theory: Perturbation theory for non-degenerate states, Applications. linear and quadratic stark effects in hydrogen atom, validity of time independent perturbation theory, Degenerate perturbation theory, examples: linear stark effect, Normal Zeeman effect. **Time dependent perturbation theory**: time dependent perturbation series-transition probability, transition to the Continuum-Fermi golden rule, Harmonic perturbation, sinusoidal perturbation on 1D simple harmonic oscillator.

Unit 3 : Interaction of radiation with matter **12 hrs**

Elements of Field quantization: Quantization of electromagnetic radiation, transition rates for emission andabsorption, Transition rate within dipole approximation, the electric dipole selection rules, spontaneous emission rate, Identical particles scattering.

Scattering:scattering cross-section, scattering amplitude, partial waves, scattering by a spherically symmetric potential- partial wave analysis, optical theorem, scattering by perfectly rigid sphere potential, Scattering cross section-Born approximation-integral method, Validity of Born approximation.

Unit – 4: Relativistic quantum mechanics **12 hrs**

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. Quantum mechanics: concepts and applications, NouredineZettili, 2nd Edition, Wiley (2018)
3. Introduction to Quantum mechanics, **David J. Griffiths**, 2nd Edition, Parson Education (2005).
4. Modern Quantum mechanics**, J.J. Sakurai**, Pearson Education, (2000).
5. Quantum mechanics, **V.KThankappan,** 2nd Edition 2004.Pri
6. Quantum Mechanics, **E. Merzbacher,** 3rd edition, John Wiley(1994).
7. Quantum mechanics, **Stephen Gasiorowicz**, john Wiley (2003).
8. Principles of Quantum mechanics ,**R. Shankar,** 2nd Edition, Premium press, NY (1994)
9. Relativistic Quantum mechanics and Relativistic Quantum fields, **J.D. Bjorken and S.D. Drell**, Mc. Graw-hill,New York (1968).
10. Quantum mechanics, **L.I.Schiff Mc. Graw-hill**, (1955).
11. 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.
M21SP0202	STATISTICAL MECHANICS	HC	4	0	0	4	4

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:

1. Solve day-to-day life selected problems using thermodynamics laws.
2. Analyse various distribution laws.
3. Apply the concepts to test distribution laws.
4. Apply the distribution laws to solve physical problems.

Course Content:

Unit – 1: **12 hrs**

Thermodynamics

Thermodynamic laws, Isothermal process, Adiabatic process, Isochoric process, Isobaric process, Relation between thermodynamic laws, Examples & Numerical problems of thermodynamics process in day to day life: 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. Numerical problems.

Unit-2 **12 hrs**

Classical statistical mechanics:

The postulate of equal a priori probability; The Liouville theorem; Statiscal Ensembles & examples - microcanonical ensemble, canonical ensemble, Grand canonical ensemble, energy mean value and fluctuations, Reduction of Gibbs distribution to Maxwell andBoltzmann 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. Numerical problems.

Unit-3 **12 hrs**

Quantum statistical mechanics

The postulates of quantum statistical mechanics – equal priori probability & Random phases, Symmetric & Antisymmetric of wave functions, The Liouville theorem in quantum statistical mechanics,The quantum distribution functions – Fermi-Dirac distribution and probability of electron at different temperatures, Bose-Einstein statistics, the derivation of the corresponding distribution functions, the Boltzmann limit of Boson and Fermion gases. Numerical problems on FD distribution & BE statistics.

Unit-4 **12 hrs**

Applications of quantum statistics

Application of Fermi-Dirac statistics – to derive Fermi energy & total energy, 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., Statistica 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.
M21SP0203	**Electrodynamics**	HC	4	0	0	4	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, Maxwell's equationsand Poynting's theorem,and
4. physics concepts in Electrodynamics.
5. Analysis and communicate scientific information of wave guides,electromagnetic radiation by using concepts ofelectrostatics, magneto statics and Maxwell's equations.

Course Content:

Unit -1: 12 hrs

Electrostatics: Divergence and curl of electrostatic field, Applications of Gauss law, electrostatic potential, Poisson and Laplace equations, Boundary conditions, uniqueness theorems, electrostatic potential energy,Electrical energy of a localized charge distribution,Electrical energy of a continuous charge distribution, monopole and dipole terms, electric field of a dipole, multipole expansion of the potential, dipole-dipole interaction, Electrostatic fields in matter: polarization, internal field equations, electrostatic energy in dielectric media.

Unit - 2: 12 hrs

Magnetostatics: Current density, Biot-savart law, the Magnetic Field of a Steady Current, thedivergence and curl of Magnetic field **B**, Ampere's law, magnetic vector potential, Boundary Conditions, multipole expansion of vector potential, magnetic moment, Magnetic fields in matter: Magnetization, Torques and forces on magnetic dipoles, effect of a magnetic field on atomic orbits, the field of a magnetized object, Magnetic Susceptibility and Permeability, magnetic scalar potential, Energy in the magnetic field.

Plasma Physics: Plasma behavior in magnetic field, plasma as a conducting fluid-magnetohydrodynamics, magnetic confinement-Pinch effect.

Unit -3: 12 hrs

Electrodynamics: Faraday law of induction, the Induced Electric Field, Maxwell's equations, displacement current, Maxwell equations in matter, the Continuity Equations, Poynting's theorem, conservation of momentum and energy for a system of charged particles

Electromagnetic Waves: The Wave equation for E and B, Energy and Momentum in Electromagnetic Waves, Plane waves in non-conducting and conducting medium, skin depth,Linear and circular polarizations, Reflection and refraction of plane waves at normal incident, total internal reflection, and reflection from a surface of a metal, Frensnel's law.

Unit 4: **12 hrs**

Wave guides: Wave guide equations, TE Waves in a Rectangular Wave Guide, The Coaxial Transmission Line.

Electromagnetic radiation: Retarded Potentials, Radiation from an oscillating dipole, linerantenna, 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.

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

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SP0204	ATOMIC AND MOLECULAR PHYSICS	HC	4	0	0	4	4

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

Course Content:

Unit – 1:**Atomic Physics** **12 hrs**

Brief review of early atomic models of Bohr and Sommerfeld, Bohr's calculation of radius, energy and spectral lines.Sommerfeld explanation for spectral lines splitting, Failures of Bohr and Sommerfeld models.One electron atom: Quantum states, Atomic orbitals, Radial and probability density wavefunctions and spectrum of hydrogen, Rydberg Atoms (brief treatment), Relativistic corrections to spectra of alkali atoms, Spectroscopic terms and notation Spin-orbit interaction and fine structure in alkali spectra. Lamb shift in hydrogen (qualitative Discussion only).

Unit – 2:Two electron atom **12 hrs**

Identical particles and the total wave function representation, 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 Spectroscopy-1 **12 hrs**

Microwave spectroscopy, Brief treatment of chemical bonds: covalent, ionic, vander Waal'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.Infrared Spectroscopy, 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

Unit – 4:Molecular Spectroscopy-2 **12 hrs**

Raman spectroscopy: Theory of Raman effect, experimental techniques, rotational Raman spectra of diatomic and linear polyatomic molecules. Comparison of infrared and Raman spectra, Electronic spectroscopy of Molecules: 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,Introduction to electron spin resonance and nuclear magnetic resonance spectra

Reference Books:

1. Physics of atoms and molecules, Bransden and Joachain, (2nd Edition) Pearson Education, 2004.
2. Fundamentals of Molecular Spectroscopy, Banwell and Mccash, Tata McGraw Hill, 1998.
3. Modern Spectroscopy, J.M. Hollas, John Wiley, 1998.
4. 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.
M21SP0211	ELECTRONICS-I (DIGITAL ELECTRONICS)	SC	4	0	0	4	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 design and analyze a given combinational or sequential circuit using Boolean Algebra as a tool to simplify and design logic circuits.
4. To design various the logic design of programmable devices, including PLDs and 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 and the use of implementation of logic circuits.
3. Draw the logic circuits by simplifying Boolean expressions using theorems, laws and K-map.
4. Analyse the operation of Combinational and Sequential logic circuits and DAC, 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, 1 and 2 complements, Complement Codes: Excess-3 code, Gray code, examples. Basic gates: AND, OR, NOT,NAND,NOR, X-OR GATE, INHIBIT CIRCUIT, Universal gates NAND and NOR, TTL and CMOSLogic families and comparison.

Unit -2:

12hrsBoolean operations and expressions: Introduction, Logic Operators,Simplification of logic expressions, Boolean laws; Postulates theorems and properties–Product of Sums (POS) and Sum of Products(SOP) – Karnaugh Map method – Two, three, four, five variable K-maps examples, Converting Boolean expressions to Logic and Vice versa, NAND and NOR implementation– Don't-Care conditions –examples.

Unit-3: **12 hrs**

Combinational and Sequential circuits: Half and full Adder, implementation of full adder using half adders– Half and full Subtractor – Binary parallel adder – BCD adder, block diagram and working– Magnitude comparator(1 and 2 bit)– Encodersoctal to binary encoder &DecodersBCD to 7- segment display– Multiplexers–De-multiplexer.

Sequential circuits: Comparison of Combinational and Sequential circuits, Latches, Flip-flops, SR, JK-Flip-flop, JK Master-Slave, D, T flip-flops, timing diagrams, counters, synchronous Decade counter and asynchronous counters, registers, shift registers, timing sequences.

Unit- 4: **12hrs**

A/D and D/A conversion circuits: Introduction, Digital to Analog Converters, Weighted Resistor DAC, R-2R Ladder DAC, advantages, disadvantages and applications. A/D converters, Counter type A/D converter,Successive Approximation Method, advantages, disadvantages and Applications, specifications, **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.
M21SP0212	CONDENSED MATTER PHYSICS - I	SC	4	0	0	4	4

Course objectives:

1. The atomic structure of a material depends on the method of synthesis and on various parameters involved in the technique.
2. This course will introduce the fundamental concepts of reciprocal lattice and to understand the diffraction principle and use of X-rays.
3. To know about lattice representation and reciprocal lattices.
4. To determine and analyze the crystal structure using x-ray diffraction.
5. To understand the optical and luminescence properties of ionic crystals.

Course outcomes:

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

1. Illustrate reciprocal lattice and its construction.
2. Understand the theoretical framework like indexing and interpretation of Moving film methods.
3. Characterize the crystal structures of materials using different X-ray analysis methods
4. Analyze the optical Properties and luminescence mechanisms in ionic crystals.

Unit -1: **12 hrs**

Real and Reciprocal lattice: Introduction to Graphical construction, primitive vectors, Physical interpretation of the reciprocal space interpretation of Bragg's law using reciprocal lattice concept, general spacing formula, transformation equations and their importance.**The Laue method and Rotating crystal methods:** Reciprocal lattice construction, instrumentation, flat plate cameras, front reflection region, 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. Numerical problems.

Unit -2: **12 hrs**

Moving film methods: Weissenberg method, Influence, The precession method, reciprocal lattice construction for zero level and higher levels, indexing procedure, interpretation of different photographs. Single crystal diffractometer: parafocussing and goniometry, intensity measurements. Applications of moving film methods. Numerical problems.

Unit - 3: **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 with illustration, 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 crystal system, powder diffractometer and applications. Numerical problems.

Unit-4 **12 hrs**

Optical properties of materials: 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. Luminescence, photoconductivity.Color centers in ionic crystals- Types of Color centers- methods of production-mechanism - Characteristic absorption bands, Properties of Color centers- Applications.

Reference Books:

1. The Laue Method, Elsevier Science & Technology (Firm) Academic Press, 1974.
2. Elements of X-ray Crystallography, L.V. Azaroff: McGraw Hill, New York, 1968.
3. An introduction to Crystallography, Michael M Wooffen: Cam bridege University Press, 1997
4. Crystal growth Processes and methods, Santhana Raghavan and Ramaswamy: KRU Publications, Kumbakonam, 2000.
5. Crystallography for solid state physics, Verma and Srivastava: New age international Ltd. 1997.
6. Solid State Physics, Charles Kittel: Wiley Eastern, 1984.
7. X-ray crystallography, M.J.Burger: John Wiley, New York, 1952.
8. Crystalline Solids, Duncan M and C. Mike: Nelson, London, 1973.
9. The powder method in X-ray cryst. L.V. Azaroff and M.J.Burger: McGraw Hi11s, 1958.
10. Luminescence of Solids, D. R. Vij, Plenum Press, 1998.
11. Optical Properties of Materials and Their Applications, Jai Singh: John Wiley & Sons,2020

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SP0213	**PHOTONICS -I: LASERS AND MODERN OPTICS**	SC	4	0	0	4	4

Course Objectives:

1. To illustrate the Laser systems, principles and its applications.
2. To explain the basic principles of Laser induced Nonlinear optical phenomenon.
3. To understand modern optics tools and applications.

Course Outcomes:

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

1. Understand the principle and mechanism underlying in different LASER systems.
2. Describe the LASER induced nonlinear optical phenomenon in materials.
3. Apply Laser beam interference and Fourier analysis in holography and optical signals respectively.
4. Demonstrate Optical fibres and its wave guiding mechanism.

UNIT – I: Basic principles of lasers **12 hrs**

Spontaneous and stimulated emission – Coherence - Population inversion- Einstein coefficients – Pumping schemes – Threshold condition for laser oscillation – Losses and Q-factor –Principles and working mechanisms of Ruby, Nd:YAG, Ar ion, CO_2 and semiconducting lasers – Applications.

UNIT II : Non-linear Optics Basic Principles **12 hrs**

Origin of optical nonlinearity - Harmonic generation – Second harmonic generation – Phase matching condition – Third harmonic generation – Optical mixing – Parametric generation of light – Parametric light oscillator – Frequency upconversion – Self focusing of light – Phase conjugate optics-Guided wave optics - Nonlinear optical materials.

UNIT – III: Holography and Fourier Optics **12 hrs**

Introduction to Holography – Basic theory of Holography – Recording and reconstruction of Hologram – Diffuse object illumination – Speckle pattern – Fourier transform Holography – Applications of Holography. Introduction to Fourier optics– Two dimensional Fourier transforms – Transforms of DiracDelta function – Optical applications – linear systems- The convolution integral – convolution theorem- Spectra and correlation – Parsevel's formula – Auto correlation and cross-correlation – Apodization – Array theorem – Fourier methods in diffraction -Fraunhofer diffractionof single slit, double slit and transmission grating using Fourier method.

UNIT – IV: Fiber Optics **12 hrs**

Total internal reflection - Optical fiber modes and configuration – Single mode fibers – Graded index fiber structure – Fiber materials and fabrication – Mechanical properties of fibers – Fiber optic cables –

Attenuation – Signal distortion on optical wave guides- Erbium doped fiber amplifiers – Solitons in optical fibers - Block diagram of fiber optic communication system - Applications of optical fibers in communication and medicine.

Text and Reference Books

1. Introduction to Electrodynamics, D.J. Griffiths, 4 th Edition, Prentice-Hall of India, ND, 2013.
2. Electromagnetics, B.B. Laud, 3rd Edition, New Age International Publishers Ltd, N D, 2011.
3. Fundamentals of Electromagnetic theory, 2nd Edition, S.K. Dash and S.R. Khuntia, ND, 2011.
4. Modern Optics by G.R. Fowels, 1989.
5. Laser and their Applications, M.J. Beesly, Taylor and Francis, 1976
6. Lasers and Non-Linear Optics, B.B. Laud, 3rd Edition, New Age International Publishers Ltd,2011.
7. Optics, E. Hecht, Addison Wiley, 1974. 9. Optical Fiber Communications, Gerel Keiser, McGraw Hill Book, 2000

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SPM201	Lab View introduction and interfacing	MC	0	0	0	0	2

Course Objectives

1. To understand the various steps in Lab View introduction and interfacing.
2. To understand the basic concepts in Lab View introduction and interfacing
3. To learn to write programs (using structured programming approach) in Lab View introduction and interfacing.

Out comes:

The students will be able to

1. Solve and the various steps in Lab View introduction and interfacing
2. Analysis the basic concepts in Lab View introduction and interfacing
3. Write programs (using structured programming approach) in Lab View introduction and interfacing.

Unit-1 **6 hrs**

Introduction of LabVIEW: LabVIEW Environment: Definition Necessity of LabVIEW Definitions of VI, LabVIEW benefits, Programming and Execution methods, Introductions of 3rd party interfaces and toolkits.

Unit- 2 **6 hr**

Designing the Software: How to start up the Vis, Front panel designing and working environment, Definitions of Control and Indicators, Types of Control and Indicators,

Explanations of Controls Palette, Explanations Block Diagram and its working, Terminals, Functional Pallet.

Unit-3 **6 hrs**

Basic Programming: How to use Numerical functions, Designing of Boolean operations, Comparator applications, Exercises in basic programming, Programming Loops: About For loops While loop designing, Flat Sequences, Applications based on Loops.

Unit- 4 **6 hrs**

Data Handling and interfacing: Introduction of String, Arrays, Differentiations between Waveform charts and Waveform Graphs, Acquire and use the system files based on File I/O functions, External Interfaces: VISA explanations, GPIB communications, Serial communications and interfacing methods, LabVIEW instrumentation drivers.

References:

1. LabVIEW for Everyone: Graphical Programming Made Easy and Fun (3rd Edition) (National Instruments Virtual Instrumentation Series) Jeffrey Travis, Jim Kring , August 2006,
2. LabVIEW Student Edition, National Instruments, Inc., Robert H. Bishop, Pearson publishers, 2015.
3. Online resources, NI forum and NI help tools.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SP0205	GENERAL PHYSICS LAB - II (PRACTICAL)	HC	0	0	2	2	4

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 Rydbergconstant 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.
M21SP0206	ATOMIC AND MOLECULAR PHYSICS (PRACTICAL)	HC	0	0	2	2	4

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.

List of Experiments:

1. Determination of electronic charge: Millikan's oil drop experiment.

2. Determine the separation between the etalon mirror of Fabry Perot Etalon usingspectrometer: FabryPerot Interferometer.

3. Determination of nature of light emerging from a Babinet compensator: Babinet Compensator.
4. Recording the spectra of metal rods using Arc Spectrum.
5. Determine the dissociation energy and force constant of Iodine, using Iodine absorption spectrum.
6. Estimating the rotational constant and bond length of $15N_2$ molecule by studying Rotational Raman Spectrum.
7. Determination of absorption Co-efficient of solution.
8. Recording the absorption spectra of FTO (Fluorine doped Tin Oxide) &ITO(Indium doped Tin oxide) using UV-Visible absorption spectroscopy.
9. Identifying the stretching and bending vibrational modes in FTIR spectrum.

THIRD SEMESTER

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SP0301	**Astrophysics**	HC	4	0	0	4	4

Course objectives:

1. To make students learn fundamental concepts in astrophysics that will equip them to better
2. understand newscientific discoveries made in the coming years and decades
3. To learn about the origin and evolution of life and the search for life beyond the Earth.
4. To acquire knowledge of techniques and methods used to gain new knowledge inphysics and
5. astronomy
6. To understand astrophysics as a way to describe our real physical world

Course outcomes

4. To explain the basic concepts of astrophysics.
5. To describe the features of objects in solar system.
6. Demonstrate an understanding of life of origin on earth and exoplanet.
7. Knowledge of the environmental conditions that might allow a planet to be habitable

Syllabus

Unit-1: 12 hrs

Basic concepts of Astrophysics: Sky coordinates and motions, earth rotation, timekeeping (sidereal vs synodic period), Trigonometric Parallax,Planetary motions - Kepler's Laws – Gravity,Light & Energy –Optical & Modern Telescopes –working &characteristics, Astronomical Instruments – Photometer, Photographic plates, Spectrographs, Charge Coupled Detector – basic principle & working.

Unit-2: 12 hrs

Formation of star & solar system: Formation star, Classifications of star – HR diagram, Main sequence evaluation, White dwarfs, Neutron stars, Pulsars, Supernovae, Stellar Black holes, Theories of formation of solar system, sun – characteristics & its different zones, Interior & Exterior planets – properties, satellites, Kuiper belt, Oort clouds.

Unit-3: 12 hrs

High energy Astrophysics: Radiation-matter interaction – Sources of high energy (UV-gamma rays) radiation in theuniverse - Detectors for high energy particles, X-rays, gamma rays and neutrinos – Spaceastronomy - Elements of General Relativity - compact stars – magnetospheric processesaround neutron stars (pulsars and magnetars) – interacting binaries – Roche potential andaccretion – Shkura-Sunyaev thin disk model – Gamma Ray Bursts.

Unit -4: 12 hrs

Astrobiology, Habitable planets &-Extraterrestrial Intelligence: Introduction, History of Astrobiology, Life on earth, structure of Life – building blocks, cells, Life on earth – Conditions on early earth, evidence of life, the tree of life, life in extreme environments, the rise of multicellularity, the great oxidation event

Habitable planets – Characteristics & Conditions, Life on Mars – locations, Europa, Enceladus&Other Icy Bodies, Methods of detection of exoplanets, Bio-signature of life on exoplanet atmosphere, How to look Bio-signatures, Missions to search for Bio-signatures, Contacting Extraterrestrial civilization, the search of Extraterrestrial intelligence

Books for reference:

1. BW Carroll & DA Ostlie, An Introduction to Modern Astrophysics, Latest Edition,Addison-Wesley, 2004.
2. Martin Harwit, Astrophysical Concepts, Latest Edition, Springer,2014.
3. C.R. Kitchin, Astrophysical Techniques, CRC press,2016 .
4. Carroll, Bradley W., and Dale A. Ostlie. An Introduction to Modern Astrophysics. Reading, MA: Addison-Wesley Pub., 1995.
5. Kippenhahn, Rudolf, and Alfred Weigert. Stellar Structure and Evolution. New York, NY: Springer-Verlag, 1990.
6. Teerikorpi, P, The Evolving Universe and the Origin of Life, Springer publishing, ISBN 978-3-030-17921-2.
7. Souza, Valeria, Segura, Antígona, Foster, Jamie, Astrobiology and Cuatro Ciénegas Basin as an Analog of Early Earth, Springer, 2017
8. Donald Goldsmith, Hidden Worlds and the Quest for Extraterrestrial Life, Harvard University press,2013,
9. M. Longair, High Energy Astrophysics, vol. 1 and 2, Cambridge University Press,2012
10. F. Melia, High Energy Astrophysics, Princeton University Press, 2013
11. Ya B. Zeldovich and I.D. Novikov, Relativistic Astrophysics, vol. I, Stars and Relativity,2014

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SP0302	NANOSCIENCE AND NANOTECHONOLOGY	HC	4	0	0	4	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 nanoparticles.
4. Evaluate processing conditions to functional nanomaterialsfor 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; Physics at nanoscale: surface to volume ratio and its effect, Quantum confinement of electrons in semiconductor nanostructures: Quantum confinement in 3D, 2D, 1D and zero dimensional structures; size effect and properties of nanostructures:structural, thermal, mechanical, chemical, electrical, optical and magnetic properties;LandauerButtiker 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, quantum dots preparation: through colloidal methods, epitaxial methods, MOCVD and MBE growth of quantum dots;current-voltage characteristics: magneto tunnelling measurements; spectroscopy ofquantum Dots: absorption and emission spectra, photo luminescence spectrum; optical spectroscopy: linear and nonlinear optical spectroscopyin quantum dots.

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, 2-D materials, nanotubes and nanowires for nanodevice fabrication; Single electron transistors, coulomb blockade effects in ultra small metallic tunnel junctions - nanoparticles based solar cells and quantum dots based white LEDs; CNT based transistors; principle of dip pen lithography, Application in drug delivery and MEMS

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.
M21SP0303	NUCLEAR AND PARTICLE PHYSICS	HC	4	0	0	4	4

Course Objectives:

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

Course Outcomes:

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

1. Explain various types of nuclear of reactions
2. Construct nuclear and semi-conductor detectors
3. Apply various models to study nuclear decay
4. 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

General properties and concept of nuclei: 12 hrs

Nuclear Mass & Binding energy, Nuclear forces - Characteristics of nuclear forces, short range, saturation, chare independence andexchange characteristics,

Interaction of radiation with matter:

General description of interaction process, energy loss of heavy charged particles in matter, Bethe-Blochformula, energy loss of fast electrons, Bremstrahlung, Interaction of directly ionizing radiation

(gamma) - 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 ofreaction, threshold energy, Direct and compound nuclear mechanisms, Bohr's independence hypothesis and experimental verification.

Unit-2 **12 hrs**

Nuclear fission: energy released in fission, neutron cycle in a thermal reactor and four factorformula.

Nuclear detectors: scintillation detectors- Nal(Tl), plastic scintillation- scintillationspectrometer.

Semiconductor detectors: Surface barrier detectors, Li ion drift detectors, relation betweenapplied voltage and the depletion region in junction detectors, counter telescopes, particle identification, and position sensitive detector.

Accelerators: Van de Graff,Linear Accelerator,Cyclotron,Microtron, Synchrotron,

Unit-3 **12 hrs**

Nuclear models

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 squarewell potential, spin orbit interaction, prediction of ground state spin parity and magnetic moment of odd nuclei, Schmidt limit.

Nuclear decay

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, hadronsand leptons, detection of neutrinos**.**

Symmetries and conservation laws: conservation of energy, momentum, angularmomentum, 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).

References

1. Introduction to Nuclear Physics H.Enge: Addison Wesley, 1971.
2. Atomic and Nuclear Physics, S. N. Goshal vol II 2000.
3. Introductory Nuclear Physics Kenneth S. Krane: John Wiely and Sons, 1987.
4. The Atomic Nuclease Evans R.D. : Tata Mc. Graw hill, 1955.
5. Nuclear Physics, R R Roy and Nigam: Wiley-eastern Ltd 1983.
6. Nuclear physics an introduction, S.B. Patel: New age international (P) limited 2000.
7. Radiation Detection and Measurements, G.F. Knoll: 3rd edition, John Wiely and sons, 2000.
8. Nuclear Radiation Detectors, S.S. Kapoor and V.S Ramamurthy: Wiley and sons. Introduction to High Energy Physics D.H. Perkins: Addison Wesley, London, 2000.
9. Introduction to Elementary Particles, D.Griffiths: John Wiley1984.
10. Nuclear Interactions, S.de Benedetti: John Wiley, New York, 1964.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SP0311	ELECTRONICS - II (DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS)	SC	4	0	0	4	4

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:

Outcomes:

At the end of the course the students 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

Unit 1: **12 hrs**

AM Transmitters and Receivers: Introduction to communication, need for modulation, Generation of AM, modulation index, bandwidth of AM, Power calculations of AM wave, low level and high level modulation, comparison of levels, AM transmitter block diagram, DSBSC modulators, Balanced modulator and Ring 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: **12 hrs**

FM Transmitters and Receivers FM Transmitters: Basic requirements and generation of FM, modulation index, FM Modulation methods narrow and wideband FM.: Direct methods, Variable capacitor Modulator, Varactor Diode Modulator, FETor 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.

Digital communication systems

Unit 3: **12 hrs**

Analog to Digital Conversion: Noisy communications channels, The sampling Theorem, low pass signals and band pass signals, Pulse Amplitude modulation (PAM), 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: Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Binary Phase Shift Keying (BPSK) and Quadrature Phase Shift Keying (QPSK).

Unit 4: **12 hrs**

Information Coding and Decoding: Block diagram of information system, measure of information, entropy, Source coding: instantaneous code, Shannon's encoding algorithm Shannon-Fano encoding, Huffman minimum redundancy code, code efficiency, Error control coding, Block coding-decoding,Hamming code, Binary cyclic codes, properties of cyclic codes, generator and parity polynomial, encoder and syndrome calculation circuit.

References:

1. Principles of Communication Systems – H Taub& D. Schilling, GautamSahe. TMH, 3rd Edition. 2007.
2. Communication Systems - Simon Haykin. John Wiley, 2r" Edition, 2008.
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.2006.
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.1988.
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. "Modern Digital and Analog Communication Systems,"- B.P. Lathi, Zhi Ding, Oxford University Press.2011.
15. "Digital Communications: Fundamentals and Applications,"- B. Sklar and Ray, Pearson Education.2009.
16. Digital Communications - John G. Proakis .Masoudsalehi – 5th Edition, McGraw-Hill, 2008.
17. Digital Communication - Simon Haykin, Jon Wiley, 2005.
18. Digital Communications - Ian A. Glover, Peter M. Grant, Edition, Pearson Edu., 2008.
19. Communication Systems-B.P. Lathi, BS Publication, 2006.
20. Principles of communication systems - Herbert Taub. Donald L Schiling, Goutam Sana, 3rd Edition,Mc.Graw-Hill, 2008.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SP0312	CONDENSED MATTER PHYSICS –II	SC	4	0	0	4	4

Course Objectives:

1. 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:

4. Differentiate types of magnetic materials.
5. Analyze ESR and EPR spectral data.
6. Understand classical and quantum theory of dielectrics.
7. Classify ferroelectric crystals.

Course Content:

Unit -1: **12 hrs**

Disordered systems: Point defects-shallow impurity states in semiconductors-Localizedlattice vibrational states in solids-Vacancies, interstitials in ionic crystals- Introduction- Short range order- Long range order- Orderedlattice- Disordered lattice- Compositional. 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, hopping and its types- amorphous semiconductors- Applications.

Unit-2 **12 hrs**

Films and Surfaces: Methods of thin films preparation: Thermal evaporation- sputtering- DC,AC, diode, 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.

Mechanical properties- stress and strain analysis. Electrical properties of thin films- Measurement of resistivity by four probe method, thin film resistors, Magnetic properties- film size effect on Memory Storage- films for memory devices and applications.

Unit - 3: **12 hrs**

Dielectrics and Ferroelectrics

Dielectrics: Review dielectric constant and polarizability- 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. Soft Optical Phonons, LST Relationship, dielectric breakdown- general applications of dielectric materials. Ferroelectrics, antiferrolectric Materials, Piezoelectric, pyroelectric and ferroelectric materials,- transducer and applications.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: Neutron diffraction in magnetic structure analysis. Distinguish between hard and soft magnetic materials- 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 in typical areas.

References:

1. The Physical Principles of Magnetism : A. H. Morrish, John Wiley & sons, New York (1965)
2. Physics of Ferromagnetism :SoshinChikazumi, SushinChikazumi and C. D. Graham, Clarendon Press (1997)
3. Magnetism and Magnetic Materials : J.M.D Coey, Cambridge University Press, UK (2010)
4. Introduction To Magnetic Resonance Spectroscopy ESR, NMR, NQR : D. N. Sathyanarayana, I.K. International Publishing House Pvt. Limited (2009)

5. Solid State Physics : A. J. Dekker, Macmillan India Ltd., Bangalore (1981)
6. Introduction to Solid State Physics : 5th Edn C. Kittel, Wiley Eastern Ltd., Bangalore (1976)
7. Elementary Solid State Physics : M. A. Omar, Addison-Wesley Pvt. Ltd., New Delhi (2000)
8. Introduction to Magnetic Resonance: A. Carrington and A. D. Mclachlan, Harper & Row, New York, (1967).
9. Elements of Solid State Physics (2nd Ed): J.P. Srivastava, PHI Learning Pvt. Ltd., New Delhi (2009).
10. Solid State Chemistry and its Applications : A. R. West, University of Aberdeen, Wiley India Pvt Ltd. (2003).

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SP0313	**PHOTONICS II**	SC	4	0	0	4	4

Course objectives:

1. To provide knowledge about lasers and laser amplifiers used in Industry and research
2. To explain the basic laser radiation properties and switching mechanism
3. To demonstrate different technics of light modulation
4. To analyse and apply the knowledge of optoelectronic devices in research

Course outcomes:

1. To get knowledge of principle, mechanism and applications of LASERS
2. To understand and demonstrate LASER -matter interaction and effects
3. To illustrate non-linear optical properties and to gain knowledge of electro, acousto and magneto-optic effects
4. To apply optics and physics of materials knowledge in demonstrating optoelectronic devices

Unit 1 **12 hrs**

LASER systems and Applications

General description, Laser structure, Single mode laser theory, Excitation mechanism andworking of: CO_2, Nitrogen, Argon ion, Excimer, X-ray, Free-electron, Dye, Nd:YAG,Alexanderite and Ti:sapphire lasers, Diode pumped solid state laser, Optical parametricoscillator (OPO) lasers. Optical amplifiers- Semiconductor optical amplifiers, Erbium dopedwaveguide optical amplifiers, Raman amplifiers, Fiber Lasers. Laser applications-Lasers inIsotope separation, Laser interferometry and speckle metrology, Velocity measurements, Laser induced fusion in reactor, Laser cooling and trapping.

Unit 2 **12 hrs**

Properties of LASER radiation

Introduction, Laser linewidth, Line broadening Mechanisms-Natural broadening, collision broadening, and Doppler broadening. Laser frequency stabilization, Beam divergence, Beamcoherence, Brightness, Focusing properties of laser radiation, Laser cavity modes: Fabry Perot cavity modes, longitudinal and

transverse modes. Q-switching, Methods of Q-switching:Rotating-mirror method, Electro-optic Q-switching, Acoustic-optic Q-switchingand Passive Q-switching, Mode locking, Methods of mode locking: Active and passive modelocking techniques, Frequency doubling and Phase conjugation

Unit-3 **12 hrs**

Nonlinear Optics and Modulation of light

Nonlinear Optical Interactions - Polarization response of materials to light - Harmonic generation- Phase matching – bistability - self focusing - Third-Order Nonlinear Susceptibility- Self-Phase Modulation-Optical Solitons - Four-Wave Mixing - Kerr effect - Multiphoton processes- Stimulated Brillouin and Raman scattering.Introduction, Birefringence, Electro-optic effect, Pockels and Kerr effects, Electro-opticphase modulation, Electro-optic amplitude modulation, Electro-optic modulators: scanning andswitching, Acousto-optic effect, Acousto-optic modulation, Raman-Nath and Braggmodulators: deflectors and spectrum analyser, Magneto-optic effect, Faraday rotator as anoptical isolator. Advantages of optical modulation.

Unit- 4 **12 hrs**

Optoelectronic devices

Introduction, P-N junction diode, Carrier recombination and diffusion in P-N junction,Injection efficiency, Internal quantum efficiency, Hetero-junction, Double hetero-junction,Quantum well, Quantum dot and Super lattices; LED materials, Device configuration andefficiency, Light extraction from LEDs, LED structures-single heterostructures, doubleheterostructures, Device performances and applications, Quantum well lasers; Photodiodeand Avalanche photodiodes (APDs), Laser diodes-Amplification, Feedback and oscillation,Power and efficiency, Spectral and spatial characteristics. CCD, Solar cells.

Reference and Text books :

1. Lasers, principles and applications, J. Wilson and J.F.B. Hawkes, prentice, Hall of India, New Delhi, 1996
2. Laser fundamentals, W.T. Silfvast, Foundation books, New Delhi, 1999.
3. Semiconductor optoelectronics devices, P. Battacharya, Prentice – Hall of India, New Delhi, 1995.
4. Nonlinear Optics , Robert Boyd, Academic press, 2003.Optical Electronics,A. K. Ghatak and K. Thyagarajan, Cambridge UniversityPress, (1991).
5. Optoelectronics: An introduction, J. Wilson and J.F.B. Hawkes prentice, Hall of India, New Delhi, 1996
6. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics. John Wiley & Sons, 1991.
7. Integrated Photonics: Fundamentals, G. Lifante. John Wiley & Sons,2003.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SP0321	ELECTRONICS - III (LINEAR INTEGRATED CIRCUITS)	SC	4	0	0	4	4

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

Course Content:

Unit - 1 **12 hrs**

OPERATIONAL AMPLIFIER

General feedback structure, Properties of negative feedback, The Four Basic Feedback configurations, Voltage series (noninverting) feedback amplifier, Voltage shunt (inverting) feedback amplifier,one op-amp differential amplifier, Summing, scaling and averaging amplifier (inverting, noninverting, differential configuration), logarithmic and antilogarithmic amplifiers, integrator and differentiator, V to I converter, instrumentation amplifier. Numerical.

Unit – 2 **12 hrs**

THE PRACTICAL OP-AMP (741):

Input offset voltageand offset voltage compensation network design (for open loop, closed loop and differential amplifiers), input bias current, input offset current. total output offset voltage. Supply voltage rejection ration (SVRR), common mode rejection ratio (CMRR), Thermal drift, Noise.

Unit - 3 **12 hrs**

FREQUENCY RESPONSE OF AN OP-AMP:

Frequency response,compensating networks; dominant pole and pole zero compensation. Frequency response of internally compensated OP-AMP & non-compensated OP-AMP, open loop voltage gain as a

function of frequency, closed loop frequency response, circuit stability, slew rate; causes of slew rates and its effects in application.

Unit – 4 **12 hrs**

COMPARATORS & CONVERTERS:

Basic comparator(inverting and noninverting); characteristics and limitations,zero crossing detector,Schmittrigger,clippers& clampers(positive and negative), small signal half wave & full wave rectifiers, sample and hold circuit.555 Timer and its applications: Monostable and a stable Multivibrators.

Reference Books:

1. OP-AMP and linear integrated circuits by Ramakant A. Gayakwad,4thedition, Pearson Education, 2015.
2. Design with operation amplifiers and Analog Integrated circuits by Sergei Franco, 4th edition, McGraw-Hill,2014.
3. Integrated Electronics: Analog and Digital circuits & system by Millman&Halkias, 2nd edition, McGraw-Hill, 2012.
4. Linear Integrated Circuits by D.Roy Chaudhary, 5thedition, New age,2020.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SP0322	CONDENSED MATTER PHYSICS - III	SC	4	0	0	4	4

Course Objectives:

1. 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,defects and inabilities of composite materials.
4. Analyse and examine the data obtained from Mechanical testing instruments ,metallurgical and electron microscopes and NDT.

Unit- 1 **12 hrs**

Elements of Polymer Science: Monomers- Polymers- Average molecular weight-weight average molecular weight and number average molecular weight.Classification of polymers (based on

composition, thermalbehavior, structure, isomerism).Microstructure of polymers- chemical, geometric, random alternating, block and graft polymers, stereo regular polymers, Synthesisof polymers- chain polymerization, step Polymerization, industrial polymerization methods(Bulk, Solution, Suspension, Emulsion methods). Polymer crystallinity,degree of crystallinity,Phase transition- polymer melting and glass transition; Forming methods of Plastic Materials- compression, injection, blow, extrusion, spinning molding.

Unit -2 **12 hrs**

Ceramics and Glasses: Ceramics and their structure- Silicate structure, Preparation and Processing of cemamics,Forming and thermal treatments, Classification of ceramics- traditional and engineering. Dielectric, ferroelectric and piezoelectric and Ceramic magnets, Properties of ceramics with specific examples, Mechanical properties- strength, toughness. Fatigue failure, abrasion. Basic refractory materialsand their classification,**Glasses:** Preparation,(Float glass process,Pressed glassand blow moulding) and structure of glasses .Types of glasses- borates silicate, oxide, metallicand semiconducting glasses; tempered glass and chemically strengthened glass.

Unit - 3 **12 hrs**

Composite Materials: General Introduction, matrix Materials- polymer, metals, ceramics,Reinforcing materials- fibers, particles. 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, Concrete-concrete making materials, structure, composition, Portland cement concrete,Reinforced Concrete,prestressed concreteproperties and applications

Unit-4 **12 hrs**

Testing of Materials: Mechanical Testing –Tensile strength By Universal Testing Machine. Hardness-Brinnel,Vicker and Rockwell machines, impact testing by Charpy methods,Fatigueand Creep 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.

References:

1. Textbook of Polymer Science. Fred. W. Billmeyer John Wiley 8. Sons, Inc. (1984).
2. Polymer Science, V.R. Gowariker, N. V. Vistrwanathan, JayadevShreedhar, 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 (3 Ed), North, (1983).

Course Code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
M21SP0323	**PHOTONICS-III**	SC	4	0	0	4	4

Course objectives:

1. To provide knowledge about optical fibres and applications
2. To explain the basiccomponents integrated optics, ex: optoelectronic devices
3. To demonstrate different tools and fundamental concepts in signal processing
4. To understand the modelling of photonics crystals

Course outcomes:

1. Gain knowledge of components used in fibre optic communication and applications
2. Understand and demonstrate usage of different tools integrated optoelectronic devices
3. Demonstrate signal processing
4. Explain the modelling and properties of photonic crystals

UNIT – 1 **12 hrs**

Fibre Optic Components and Sensors: Connector principles, Fibre end preparation, Splices, Connectors, Source coupling, distribution networks, Directional couplers, Star couplers, Switches, Fiber optical isolator,Wavelength division multiplexing, Time division multiplexing, Fiber Bragg gratings.Advantage of fiber optic sensors, Intensity modulated sensors,Mach-Zehnder interferometer sensors, Current sensors, Chemical sensors –Fiber opticrotation sensors. Optical biosensors: Fluorescence and energy transfer sensing, molecularbeacons and optical geometries of bio-sensing, Bio-imaging, Bio sensing.

UNIT –2 **12 hrs**

Integrated Optics Introduction – Planar wave guide – Channel wave guide – Y-junction beam splitters andcouplers - FTIR beam splitters – Prism and grating couplers – Lens wave guide – Fabricationof integrated optical devices - Integrated photodiodes – Edge and surface emitting laser -Distributed Bragg reflection and Distributed feedback lasers - Wave guide array laser.

UNIT – 3 **12 hrs**

Optical Signal Processing

Introduction, Effect of lens on a wavefront, Fourier transform properties of a single lens,Optical transfer function, Vanderlugt filter, Image spatial filtering, Phase-contrastmicroscopy, Pattern recognition, blurring of, Image Photonic switches, Optical transistor,Optical Gates- Bistable systems, Principle of optical Bistability, Bistable optical devices, Self-electro-optic effect device.

UNIT – 4 **12 hrs**

Photonic Crystals:

Basics concepts, Theoretical modeling of photonic crystals, Features of photonic crystals, methods of fabrication, Photonic crystal optical circuitry, Nonlinear photonic crystals, photonic crystal fibers, Photonic crystals and optical communications, Photonic crystalsensors.

Text and Reference Books

1. Fibre Optic Communication, Joseph C. Palais, Pearson Education Asia, India, 2001
2. Introduction To Fibre Optics, A.Ghatak And K.Thyagarajan, Cambridge UniversityPress,New Delhi, 1999
3. Optical Guided Wave Signal Devices, R.Syms And J.Cozens. Mcgraw Hill, 1993.
4. Optical Electronics, A Ghatak and K. Thyagarajan, Cambridge University Press, NewDelhi, 1991
5. Fundamentals of Photonics, B.E.A. Saleh and M.C. Teich, John Willy and Sons,1991
6. Introduction to Fourier Optics, Joseph W. Goodman, McGraw-Hill, 1996.
7. Nanophotonics, P.N.Prasad, Wiley Interscience, 2003.
8. 8.Biophotonics, P.N.Prasad, Wiley Publications, 2004.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SPO301	Astrobiology and Extraterrestrial Life	OE	4	0	0	4	4

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.

Unit -1 **6 hrs**

Basic Concepts of Astrophysics:

Basic concepts - Astronomical Units, Light year, parallax, Astronomical Coordinates, Kepler's Laws, Optical telescopes and their characteristics, Modern Optical telescopes, Astronomical Instruments – Photometer, Photographic plates, Spectrographs, Charge Coupled Detector.

Unit-2 **6 hrs**

Astrobiology

History of Astrobiology, Life on earth, structure of Life – building blocks, cells, Life on earth – Conditions on early earth, evidence of life, the tree of life, life in extreme environments, the rise of multicellularity, the great oxidation event.

Unit-3 **6 hrs**

Star & Solar system

Formation of star, Classification of star – HR diagram, White dwarfs, Neutron stars, Pulsars, Supernovae, Stellar Black holes, Solar system - formation of solar system, sun – characteristics & its different zones, Interior & Exterior planets – properties, satellites, Kuiper belt, Oort clouds.

Unit-4 **6 hrs**

Habitable planets & Extraterrestrial Intelligence

Habitable planets – Characteristics & Conditions, Life on Mars – locations, Europa, Enceladus & Other Icy Bodies, Methods of detection of exoplanets, Bio-signature of life on exoplanet atmosphere, How to

look Bio-signatures, Missions to search for Bio-signatures, Contacting Extraterrestrial civilization, the search of Extraterrestrial intelligence.

Books for reference:

1. BW Carroll & DA Ostlie, An Introduction to Modern Astrophysics, Latest Edition,Addison-Wesley (2005).
2. Martin Harwit, Astrophysical Concepts, Latest Edition, Springer,(2014)
3. C.R. Kitchin, Astrophysical Techniques, CRC press,(2015).
4. Carroll, Bradley W., and Dale A. Ostlie. An Introduction to Modern Astrophysics. Reading, MA: Addison-Wesley Pub., 1995.
5. Kippenhahn, Rudolf, and Alfred Weigert. Stellar Structure and Evolution. New York, NY: Springer-Verlag, 1990.
6. Teerikorpi, P, The Evolving Universe and the Origin of Life, Springer publishing,2001.
7. Souza, Valeria, Segura, Antígona, Foster, Jamie, Astrobiology and Cuatro Ciénegas Basin as an Analog of Early Earth, Springer, 1990.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21PTM301	SOFT SKILL TRAINING	MC	0	0	0	0	2

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

1. Understand Resume writing and preparation for interview

Course Outcome:

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

1. Write the resume, E-mails
2. Face the interview

Content

1. Group Discussion - Do's and Don'ts , Prerequisites
2. Resume Writing - Types, Content and Tips to make an effective resume
3. Self Introduction - Video Screening, telephonic and Direct
4. Grooming
5. Presentation skills
6. Email Writing
7. Interview Facing Skills - Different kinds, rounds in Interview and tips to clear interviews, Mock Interviews
8. Soft skills Assessments

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SP0304	GENERAL PHYSICS LAB –III (PRACTICAL)	HC	0	0	2	2	4

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 one experimentation.

Course Content:

LIST OF EXPERIMENTS:

1. Hall effect experiment: Determination of Hall co-efficient and charge carrier density.
2. Determination of laser beam parameters
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.
M21SP0331	ELECTRONICS LAB (PRACITICAL)	SC	0	0	2	2	4

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. Design Schmitt trigger and test the circuit for the given values of UTP and LTP using OP-AMP MA741.
2. OP-AMP as square wave generator.
3. Schmitt trigger.
4. Voltage regulator
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. Amplitude modulation and demodulation.
9. DSB SC modulation and demodulation.
10. SSB SC modulation and demodulation.
11. Frequency modulation and demodulation.
12. Pre Emphasis-De Emphasis circuits.
13. Verification of sampling theorem.
14. PAM generation and reconstruction.
15. PWM AND PPM: generation and reconstruction
16. Delta and Adaptive delta modulation.
17. TDM of two band limited signals.

18. ASK generation and detection.
19. FSK generation and detection.
20. PSK generation and detection.
21. Line coding and decoding.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SP0332	CONDENSED MATTER PHYSICS LAB (PRACTCAL)	SC	0	0	2	2	4

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 ($MnSO_4$,
2. $MnCl_2$) by Quincke's method.
3. 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.
M21SP0333	PHOTONICS LAB (PRACTICAL)	SC	0	0	2	2	4

Course objectives

1. To provide knowledge about lasers and laser amplifiers used in Industry and research
2. To explain the basic laser radiation properties and switching mechanism
3. To demonstrate different techniques of light modulation
4. To analyze and apply the knowledge of optoelectronic devices in research

Course outcomes:

1. To get knowledge of principle, mechanism and applications of LASERS
2. To understand and demonstrate LASER -matter interaction and effects
3. To illustrate non-linear optical properties and to gain knowledge of electro, acousto and magneto-optic effects
4. To apply optics and physics of materials knowledge in demonstrating optoelectronic devices

Course Content:

1. Verification of Gaussian nature of the given laser beam
2. Evaluation of divergence angle of the laser beam
3. Determined the beam divergence and spot size of a given laser
4. Determination of wavelength of a He-Ne laser beam using Mach-Zender Interferometer
5. Measurement of refractive index of the air using Mach-Zender Interferometer
6. Measurement of refractive index of the transparent materials using Mach-Zender Interferometer
7. Characteristics study of semiconductor diode Laser

   (i) Study the characteristics of the diode current versus optical output powers
   (ii) Study the characteristics of the temperature dependence of the threshold current for laser emission
8. Construct the Diffraction Grating by using Holography technique
9. Measurement of propagation loss using optical power meter.
10. Study the Electro-Optic effect in $LiNbO_3$ Crystal and calculate the half-wave voltage

FOURTH SEMESTER

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SP0401	RESEARCH METHODOLOGY	HC	2	0	0	2	2

Course Objectives:

1. To gain familiarity with a research phenomenon or to achieve new insights into it
2. To portray accurately the research methods
3. To determine the research problem for literature reviews

Course Outcomes:

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

1. Understand the various methods of research
2. Find the research problem from literature reviews
3. Analysis the data by mathematical models
4. Interpret the collection of data

Unit-1 **6 hrs**

Research and Types of research: Meaning of Research,Objectives of Research, Motivation in Research, Types of research, research approach, significance of research, Research methods vs Methodology, Applied vs. Fundamental research, Quantitative vs. Qualitative research, Conceptual vs Empirical, Research Process, Criteria of good Research

Unit-2 **6hrs**

Formulation of research problem: Defining and formulating the research problem -Selecting the problem -Necessity of defining the problem -Importance of literature review in defining a problem, Critical literature review, Identifying gap areas from literature review, Development of working hypothesis.

Unit-3 **6hrs**

Data Collection and analysis: Execution of the research, Observation and Collection of data, Methods of data collection, Modeling, Mathematical Models for research, Data processing and Analysis strategies, Hypothesis-testing, Generalization-and-Interpretation

Unit-4 **6hrs**

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing for funded projects, Different Steps in Writing Report funded projects, Layout of the Research Report for publications, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Report.

References:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology,Ess Publications. 2 volumes.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SPO402	MAJOR PROJECT	HC	0	0	8	8	16

Course Objective:

1. 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 andformulate 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.
M21SPON01	**MOOC/SWAYAM/ INTERNSHIP**	SC	4	0	0	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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