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# UNIVERSITY OF MYSORE

Estd. 1916

VishwavidyanilayaKaryasoudha
Crawford Hall, Mysuru- 570 005

No.AC2(S)/151/2020-21

Dated: 26-10-2021

## Notification

**Sub:-** Syllabus and Examination Pattern of Physics (UG) with effective from the Academic year 2021-22 as per NEP-2020.

**Ref:-**
1. Decision of Board of Studies in Physics (UG) meeting held on 27-09-2021.
2. Decision of the Faculty of Science & Technology Meeting held on 16-10-2021.
3. Decision of the Academic Council meeting held on 22-10-2021.

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The Board of studies in Physics (UG) which met on 27-09-2021 has recommended & approved the syllabus and pattern of Examination of Physics Programme with effective from the Academic year 2021-22 as per NEP -2020.

The Faculty of Science & Technology and Academic Council at their meetings held on 16-10-2021 and 22-10-2021 respectively have also approved the above said proposal and it is hereby notified.

The syllabus and Examination pattern is annexed herewith and the contents may be downloaded from the University Website i.e., www.uni-mysore.ac.in.

**Registrar**

Registrar
University of Mysore
Mysore

**To:-**

1. All the Principal of affiliated Colleges of University of Mysore, Mysore. Those who are running B.Sc Courses.
2. The Registrar (Evaluation), University of Mysore, Mysuru.
3. The Chairman, BOS/DOS, in Physics, Manasagangothri, Mysore.
4. The Dean, Faculty of Science & Technology, DoS in Psychology, MGM.
5. The Director, Distance Education Programme, Moulya Bhavan, Manasagangotri, Mysuru.
6. The Director, PMEB, Manasagangothri, Mysore.
7. Director, College Development Council , Manasagangothri, Mysore.
8. The Deputy Registrar/Assistant Registrar/Superintendent, Administrative Branch and Examination Branch, University of Mysore, Mysuru.
9. The PA to Vice-Chancellor/ Registrar/ Registrar (Evaluation), University of

# B.Sc., Physics (Honors)

# B.Sc., / M.Sc., (Physics) Syllabus

**Multi-Disciplinary Programme as per NEP-2020**

# Contents

# Introduction:

The New Education Policy (2020) is a paradigm shift from the conventional system we practice even today. Giving students the entire freedom to choose what to learn, how to learn, where to learn and when to learn, will enable a personalized education that suits his/her own personality. The drive to change the pedagogy in the curriculum and syllabi will cater to the cognitive, affective and psycho-motor domain of learning, which will fruitfully engage to student and guide him to ascend the Blooms levels of learning hierarchy, elevating them from just remembering to become creative through acquiring skills of application, evaluation and analysis. Such an approach will enable the institution and the individual to design and execute education that is suitable and doable. The wonderful Academic Credit accumulation and the multiple exit/entry options enable multi-displinarity obtainable from multiple institutions, and even from recognized digital platforms. This will create unprecedented opportunities to the students to self-evaluate and change course at every stage of education as they learn. Introducing the possibility of cutting across disciplines to pursue one's interest and talent can boost curricular and extra-curricular activities by an equal measure. This will definitely enable the blooming of creativity among individuals who will not only be excellent and productive employees, but also assume the mantle of becoming entrepreneurs and job providers. The opportunity for the teacher to adopt novel pedagogies will make classrooms vibrant, meaningful and effective. The student choices will also lead to a healthy cross-disciplinary interaction between institutions and consequently enhancing their capabilities and credibility.

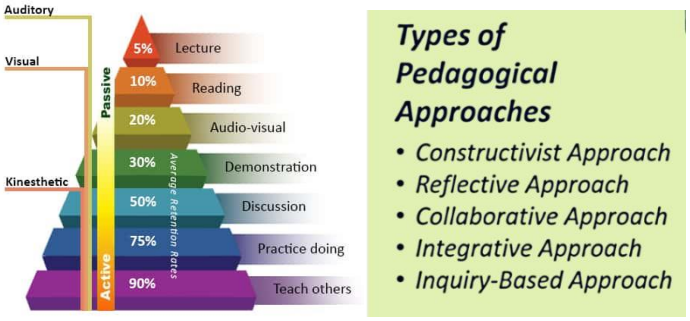
**The NEP-2020 is based on Outcome Based Education**, where the Graduate Attributes and employment opportunities are first kept in mind to reverse-design the Programs, Courses and Supplementary activities to attain the graduate attributes and learning outcomes.

- Attribute 1: Deep discipline knowledge and intellectual breadth. ...
- Attribute 2: Creative and critical thinking, and problem solving. ...
- Attribute 3: Teamwork and communication skills. ...
- Attribute 4: Professionalism and leadership readiness. ...
- Attribute 5: Intercultural and ethical competency.

The learning outcomes-based curriculum framework for a degree in B.Sc. (Honours) Physics is intended to provide a comprehensive foundation to the subject and to help students develop the ability to successfully continue with further studies and research in the subject while they are equipped with required skills at various stages. The framework is designed to equip students with valuable cognitive abilities and skills so that they are successful in meeting diverse needs of professional careers in a developing and knowledge-based society. The curriculum framework takes into account the need to maintain globally competitive standards of achievement in terms of the knowledge and skills in Physics,

as well develop scientific orientation, spirit of enquiry problem solving skills and human and professional will values which foster rational and critical thinking in the students.

It is imperative that in the spirit of the NEP, several academic matters have to change. The most important among these will be the pedagogy that will be adopted in the Teaching-Learning experience to enrol, engage and involve and inspire the students. The learning that happens by employing different types of pedagogies is shown below, and thus need to be adopted in the teaching-learning process for effective cognition by the students using the Auditory, Visual and Kinaesthetic approaches:




Along with conventional teaching methods, Activity based pedagogies are seen to be extremely effective in achieving the Program Educational Objectives. The Committee has attempted to consider both the spirit of the NEP and the existing system and framed the syllabus within the Curriculum options offered by the Higher Education Council. The broad topic level syllabus for all the 5 years (10 semesters) for an integrated B.Sc + M.Sc program has been provided. However, a detailed syllabus has to been provided for the First Two Semester. Attempts have been made to sincerely bring in Activity based pedagogy. The activities have been listed and a few examples have been provided to guide the teacher of how to create their own activities that engage and illuminate students by group and self-involvement methods and a possible evaluation method.

The Committee felt that a more comprehensive curriculum, syllabus and details have to be evolved with time and also the necessary academic resources and infrastructure have to be provided to implement the NEP-2020 effectively to attain the aspirations of the policy. The Committee also makes the following recommendations specifically for the Physics syllabus, which can be appropriately considered:

## Recommendations:

- Since studying Physics well (choosing Physics as core Discipline A) will inevitably involve having sufficient knowledge of Mathematics and Chemistry, the student should be able to choose these subjects either as Discipline B or as an Open Elective.

- Since the list of Open Electives that will be offered by the Physics departments being applied in nature and will be useful for Physics graduates also, they should also be accessible for the students to choose (if their content is not covered in the syllabus of Physics as Discipline A).

- Some Open Electives should be multi-disciplinary and should be designed by 2 to 3 separate faculty (eg. Nanoscience and Nanotechnology)

- The SECs should be treated as 'Non-credit compulsory Courses', due the nature of the courses and to reduce the Credit load on students.

- Research should start in the VII semester itself, since it is difficult to do a meaningful project in only the 8th semester. This is especially important since NEP provides an opportunity for students to directly go for a Ph D program after the 4 year Honours program.

- Since the NEP suggests a 70:30 ratio for summative and formative assessments, the syllabus for the core discipline must be proportionately reduced and the 30% internal (formative) assessment can be made for the following:
    - One 10% mid-semester test
    - Two 10% each Activity based tasks

- The Question Paper patterns should be left to the prerogative of the respective University to design as per their convenience.

- An extensive training for Physics undergraduate teachers that integrates Outcome Based Education and the New Education Policy has to be provided for effective implementation in the coming years.

## Programme Educational Objectives:

1. Graduates will demonstrate competence in respective domain as they apply skills to conduct scientific research and contribute to quality education.
2. Graduates will be recognized as experts in educational and research institutes as well as industries in identifying and solving global challenges.
3. Graduates will become leading researchers and professors who create and disseminate new knowledge in scientific and allied fields.

## Graduate Attributes and Programme Outcomes:

| Exit with: | Credits Required |
|---|---|
| **Certificate** upon the Successful Completion of the First Year (Two Semesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme | 44 - 48 |

1. **Discipline Knowledge:** Knowledge of science and ability to apply to relevant areas.
2. **Problem solving:** Execute a solution process using first principles of science to solve problems related to respective discipline.
3. **Modern tool usage:** Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.
4. **Ethics:** Apply the professional ethics and norms in respective discipline.
5. **Individual and teamwork:** Work effectively as an individual as a team member in a multidisciplinary team.
6. **Communication:** Communicate effectively with the stake holders, and give and receive clear instructions.

| Exit with: | Credits Required |
|---|---|
| A **Diploma** upon the Successful Completion of the Second Year (Four Semesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme | 88 - 96 |

1. **Discipline Knowledge:** Knowledge of science and ability to apply to relevant areas.
2. **Conduct investigations:** Conduct investigations of technical issues as per their level of understanding and knowledge.
3. **Problem solving:** Formulate and implement a solution process using first principles of science to solve problems related to respective discipline.
4. **Modern tool usage:** Apply a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.
5. **Ethics:** Apply and commit to the professional ethics and norms in respective profession.
6. **Individual and teamwork:** Work effectively as an individual in a multidisciplinary team.
7. **Communication:** Communicate effectively with the stake holders, and give and receive clear instructions.

| Exit with: | Credits Required |
|---|---|
| **Basic Bachelor Degree** at the Successful Completion of the Third Year (Six Semesters) of the multidisciplinary Four- year Undergraduate Programme/Five-year Integrated Master's Degree Programme | 132 - 144 |

1. **Discipline Knowledge:** Knowledge of basics of science and ability to apply the understanding of fundamentals of major discipline in solving complex problems.
2. **Conduct investigations:** Conduct investigations of issues in their respective disciplines and arrive at valid conclusions.
3. **Problem solving:** Implement a solution process using first principles of science to solve problems related to respective discipline.
4. **Modern tool usage:** Select and use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.
5. **Environment and Society:** Evaluate the impact of scientific solutions on society and environment and the need for sustainable solutions.
6. **Ethics:** Demonstrate professional ethics, responsibilities and norms in respective profession.
7. **Individual and teamwork:** Work effectively as an individual as a team member and as a leader in a multidisciplinary team.
8. **Communication:** Communicate effectively with the stake holders, write and comprehend project reports and documentation, deliver effective presentations, and give and receive clear instructions.
9. **Project Management and Finance:** Apply the knowledge of scientific and technological principles to one's own work to manage projects in multidisciplinary settings.
10. **Lifelong Learning:** Engage in lifelong learning in the context of changing trends in respective discipline.

| Exit with: | Credits Required |
|---|---|
| **Bachelor Degree with Honours** in a Discipline at the Successful Completion of the Fourth Years (Eight Semesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme | 176 - 192 |

1. **Discipline Knowledge:** Knowledge of basics of science and research, and ability to apply the understanding of fundamentals of specialized discipline in solving complex scientific problems.
2. **Conduct investigations:** Conduct investigations of issues using research methods and research-based discipline knowledge including design of experiments, data collection, interpretation and analysis to arrive at valid conclusions.
3. **Problem analysis:** Identify, formulate and analyse complex scientific problems using first principles of respective discipline.
4. **Design and Development of solutions:** Design solutions for complex scientific problems and execute them by considering the environmental, societal and public safety aspects appropriately.

5. **Modern tool usage:** Identify, select and use a modern scientific, engineering and IT tool or technique for modelling, prediction, data analysis and solving problems in the areas of their discipline.
6. **Environment and Society:** Evaluate the impact of scientific solutions on society and environment and design sustainable solutions.
7. **Ethics:** Demonstrate professional ethics, responsibilities and norms in respective profession.
8. **Individual and teamwork:** Work effectively as an individual as a team member and as a leader in a multidisciplinary team.
9. **Communication:** Communicate effectively with the stakeholders with emphasis on communicating with scientific community, comprehend scientific reports, write research papers and projects proposals and reports, deliver effective presentations, and give and receive clear instructions.
10. **Project Management and Finance:** Apply the knowledge of scientific and technological principles to one's own work to manage projects in multidisciplinary settings.
11. **Lifelong Learning:** Identify knowledge gaps and engage in lifelong learning in the context of changing trends in respective discipline.

# Options for Study

- The programmes are flexible enough to allow liberty to students in designing them according to their requirements. Students may choose a single Major, one Major with a Minor, and one Major with two Minors. Teacher Education or Vocational courses may be chosen in place of Minor/s. Below listed are the various options students may choose from.

- One Major subject/discipline, Two Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses including Extracurricular Activities.

- One Major and one Minor subject/discipline along with Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses including Extracurricular Activities

- Two Major subject/disciplines along with Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses, including Extracurricular Activities (subject to fulfilling the requirements as stated in 3.i and 3.ii)

- One Major subject/discipline and one Vocational course along with Languages, Generic Electives, Ability Enhancement and Skill Development and courses including Extracurricular Activities.

- One Major Discipline and One Education Discipline along with Languages, Generic Electives, Ability Enhancement and Skill Development Courses including Extracurricular Activities.

# Proposed Curriculum Framework for Multidisciplinary Four- year Undergraduate Programme

| Year | Objective | Nature of Courses | Outcome | No. of courses |
|---|---|---|---|---|
| **1st year – (1st & 2nd Semesters)** | Understanding and Exploration | 1. Major Core Courses<br>2. Minor/Related Discipline<br>3. Languages,<br>4. Ability Enhancement Compulsory Courses<br>5. Skill Enhancement/ Development Courses | Understanding of Disciplines<br>Language Competency<br>Gaining perspective of context/Generic skills<br>Basic skills sets to pursue any vocation | 1+1<br>1+1<br>2+2<br>1+1<br><br>1+1 |
| **Exit option with Certification** | | | | |
| **2nd Year - (3rd & 4th Semesters)** | Focus and Immersion | 1. Major Core Courses<br>2. Minor/ Related Discipline<br>3. Ability Enhancement<br>4. Skill based Vocational<br>5. Extra-Curricular Activities | Understanding of disciplines<br>Gaining perspective of context<br>Skill sets to pursue vocation<br>Development of various Domains of mind &Personality | 2+2<br>1+1<br>1+1<br>1+1<br>1+1 |
| **Exit Option with Diploma** | | | | |
| **3rd Year - (5th & 6th Semesters )** | Real time Learning | 1. Major Discipline Core and Elective Courses<br>2. Minor Discipline/ Generic or Vocational Electives /Field based Learning/ Res. Project | In depth learning of major and minor disciplines, Skill sets for employability.<br>Exposure to discipline beyond the chosen Subject<br>Experiential learning/ Res. | 2+2<br><br>1+1<br>1+1 |
| **Exit option with Bachelor Degree** | | | | |
| **4th Year - (7th &8th Semesters)** | Deeper Concentration | Major Discipline Core and Elective courses<br>Research/Project Work with Dissertation | Deeper and Advanced Learning of Major Discipline Foundation to pursue Doctoral Studies & Developing Research competencies | 4+4 |
| **Bachelor Degree with Honours** | | | | |
| 5th Year - (9th & 10th Semesters) | Master of the subject | Major Discipline Core and Elective courses/Research/Project Work with Dissertation | Deeper and Advanced Learning of the Major Discipline towards gaining proficiency over the subject | 4+4/6+6 |
| Master's Degree | | | | |

## MODEL FOUND APPROPRIATE AND ADOPTED

### IIA. Model Program Structures for the Under-Graduate Programs

| Bachelor of Science (Basic/ Hons.) in subjects with practical, with one major and one minor Sem. | Discipline Core (DSC) (Credits) (L+T+P) | Discipline Elective(DSE) / Open Elective (OE) (Credits) (L+T+P) | Ability Enhancement Compulsory Courses (AECC), Languages (Credits) (L+T+P) | Skill Enhancement Courses (SEC) | | Total Credits |
|---|---|---|---|---|---|---|
| **Skill based (Credits) (L+T+P)** | | | **Value based (Credits) (L+T+P)** | | | |
| I | Discipline A1(4+2) Discipline B1(4+2) | OE-1 (3) | L1-1(3), L2-1(3) (4 hrs each) | SEC-1: Digital Fluency (2) (1+0+2) | Physical Education for fitness(1)(0+0+2) | Health & Wellness (1) (0+0+2) | 25 |
| II | Discipline A2(4+2) Discipline B2(4+2) | OE-2 (3) | L1-2(3), L2-2(3) (4 hrs each) | Environmental Studies (2) | Physical Education - Yoga(1) (0+0+2) | NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2) | 25 |
| **Exit option with Certificate (50 credits)** | | | | | | | |
| III | Discipline A3(4+2) Discipline B3(4+2) | OE-3 (3) | L1-3(3), L2-3(3) (4 hrs each) | SEC-2: Artificial Inte-lligence (2)(1+0+2) | Physical Education- Sports skills(1)(0+0+2) | NCC/NSS/R&R(S&G)/Cultural (1) (0+0+2) | 25 |
| IV | Discipline A4(4+2) Discipline B4(4+2) | OE-4 (3) | L1-4(3), L2-4(3) (4 hrs each) | Constitution of India (2) | Physical Education -Games (1) (0+0+2) | NCC/NSS/R&R(S&G)/Cultural (1) (0+0+2) | 25 |
| **Exit option with Diploma (100 credits) OR Choose any one of the core subjects as Major and the other as Minor** | | | | | | | |
| V | Discipline A5(3+2) Discipline A6(3+2) Discipline B5(3+2) | | Vocational-1 (3) | SEC-3: SEC such as Cyber Security (2) (1+0+2) | | | 20 |
| VI | Discipline A7(3+2) Discipline A8(3+2) Discipline B6(3+2) | | Vocational-2 (3) Internship (2) | SEC-4: Professional Communication (2) | | | 22 |
| **Exit option with Bachelor of Arts, B.A./ Bachelor of Science, B.Sc. Basic Degree (142 credits) or continue studies with the Major** | | | | | | | |
| VII | Discipline A9(3+2) Discipline A10(3+2) Discipline A11(3) | Discipline A, E-1 (3) Discipline A, E-2 (3) Res.Methodology (3) | | | | | 22 |
| VIII | Discipline A12(3+2) Discipline A13(3) Discipline A14(3) | Discipline A, E-3(3) Research Project (6)* | | | | | 20 |
| **Award of Bachelor of Arts Honours, B.A. (Hons.)/ Bachelor of Science Honours, B.Sc. (Hons) degree in a discipline (184 credits)** | | | | | | | |

# Curriculum Structure-Physics

## (Core and Electives)

### Semesters- I to X

| SEM | DSC | Core Papers |
|---|---|---|
| **Sem-1 :** | A1 | Mechanics & Properties of Matter |
| **Sem -2 :** | A2 | Electricity and Magnetism |
| **Sem-3 :** | A3 | Wave motion and optics |
| **Sem-4:** | A4 | Thermal Physics & Electronics |
| **Sem-5 :** | A5<br>A6 | 1. Classical Mechanics and Quantum Mechanics- I<br>2. Elements of Atomic, Molecular Physics |
| **Sem -6 :** | A7<br>A8 | 1. Elements of Nuclear Physics and Nuclear Instruments<br>2. Elements of Condensed Matter Physics |
| **Sem-7** | A9<br>A10<br>A11 | 1. Mathematical Methods of Physics – I<br>2. Classical Electrodynamics.<br>3. Experimental methods of Physics<br>4. Research Methodology<br>(Select Two DSE subjects from the Pool B-I shown below) |
| **Sem-8** | A12<br>A13<br>A14 | 1. Classical Mechanics and Quantum Mechanics-II<br>2. Statistical Mechanics<br>3. Astrophysics & Astronomy<br>4. Research Project*<br>(Select Two DSE subjects from the Pool B-II shown below)<br>*In lieu of the research Project, two additional elective papers/ Internship may be offered. |
| **Sem-9** | A15 | 1. Mathematical Methods of Physics – II<br>(Select One DSE subjects from the Pool B-III shown below)<br>2. Research Project |
| **Sem-10** | A17 | 1. Quantum Mechanics – III<br>(Select One DSE subjects from the Pool B-IV shown below)<br>2. Research Project |

** The Topics of 5th Sem and above need to be revisited*

## Open Electives for 1st to 4th Semesters

| Sl.No. | 1 to 4 Semester |
|---|---|
| 1. | Energy Sources |
| 2. | Climate Science |
| 3. | Astronomy |
| 4. | Medical Physics |
| 5. | Optical Instruments |
| 6. | Sports Science |
| 7. | Nanotechnology |
| 8. | Electrical Instruments |
| 9. | Electronic Instruments |
| 10. | Physics for all |
| 11. | Space Missions |

## Discipline Specific Electives for 7th to 10th Semesters

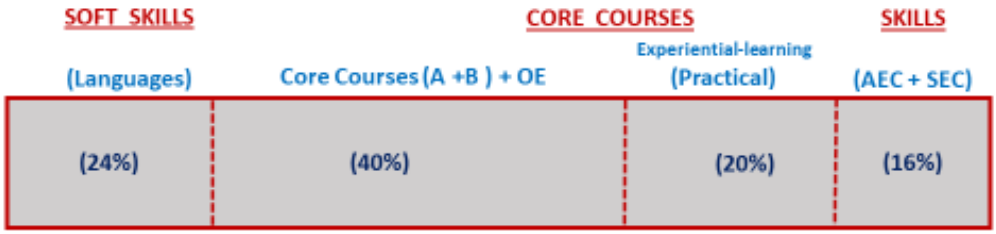
| | 7th Sem Electives<br>Pool B-I (Select any two) | | 8th Sem Electives<br>Pool B-II (Select any two) |
|---|---|---|---|
| A. | Condensed Matter Physics-1 | A. | Atomic & Molecular Physics-1 |
| B. | Nuclear and Particle Physics | B. | Materials Physics & Nano materials |
| C. | Theoretical and Computational Physics-I | C. | Lasers and non-linear optics |
| D. | Biophysics | D. | Plasma Physics |
| E. | Astronomy and Astrophysics | E. | Physics of Semiconductor devices |

| | 9th Sem Electives<br>(Specialization papers)<br>Pool B-III | | 10th Sem Electives<br>(Specialization papers)<br>Pool B-IV |
|---|---|---|---|
| A. | Condensed Matter Physics-2 | A. | Condensed Matter Physics-3 |
| B. | Nuclear and Particle Physics-2 | B. | Nuclear and Particle Physics-3 |
| C. | Atomic & Molecular spectroscopy-1 | C. | Atomic & Molecular spectroscopy-2 |
| D. | Materials Physics & Nanophysics –1 | D. | Materials Physics & Nanophysics -2 |
| E. | Theoretical and Computational Physics-I | E. | Theoretical and Computational Physics-2 |
| F. | Astronomy and Astrophysics-1 | F. | Astronomy and Astrophysics-2 |

## Detailed Syllabus for Semesters I & II
## B.Sc., Physics

## Detailed Syllabus for Semesters I & II

**Semesters I & II**




**Exit with Certificate:**

**POSSIBLE JOBS after EXIT:**

1. Lab Technicians
2. Data Entry Operators
3. Mechanical Repair and Maintenance
4. Electrical Repair and Maintenance
5. Electronics Repair and Maintenance

**Technical Skills (Options):**

1. ICT
2. Equations and Graphs
3. Chemical Handling
4. Materials testing
5. Electrical Maintenance
6. Basic- Data Mgmt.
7. Electronic Maintenance
8. Laboratory practices and safety

**Observations:**

1. Focus on two Languages, (Kannada Compulsory)
2. Core learning theory component of 40%
3. Core Experiential Learning (Practical & Field Work) of 20%
4. Formative Assessment 30% including Activity based Pedagogy (20%)
5. Summative Assessment 70%
6. Compulsory Courses include Digital Fluency, Health & Wellness, Yoga, NCC/NSS/Cultural, etc.

## Course Content Semester – I

### Mechanics and Properties of Matter

| | |
|---|---|
| Course Title: Mechanics and Properties of Matter | Course Credits:4 |
| Total Contact Hours: 52 | Duration of ESA: 3 hours |
| Formative Assessment Marks: 40 | Summative Assessment Marks: 60 |
| Model Syllabus Authors: Physics Expert Committee | |

## Programme Outcomes (POs)

**PO-1:** Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.

**PO-2:** Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.

**PO-3:** Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.

**PO-4:** Ethics: Apply the professional ethics and norms in respective discipline.

**PO-5:** Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.

**PO-6:** Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

## Course Articulation Matrix:

### Mapping of Course Outcomes (COs) with Program Outcomes (POs)

**Program Outcomes (POs)**

| Course Outcomes (COs) *(UGC guidelines)* | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| CO-1: Will learn fixing units, tabulation of observations, analysis of data (graphical/analytical) | **x** | **x** | | | | x |
| CO-2: Will learn about accuracy of measurement and sources of errors, importance of significant figures. | **x** | **x** | | | | |
| CO-3: Will know how g can be determined experimentally and derive satisfaction. | **x** | | | | | |
| CO-4: Will see the difference between simple and torsional pendulum and their use in the determination of various physical parameters. | **x** | | | **x** | **x** | **x** |
| CO-5: Will come to know how various elastic moduli can be determined. | **x** | | | | x | **x** |

| | | | | | | |
|---|---|---|---|---|---|---|
| CO-6: Will measure surface tension and viscosity and appreciate the methods adopted. | **x** | **x** | | | | |
| CO-7: Will get hands on experience of different equipment. | **x** | **x** | **x** | | **x** | **x** |

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course are Marked ‘X’ in the intersection cell if a course outcome addresses a particular program outcome.

| Mechanics & Properties of Matter | | Hrs |
|---|---|---|
| **Credit : 4+2** | **Unit – 1** **Theory : 4 hours /Week** | |
| **Chapter No. 1** | **Topics** to be covered/taught/learnt:<br>**Units and measurements:** System of units (CGS and SI), measurement of length, mass and time, dimensions of physical quantities, dimensional formulae. Minimum deviation, errors. | (13) |
| **Chapter No. 2** | **Momentum and Energy**: Work and energy, Conservation of momentum (linear). Conservation of energy with examples. Motion of rockets. | |
| **Chapter No. 3** | **Special Theory of Relativity:** Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities. | |
| **Topics for self study( If any)** | **Self Study**<br>Chapter.4 Laws of Motion: Newton's Laws of motion. Dynamics of single and a system of particles. Centre of mass. Ref: 1-4,9,10 | |
| | **Suggested Activities** | |
| **Activity No. 1** | 1. i). Students can measure diameters of small balls of different size and estimate their volumes.<br>2. ii). Students can measure lengths of nails of different size.<br>iii). Students can measure volume of a liquid<br>iv). Students can measure distances and put the result both in CGS and SI units in 2, 3 and 4 significant figures. Ask them to mention the precession of the measurement.<br>v). students can estimate standard deviations wherever possible. | |
| **Activity No. 2** | Students can try and understand conservation of energy in every day examples. For example:<br>i) What happens in solar conservation panels<br>ii) Pushing an object on the table it moves<br>iii) Moving car hits a parked car causes parked car to move.<br>In these cases, energy is conserved. How? Understand and verify if possible. | |
| **Unit – 2** | | |
| **Chapter No. 4.** | **Laws of Motion:** Newton's Laws of motion. Dynamics of single and a system of particles. Centre of mass. | (13) |
| **Chapter No. 5.** | **Dynamics of Rigid bodies**: Rotational motion about an axis, Relation between torque and angular momentum, Rotational energy. moment of inertia: M I of a rectangular Lamina and solid cylinders. Flywheel,<br>Theory of compound pendulum and determination of g. | |
| **Chapter No. 6.** | **Gravitation:** Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's laws (statements). Satellite in a circular orbit. | |

| | | |
|---|---|---|
| **Topics for self study( If any)** | **Chapter 7**: Geosynchronous orbits. Basic idea of global positioning system (GPS). Ref: 1-4,9,10 | |
| | **Suggested Activities** | |
| **Activity No. 3** | Activity:<br>Moment of inertia is an abstract concept. It simply gives a measure of rotational inertia of a rigid body and it is proportional to the product of the square of radius, r of the body and its mass, m. Students by referring to websites, can construct and perform simple experiments to verify that MI $\alpha$ $mr^2$.<br>Reference : www.khanacademy.org, www.pinterest.com, www.serc.cerleton.edn | |
| **Activity No. 4** | Activity:<br>Prepare suitable charts and give seminar talks in the class. | |

| | | |
|---|---|---|
| **Unit - 3** | | |
| **Chapter No. 8** | **Elasticity:** Hooke's law - Stress-strain diagram, elastic moduli-relation between elastic constants, Poisson's Ratio-expression for Poisson's ratio in terms of elastic constants.<br>Work done in stretching and work done in twisting a wire-Twisting couple on a cylinder.<br>Torsional pendulum-Determination of rigidity modulus and moment of inertia - q, $\eta$ and $\sigma$ by Searle's method | (13) |
| | **Suggested Activities** | |
| **Activity No. 5** | **Activity:**<br>Arrange a steel spring with its top fixed with a rigid support on a wall and a meter scale along side. Add 100 g load at a time on the bottom of the hanger in steps. This means that while putting each 100g load, we are increasing the stretching force by 1N. Measure the extension for loads up to 500g. Plot a graph of extension versus load. Shape of the graph should be a straight line indicating that the ratio of load to extension is constant. Go for higher loads and find out elastic limit of the material. | |
| **Activity No.6** | **Activity:**<br>Repeat the above experiment with rubber and other materials and find out what happens after exceeding elastic limit. Plot and interpret. | |

| Unit - 4 | | |
|---|---|---|
| **Chapter No. 9** | **Surface tension:** Definition of surface tension. Surface energy, relation between surface tension and surface energy, pressure difference across curved surface example, excess pressure inside spherical liquid drop, angle of contact. | (13) |
| **Chapter No. 11** | **Viscosity:** Streamline flow, turbulent flow, equation of continuity, determination of coefficient of viscosity by Poisulle's method, Stoke's method. Problems. | |
| **Topics for self study( If any)** | Capillarity determination of surface tension by drop weight method.<br>Ref: 6,7,9,10 | |
| | **Suggested Activities** | |
| **Activity No.7** | 1. Measure surface tension of water and other common liquids and compare and learn<br>i) Why water has high ST? think of reasons.<br>ii) Check whether ST is a function of temperature? You can do it by heating the water to different temperatures and measure ST.<br>iii) Plot ST versus T and learn how it behaves.<br><br>Mix some quantity of kerosene or any oil to water and measure ST. Check whether ST for the mixture is more or less than pure water. List the reasons. | |
| **Activity No. 8** | Activity:<br>2. Collect a set of different liquids and measure their viscosity.<br>i) Find out whether sticky or non-sticky liquids are most viscous. List the reasons.<br>ii) Mix non sticky liquid to the sticky liquid in defined quantities and measure viscosity. Find out viscosity is increasing or decreasing with increase of non-sticky liquid concentration.<br>iii) Do the above experiment by mixing sticky liquid to the non sticky liquid. Find out change in viscosity with increase of concentration of sticky liquid.<br><br>List the applications where concept of Viscosity plays a dominant role | |

## Text Books:

| Sl No | Title of the Book | Authors Name | Publisher | Year of Publication |
|---|---|---|---|---|
| **1** | Mechanics by, New Eition | D. S. Mathur | S.Chand & Co. | 2000 |
| **2** | Mechancis and Relativity by 3rd Edition, | Vidwan Singh Soni, | PHI Learning Pvt. Ltd. | |
| **3** | Mechanics Berkeley Physics Course, Vol.1: | Charles Kittel, *et.al.* | Tata McGraw-Hill | 2007 |
| **4** | Properties of Matter | Brijlal & Subramanyam. | | |

## References Books

| Sl No | Title of the Book | Authors Name | Publisher | Year of Publication |
|---|---|---|---|---|
| **1** | Physics. 9th Edn, | Resnick, Halliday & Walter, | Wiley | 2010 |
| **2** | Physics Vol-I | Halliday and Resnick, | | |

## List of Experiments to be performed in the Laboratory:

| | |
|---|---|
| 1. | Determination of g using bar pendulum (L versus T and L versus $LT^2$ graphs). |
| 2. | Determination of moment of inertia of a Fly Wheel. |
| 3. | Determination of rigidity modulus using torsional pendulum. |
| 4. | Modulus of rigidity of a rod – Static torsion method. |
| 5. | Determination of elastic constants of a wire by Searle's method. |
| 6. | Young's modulus by Koenig's method. |
| 7. | Viscosity by Stoke's method. |
| 8. | Verification of Hook's law. |
| 9. | Determination of surface tension of a liquid and the interfacial tension between two liquids using drop weight method. |
| 10. | Study of motion of a spring and to calculate Spring constant, g and unknown mass. |
| 11. | Determination of Young's modulus of a bar by the single cantilever method. |
| 12. | Determination of Young's modulus of a bar by uniform bending method. |
| 13. | Radius of capillary tube by mercury pellet method. |
| 14 | Verification of parallel and perpendicular axis theorems. |

(Minimum EIGHT experiments have to be carried out)

## Reference Book for Laboratory Experiments

| Sl No | Title of the Book | Authors Name | Publisher | Year of Publication |
|---|---|---|---|---|
| **1** | Physics through experiments | B.Saraf | Vikas Publications | 2013 |
| **2** | A lab manual of Physics for undergraduate classes, 1st Edition, | | Vikas Publications. | |
| **3** | BSc Practical Physics Revised Ed | CL Arora | S.Chand & Co. | 2007 |
| **4** | An advanced course in practical physics. | D. Chatopadhyay, PC Rakshit, B.Saha | New Central Book Agency Pvt Ltd. | 2002 |

# Semester – II

# Electricity & Magnetism

| | |
|---|---|
| Course Title: Electricity and Magnetism | Course Credits: 4 |
| Total Contact Hours: 52 | Duration of ESA: 3 hours |
| Formative Assessment Marks: 40 | Summative Assessment Marks: 60 |

| Model Syllabus Authors: | Physics Expert Committee |
|---|---|

## Programme Outcomes

1. Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.
2. Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.
3. Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.
4. Ethics: Apply the professional ethics and norms in respective discipline.
5. Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.
6. Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)**

**Program Outcomes (POs)**

| Course Outcomes (COs) | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| i. Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges. | x | x | | | | |
| ii. Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics. | x | | | | | |
| iii. Apply Gauss's law of electrostatics to solve a variety of problems. | x | x | | | x | |
| iv. Describe the magnetic field produced by magnetic dipoles and electric currents. | x | | | | | |
| v. Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields. | x | | | | | |
| vi. Describe how magnetism is produced and list examples where its effects are observed. | x | | | | x | x |
| vii. Apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor. | x | x | | | x | x |
| viii. Apply various network theorems such as Superposition, Thevenin, Norton, Reciprocity,• Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis, and electrical machines. | x | x | | | x | x |

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

| **Electricity & Magnetism** | | **Hrs** |
|---|---|---|
| **Unit – 1** | | |
| **Chapter No. 1** | **Topics to be covered/taught/learnt:**<br>Electric charge and field<br>Coulomb's law, electric field strength, electric field lines, point charge in an electric field and electric dipole, work done by a charge (derivation of the expression for potential energy) | 3 |
| **Chapter No. 2** | **Topics to be Covered**<br>Gauss's law and its applications (electric fields of a (i) spherical charge distribution, (ii) line charge and (iii) an infinite flat sheet of charge). | 3 |
| **Chapter No. 3** | **Topics to be Covered**<br>Electric potential, line integral, gradient of a scalar function, relation between field and potential. Potential due to point charge and distribution of charges (Examples: potential associated with a spherical charge distribution, infinite line charge distribution, infinite plane sheet of charges). Constant potential surfaces, Potential due to a dipole and electric quadrupole. | 7 |
| **Topics for self study( If any)** | *Constant potential surfaces - for self learning*<br>*Work out problems listed in the reference* | |
| | **Suggested Activities** | |
| **Activity No. 1** | 1. Learn the difference between and DC and AC electricity and their characteristics.<br>Voltage and line frequency standards in different countries.<br>2. A small project report on production of electricity as a source of energy: Different methods | |
| **Activity No. 2** | 1. Learn to use a multimeter (analog and digital) to measure voltage, current and resistance. Continuity testing of a wire.<br>2. Learn about household electrical connection terminals: Live, neutral and ground and voltage between the terminals. Role of earthing and safety measures | |
| **Unit – 2** | | |

| | | |
|---|---|---|
| **Chapter No. 4.** | **Topics to be covered**<br>Conductors in electrostatic field<br>Conductors and insulators, conductors in electric field. Capacitance and capacitors, calculating capacitance in a parallel plate capacitor, parallel plate capacitor with dielectric, dielectrics: an atomic view. Energy stored in a capacitor, Dielectric and Guass's law. | 6 |
| **Chapter No. 5.** | **Topics to be covered**<br>Electric currents and current density. Electrical conductivity and Ohm's law. Physics of electrical conduction, conduction in metals and semiconductors, circuits and circuit elements: Variable currents in capacitor circuits, Resistor, inductor and capacitor and their combination. force on a moving charge. | 7 |
| **Topics for self study( If any)** | *Currents and voltage in combination of R, L and C circuits* | |
| | **Suggested Activities** | |
| **Activity No. 3** | 1. Learn about electrical appliances which work with AC and DC electricity<br>2. Learn about types of resistors and their colour codes and types of capacitors(electrolytic and non-electrolytic) | |
| **Activity No. 4** | 1. Learn about power transmission: 3-phase electricity, voltage and phase<br>2. Visit a nearby electrical power station. Interact with line men, Electrical engineers and managers. Discuss about power loss in transmission. How to reduce it?<br>3. Prepare a small project report on street lighting and types of electrical bulbs. | |

| | | |
|---|---|---|
| **Unit – 3** | | |
| **Chapter No.6** | **Topics to be covered**<br>Magnetism<br>Definition of magnetic field, Ampere's law and Biot-Savart law (magnetic force and magnetic flux), Magnetic force on a current carrying conductor, Hall effect.<br>Electromagnetic induction, conducting rod moving in a magnetic field, law of induction and mutual inductance, self inductance and energy stored in a magnetic field. | 7 |
| **Chapter No. 7** | **Topics to be covered**<br>Alternating current circuits: Resonant circuit, alternating current, quality factor, RL, RC, LC, LCR circuits, admittance and impedance, power and energy in AC circuits. | 6 |
| **Topics for self study( If any)** | Hall Effect | |
| | **Suggested Activities** | |
| **Activity No. 5** | **Activity:**<br>1. Prepare a small project report on street lighting and types of electrical bulbs.<br>2. Learn the measurement of electric current using tangent galvanometer. | |
| **Activity No.6** | **Activity:**<br>Build a small coil with insulated copper wire. Connect an ammeter micro/milli ammeter. Verify magnetic induction using a powerful bar magnet. | |
| **Unit - 4** | | |
| **Chapter No. 8** | Electromagnetic waves:<br>Equation of continuity, Maxwell's equations, displacement current, electromagnetic wave, energy transported by electromagnetic waves. Electromagnetic waves in different frames of reference, Field of a current loop, magnetic moment, Electric current in atoms, electron spin and magnetic moment, magnetization and magnetic susceptibility. | 8 |
| **Chapter No. 9** | **Topics to be covered:**<br>Types of magnetic materials: diamagnetic, paramagnetic and ferromagnetic materials. B-H hysteresis curves. | 5 |
| **Topics for self study( If any)** | *B-H curves and its characteristics*<br>*Ferrites* | |

| | Suggested Activities | |
|---|---|---|
| **Activity No.7** | **Activity:**<br>1. Prepare a small project report on production of magnetic field: Permanent magnets, electromagnets and superconducting magnets.<br>2. Learn the principle of working of a Gauss meter to measure magnetic field | |
| **Activity No. 8** | **Activity:**<br>1. Model the earth's magnetic field with a diagram. Explain the effect of tilt of the earth's axis and reasons for the change in the tilt of the earth's axis over thousands of years. | |

## References Books:

| Sl No | Title of the Book | Authors Name | Publisher | Year of Publication |
|---|---|---|---|---|
| **1** | Physics-Part-II, | David Halliday and Robert Resnick | Wiley Eastern Limited | 2001 |
| **2** | Berkeley Physics Course, Vol-2, Electricity and Magnetism, Special Edition | Edward M Purcell | Tata Mc Graw-Hill Publishing Company Ltd, New Delhi | 2008 |

## List of Experiments to be performed in the Laboratory

| | |
|---|---|
| 1. | Experiments on tracing of electric and magnetic flux lines for standard configuration. |
| 2. | Determination of components of earth's magnetic field using a Ballistic galvanometer. |
| 3. | Determination of capacitance of a condenser using B.G. |
| 4. | Determination of high resistance by leakage using B.G. |
| 5. | Determination of mutual inductance using BG. |
| 6. | Charging and discharging of a capacitor (energy dissipated during charging and time constant measurements. |
| 7. | Series and parallel resonance circuits (LCR circuits). |
| 8. | Impedance of series RC circuits- determination of frequency of AC. |
| 9. | Study the characteristics of a series RC and RL Circuit. |
| 10. | Determination of self-inductance of a coil. |
| 11. | Verification of laws of combination of capacitances and determination of unknown capacitance using de - Sauty bridge. |
| 12. | Determination of $B_H$ using Helmholtz double coil galvanometer and potentiometer. |

(Minimum EIGHT experiments have to be carried out)

# Syllabus for III and IV Semesters

# Semester-III

# Wave motion and Optics

| Content | Hrs |
|---|---|
| **Unit – 1: Waves and Superposition of Harmonic Waves** | |

| | | |
|---|---|---|
| **Chapter 1. Waves** | Plane and Spherical Waves. Longitudinal and Transverse Waves. Characteristics of wave motion, Plane Progressive (Travelling) Wave and its equation, Wave Equation – Differential form (derivation). Particle and Wave Velocities: Relation between them, Energy Transport – Expression for intensity of progressive wave, Newton's Formula for Velocity of Sound. Laplace's Correction (Derivation). Brief account of Ripple and Gravity Waves. | 05 |
| | Text Book : 1-4 | |
| **Chapter 2. Superposition of Harmonic Waves** | Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats) – Analytical treatment.<br>**Self-Study:** Superposition of two perpendicular Harmonic Oscillations: Lissajous Figures with equal and unequal frequency- Analytical treatment. Uses of Lissajous' figures. | 06 |
| | Text Book : 1-4 | |
| | **Suggested Activities** | |
| | Preparation of report and presentation on harmonics in musical instruments. | 02 |
| | Study of Characteristics of loud speaker and microphone. | |
| **Unit – 2: Standing Waves and Acoustics** | | |
| **Chapter 3. Standing Waves** | Velocity of transverse waves along a stretched string (derivation), Standing (Stationary) Waves in a String - Fixed and Free Ends (qualitative). Theory of Normal modes of vibration in a stretched string, Energy density and energy transport of a transverse wave along a stretched string. Vibrations in rods – longitudinal and transverse modes (qualitative). Velocity of Longitudinal Waves in gases (derivation).<br>**Self-Study:** Normal Modes of vibrations in Open and Closed Pipes – Analytical treatment. Concept of Resonance, Theory of Helmholtz resonator. | 08 |
| | Text Book : 1-4 | |
| **Chapter 4. Acoustics** | Absorption coefficient, Reverberation and Reverberation time, Sabine's Reverberation formula (derivation), Factors affecting acoustics in buildings, Requisites for good acoustics. Acoustic measurements – intensity and pressure levels. | 03 |
| | Text Book : 1-4 | |
| | **Suggested Activities** | |
| | Preparation of report and presentation on resonance phenomenon in natural and artificial systems. | 02 |
| | Visit to auditorium and preparation of report on materials / designs used for good acoustics. | |

| | | |
|---|---|---|
| **Unit – 3: Nature of light and Interference** | | |
| **Chapter 5 Nature of light** | The corpuscular model of light-The wave model-Maxwell's electromagnetic waves-Wave Particle Duality | 4 |
| | Text Book No 5; Sections 2.1 to 2.4 and 2.8 | |
| **Chapter 6 Interference of light by division of wave front** | Huygen's theory-Concept of wave-front-Interference pattern produced on the surface of water-Coherence-Interference of light waves by division of wave-front- Young's double slit experiment- derivation of expression for fringe width-Fresnel Biprism- Interference with white light- Numerical Problems | 4 |
| | Text Book No 5; Sections 12.1 to 12.2, 14.1 to 14.5, 14.7 to 14.9 | |
| **Chapter 7 Interference of light by division of amplitude** | Interference by division of amplitude-Interference by a plane parallel film illuminated by a plane wave-Interference by a film with two non-parallel reflecting surfaces- colour of thin films—Newton's rings-(Reflected light)-Michelson Interferometer-Determination of wavelength of light* | 6 |
| | Text Book No 5; Sections 15.1 to 15.2, 15.8 to 15.11 | |
| | **Suggested Activities** | |
| | Make Your Own Double Slit Experiment | |
| | Reference :(https://www.youtube.com/watch?v=kKdaRJ3vAmA) | |
| | Activity: What is the reason for the colours like rainbow which we see on ground when oil/petrol spills during rainfall? | |
| | Reference :https://www.scientificamerican.com/article/why-do-beautiful-bands-of/ | |
| **Unit –4: Diffraction and Polarisation** | | |
| **Chapter 8 Fraunhofer diffraction** | Introduction- Fraunhofer diffractions- Single slit diffraction pattern-position of Maxima and Minima (Qualitative arguments)- Two slit diffraction pattern-position of Maxima and minima- Theory of plane diffraction grating-Grating spectrum- normal and oblique incidence- Resolving power and dispersive power of a grating Single slit; Double Slit. Multiple slits & Diffraction grating. | 5 |
| | Text Book No 5; Sections 18.1 to 18.2, 18.6,18.8 to 18.9 | |
| **Chapter 9 Fresnel Diffraction** | Fresnel Diffraction- Fresnel half period zones-Diffraction by a circular aperture-diffraction by an opaque disc-The zone plate -comparison between zone plate and convex lens. | 3 |
| | Text Book No 5; Sections 20.1 to 20.3 | |
| **Chapter 10 Polarisation** | Introduction-Production of polarized light- The wire Grid polarizer and Polaroid-Superposition of two disturbances-Phenomenon of double refraction-Quarter wave plates and half wave plates- Analysis of polarized light-optical activity | 4 |
| | Text Book No 5; Sections 22.1, 22.3,22.4,22.6 to 22.8 | |
| | **Suggested Activities** | |
| | USING CDs AND DVDs AS DIFFRACTION Gratings | 1 |

| | | |
|---|---|---|
| | Ref: https://www.nnin.org/sites/default/files/files/Karen_Rama_USING_CDs_AND_DVDs_AS_DIFFRACTION_GRATINGS_0.pdf | |
| | 1. What is the physics behind 3D movies? Group Discussion<br>2. (https://www.slideserve.com/rae/physics-behind-3d-movies-powerpoint-ppt-presentation) | |

## Text Books

| Sl No | Title of the Book | Authors Name | Publisher | Year of Publication |
|---|---|---|---|---|
| 1 | The Physics of Waves and Oscillations, | N K Bajaj | Tata McGraw-Hill Publishing Company Ltd., Second Edition, | 1984 |
| 2 | Waves and Oscillations | N Subramanyam and Brij Lal | Vikas Publishing House Pvt. Ltd., Second Revised Edition | 2010 |
| 3 | A Text Book of Sound | D R Khanna and R S Bedi | Atma Ram & Sons, Third Edition | 1952 |
| 4 | Oscillations and Waves | Satya Prakash | Pragathi Prakashan, Meerut, Second Edition | 2003 |
| 5 | Optics | Ajoy Ghatak | McGraw Hill Education (India) Pvt Ltd | 2017 |
| 6 | A text Book of Optics | Brij Lal, M N Avadhanulu & N Subrahmanyam | S. Chand Publishing | 2012 |

## References Books

| Sl No | Title of the Book | Authors Name | Publisher | Year of Publication |
|---|---|---|---|---|
| 1 | Berkeley Physics Course – Waves, | Frank S Crawford Jr. | Tata Mc Graw-Hill Publishing Company Ltd., Special Indian Edition,. | 2011 |
| 2 | Optics | Eugene *Hecht* | Pearson Paperback | 2019 |
| 3 | Introduction To Optics | Pedrotti and Frank L , | Pearson India | 3rd Edition |
| 4 | Fundamentals of Optics | Francis Jenkins Harvey White | McGraw Hill Education | 2017 |

## List of Experiments to be performed in the Laboratory

| Sl No | Experiment |
|---|---|
| 1 | Velocity of sound through a wire using Sonometer. |
| 2 | Frequency of AC using Sonometer. |
| 3 | Study of Lissajous' Figures |

| | |
|---|---|
| 4 | To verify the laws of transverse vibration using Melde's apparatus. |
| 5 | Helmholtz resonator using tuning fork. |
| 6 | Helmholtz resonator using electrical signal generator. |
| 7 | To determine refractive index of the Material of a prism using sodium source. |
| 8 | To determine the dispersive power and Cauchy constants of the material of a prism using mercury source. |
| 9 | To determine the wavelength of sodium source using Michelson's interferometer. |
| 10 | To determine wavelength of sodium light using Fresnel Biprism. |
| 11 | To determine wavelength of sodium light using Newton's Rings |
| 12 | To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film. |
| 13 | To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating. |
| 14 | To determine dispersive power and resolving power of a plane diffraction grating. |

## Reference Book for Laboratory Experiments

| Sl No | Title of the Book | Authors Name | Publisher | Year of Publication |
|---|---|---|---|---|
| 1 | Advanced Practical Physics for students | B.L. Flint and H.T. Worsnop | Asia Publishing House. | 1971 |
| 2 | A Text Book of Practical Physics | I. Prakash & Ramakrishna | Kitab Mahal, 11th Edition | 2011 |
| 3 | Advanced level Physics Practicals | Michael Nelson and Jon M. Ogborn | Heinemann Educational Publishers, 4th Edition | 1985 |
| 4 | A Laboratory Manual of Physics for undergraduate classes | D.P.Khandelwal | Vani Publications. | 1985 |

| | | | |
|---|---|---|---|
| | | **Semester-IV**<br>**THERMAL PHYSICS AND ELECTRONICS**<br>Time: 4 Hrs. /week Max Marks : | |
| **Unit 1** | | **Laws of Thermodynamics** | **Hours** |
| | Chapter 1 | Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium,<br>Zeroth Law of Thermodynamics, Concept of Temperature, Concept of Work and Heat, State Functions,<br>First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: Equation of state for an adiabatic process, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient. | 4 |
| | Chapter 2 | **Second Law of Thermodynamics:** Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work.<br>Heat Engines: Carnot engine & efficiency (no derivation). Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale. | 5 |
| | Chapter 3 | **Entropy:** Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy, Entropy of a perfect gas. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle.<br>**Third Law of Thermodynamics.** Unattainability of Absolute Zero. | 4 |
| | Activities | 1. Make a dissertation on Laws of thermodynamics.<br>2. Make a write up of heat engines and refrigerators.<br>3. List the irreversible and irreversible processes which we may come across.<br>4. Three important concepts in the study of thermodynamics are, temperature, heat, and internal energy. Discuss the meaning of these three concepts being careful to distinguish between them.<br>**5.** http://www.physics.umd.edu/perg/abp/think/thermo/temper.htm | |
| **Unit 2** | Chapter 4 | **Thermodynamic Potentials** | |
| | | Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Surface Films and Variation of Surface Tension with Temperature. Magnetic Work, Cooling due to adiabatic demagnetization. | 3 |

| | | | |
|---|---|---|---|
| | Chapter 5 | **Maxwell's Thermodynamic Relations** | |
| | | Derivations and applications of Maxwell's Relations(1) First order Phase Transitions with examples, Clausius-Clapeyron Equation (2) Values of Cp-Cv (3)Joule-Thomson Effect and J-T coefficient(Derivation) for Vander Walls gas. | 4 |
| | Chapter 6 | **Kinetic Theory of Gases** | |
| | | Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas: Mean, RMS and Most Probable Speeds. Degrees of Freedom, Law of Equipartition of Energy (no derivation). Specific heats of Gases. | 2 |
| | Chapter 7 | **Radiation** | |
| | | Blackbody radiation, spectral distribution, concept of energy density and pressure of radiation (no derivation). Derivation of Planck's law, deduction of Stefan-Boltzmann law and Wien's displacement law from Planck's law. | 4 |
| | Activities | 1. Measuring the Solar Constant<br>Materials: Simple flat sided Jar and Thermometer.<br>Activity: Bottle containing water is exposed to solar radiation. The raise in the temperature and time taken are noted. Calculate the heat absorbed by water and relate it to the output of Sun.<br>2. Thermo emf<br>Materials: Suitable two dissimilar metal wires, voltage measuring device.<br>Activity: In this experiment student will assemble the thermocouple and study the three effects namely, Seebeck, Peltier, and Thompson.<br>3. Inverse square law of radiation<br>Materials: A cardboard with grid, a cardboard with a hole, supporting clips, ruler, candle.<br>4. Activity: Students set the device. They count the lighted squares on the cardboard with the grid by varying the distance. And make necessary measurements and calculations to arrive at inverse square law of radiation.<br>5. Activity Based Physics Thinking Problems in Thermodynamics: Kinetic Theory<br>6. http://www.physics.umd.edu/perg/abp/think/thermo/kt.htm | |
| **Unit-3** | Chapter-8 | **Semiconductor devices** | 07 hours |
| | | Introduction, p-n junction diode, Characteristics and Parameters, Diode approximations, Half-wave rectifier, Full-wave rectifier, Zener diode voltage regulators: Regulator circuit with no load, Loaded Regulator. Numerical examples as applicable.<br>**Junction Transistors**: Basics of BJT BJT operation, Common Base, Common Emitter and Common Collector Characteristics, BJT amplification, Numerical examples as applicable. | |

| | | | |
|---|---|---|---|
| | Chapter-8 | **Operational amplifier** | |
| | | Introduction to Operational Amplifiers: Ideal OPAMP, Inverting and Non-inverting OP-AMP circuits, OP-AMP applications: voltage follower, addition, subtraction | 06 hours |
| | Activities | a. Activity: Wire a DC power supply on a bread board or groove board to give a regulated output voltage of + 5 V; +15 V; Dual power output : ± 5 V; Dual power output : ± 15 V<br>b. Use: 3-pin regulators<br>c. Learn to identify the terminals of different types (packages) of BJTs.<br>d. In the case of power transistors, learn how to fix a heat sink for the transistor.<br>e. Understand the concept of virtual ground of an OP-AMP.<br>f. Learn the different types of op-amps used for different applications.<br>What is a buffer? Prepare a report on the application of buffers in instrumentation electronics. | |
| **Unit-4** | Chapter-9 | **Digital Electronics** | |
| | | Introduction, Switching and Logic Levels, Digital Waveform. Number Systems: Decimal Number System, Binary Number System, Converting Decimal to Binary, Hexadecimal Number System: Converting Binary to Hexadecimal, Hexadecimal to Binary, | 07 hours |
| | Chapter-10 | **Boolean Algebra Theorems,** | |
| | | De Morgan's theorem. Digital Circuits: Logic gates, NOT Gate, AND Gate, OR Gate, NAND Gate, NOR Gate, Algebraic Simplification, NAND and NOR Implementation: NAND Implementation, NOR Implementation. | 06 hours |
| | Activities | 1. Learn how to implement logic functions (AND and OR) using just diodes and resistors. | |

**Reference Books:**


• Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
• Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
• A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
• Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
• Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
• An Introduction to Thermal Physics, Daniel V Schroeder, 2020, Oxford University Press


| Sl No | Title of the Book | Authors Name | Publisher | Year of Publication |
|---|---|---|---|---|
| **1** | **Electronic Devices and Circuits** | **David A. Bell** | **PHI, New Delhi** | **2004** |
| **2** | **Integrated Electronics** | **Jacob Millman and CC Halkias** | | |
| **3.** | **Digital Fundamentals** | **Floyd** | **PHI, New Delhi** | **2001** |

**Lab Experiments List**

1. Mechanical Equivalent of Heat by Callender and Barne's method

2. Coefficient of thermal conductivity of copper by Searle's apparatus

4. Coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method

5. Value of Stefan's constant

6. Verification of Stefan's law

7. Variation of thermo-emf across two junctions of a thermocouple with temperature

8. Verification of Clasius –Clapeyron equation and determination of specific enthalpy

| **Sl No** | **Experiments on electronics** |
|---|---|
| 9 | V-I Characteristics of Silicon & Germanium PN Junction diodes (FB & RB)<br>V-I Characteristics of Zener Diode and voltage regulator |
| 10 | Characteristics of BJT in Common Emitter Configuration<br>Frequency response of CE Amplifier<br>Frequency response of CC Amplifier (Emitter Follower). |
| 11 | Half Wave and Full Wave Rectifier Without Filter<br>Half Wave and Full Wave Rectifier with Filter |
| 12 | Applications of Operational Amplifier<br>Non-inverting and Inverting op-amp circuits<br>Voltage follower, Adder and Subtractor circuits |
| 13 | Truth table verification of logic gates using TTL 74 series ICs.<br>Transfer characteristics of a TTL gate using CRO.<br>Logic Gates; Combinational Circuits; Sequential Circuits |

| **Sl No** | **Title of the Book** | **Authors Name** | **Publisher** | **Year of Publication** |
|---|---|---|---|---|
| **1** | **Basic Electronics Lab (P242) Manual 2015-16** | | **National Institute of Science Education and Research Bhubaneswar** | **2015** |

**Suggested Readings:**

1. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962, 9e.

2. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015, 1e.

## Student seminars

Student (4 to 5 students in a group) groups may be assigned to give a seminar on a topic. They need to make a detailed study on the topic and prepare power point slides for the presentation. One student out of the group may be called randomly to present the certain portion of the topic. Similarly, other students may be called randomly to present remaining portion of the topic, so that each student must study whole topic. In a class 2 to 3 groups may present their topic.

## Model Seminar Topics

1. Calorimetry
2. Thermometry
3. Kinetic theory of matter
4. Behavior of real gases
5. Transmission of heat
6. Transport phenomena in gases
7. Radiation laws
8. Laws of thermodynamics
9. Thermodynamical relationships
10. Heat engines
11. Production of low temperatures
12. Air conditioning systems
13. Entropy
14. Global warming
15. Classical and quantum statistics

# SYLLABUS FOR OPEN ELECTIVES

## (SEM I to IV)

## 3 Credits:  3 Lectures + 1 Tutorial

# SYLLABUS FOR OPEN ELECTIVE

## ENERGY SOURCES

**Time: 2 hrs./week + 01 Hr tutorial** **Max Marks:**

| | | **No. of lectures** |
|---|---|---|
| **Unit-I** | **Non-Renewable energy sources** | |
| | **Chapter-1: Introduction** | |
| | Energy concept-sources in general, its significance & necessity.<br>Classification of energy sources: Primary and Secondary energy, Commercial and Non-commercial energy, Renewable and Non-renewable energy, Conventional and Non-conventional energy, Based on Origin-Examples and limitations. Importance of Non-commercial energy resources. | **04** |
| | **Chapter-2: Conventional energy sources** | |
| | Fossil fuels & Nuclear energy- production & extraction, usage rate and limitations. Impact on environment and their issues& challenges. Overview of Indian & world energy scenario with latest statistics- consumption & necessity. Need of eco-friendly & green energy & their related technology. | **09** |
| | **Total** | **13** |
| **Unit-II** | **Renewable energy sources** | |
| | **Chapter-1: Introduction:** | |
| | Need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity. | **05** |
| | **Chapter 2 : Solar energy**: | |
| | Solar Energy-Key features, its importance, Merits & demerits of solar energy,<br>Applications of solar energy. Solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell -brief discussion of each. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems. | **08** |
| | Total | **13** |
| **Unit-III** | **Chapter-3: Wind and Tidal Energy harvesting**: | |
| | Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.<br>Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy. | **08** |
| | **Chapter-4 : Geothermal and hydro energy** | |
| | Geothermal Resources, Geothermal Technologies. | **02** |
| | Hydropower resources, hydropower technologies, environmental impact of hydro power sources. | **03** |
| | Carbon captured technologies, cell, batteries, power consumption | **01** |
| | **Total** | **13** |

| | | |
|---|---|---|
| | **Activity for tutorial classes 01 lectures/week**<br>1. Demonstration of on Solar energy, wind energy, etc, using training modules at Labs.<br>2. Conversion of vibration to voltage using piezoelectric materials.<br>3. Conversion of thermal energy into voltage using thermoelectric (using thermocouples or heat sensors) modules.<br>4. Project report on Solar energy scenario in India<br>5. Project report on Hydro energy scenario in India<br>6. Project report on wind energy scenario in India<br>7. Field trip to nearby Hydroelectric stations.<br>8. Field trip to wind energy stations like Chitradurga, Hospet, Gadag, etc.<br>9. Field trip to solar energy parks like Yeramaras near Raichur.<br>10. Videos on solar energy, hydro energy and wind energy. | |
| | **Reference Books:**<br>1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi<br>2. Solar energy - M P Agarwal - S Chand and Co. Ltd.<br>3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.<br>4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.<br>5. Dr. P Jayakumar, Solar Energy: Resource Assessment Handbook, 2009<br>6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).<br>7. http://en.wikipedia.org/wiki/Renewable_energy | |

# Climate Science

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**Time: 2 hrs./week + 01 Hr tutorial** **Max Marks:**

| | | |
|---|---|---|
| Module 1: | **Atmosphere**<br>Atmospheric Science (Meteorology) as a multidisciplinary science. Physical and dynamic meteorology, Some terminology, difference between weather and climate, weather and climate variables, composition of the present atmosphere: fixed and variable gases, volume mixing ratio (VMR), sources and sinks of gases in the atmosphere. Green house gases. Structure (layers) of the atmosphere. Temperature variation in the atmosphere, temperature lapse rate, mass, pressure and density variation in the atmosphere. Distribution of winds. | (13 hours) |
| Module 2: | **Climate Science**<br>Overview of meteorological observations, measurement of : temperature, humidity, wind speed and direction and pressure. Surface weather stations, upper air observational network, satellite observation. Overview of clouds and precipitation, aerosol size and concentration, nucleation, droplet growth and condensation (qualitative description). Cloud seeding, lightning and discharge. Formation of trade winds, cyclones.<br>Modelling of the atmosphere: General principles, Overview of General Circulation Models (GCM) for weather forecasting and prediction. Limitations of the models.<br>R and D institutions in India and abroad dedicated to climate Science, NARL, IITM, CSIR Centre for Mathematical Modeling and Computer Simulation, and many more | (13 hours) |
| Module 3: | **Global Climate Change**<br>Green house effect and global warming, Enhancement in concentration of carbon dioxide and other green house gases in the atmosphere, Conventional and non-conventional energy sources and their usage. EL Nino/LA Nino Southern oscillations.<br>Causes for global warming: Deforestation, fossil fuel burning, industrialization. Manifestations of global warming: Sea level rise, melting of glaciers, variation in monsoon patterns, increase in frequency and intensity of cyclones, hurricanes, tornadoes.<br>Geo-engineering as a tool to mitigate global warming? Schemes of geo-engineering. | (13 hours) |
| | **Activities to be carried out on Climate Science**:<br>1. Try to find answer to the following questions:<br>(a) Imagine you are going in a aircraft at an altitude greaten than 100 km. The air temperature at that altitude will be greater than 200$^{o}$C. If you put your hands out of the window of the aircraft, you will not feel hot.<br>(b) What would have happened if ozone is not present in the stratosphere.<br>2. Visit a nearby weather Station and learn about their activities.<br>3. Design your own rain gauge for rainfall measurement at your place. | |

| | | |
|---|---|---|
| | 4. Learn to determine atmospheric humidity using wet bulb and dry bulb thermometers.<br>5. Visit the website of Indian Institute of Tropical Meteorology (IITM), and keep track of occurrence and land fall of cyclone prediction.<br>6. Learn about ozone layer and its depletion and ozone hole.<br>7. Keep track of melting of glaciers in the Arctic and Atlantic region through data base available over several decades.<br>8. Watch documentary films on global warming and related issues (produced by amateur film makers and promoted by British Council and BBC). | |
| | **References**:<br>1. Basics of Atmospheric Science – A Chndrashekar, PHI Learning Private Ltd. New Delhi, 2010.<br>2. Fundamentals of Atmospheric Modelling- Mark Z Jacbson, Cambridge University Press, 2000. | |

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# Astronomy

**Time: 2 hrs./week + 01 Hr tutorial** **Max Marks:**

| Content | | Hrs |
|---|---|---|
| **Unit – 1 -History and Introduction** | | |
| Chapter 1 | Ancient Astronomy<br>Greek Observations, Sumerian Observations,Mayan Observations, Arabic Observations ,Chinese Observations | 2 |
| Chapter 2 | Indian Astronomy<br>Vedic Astronomy, Ancient Astronomy – Aryabhata, Varahamihira, Bhaskara Astronomy in Indian Scriptures, Precession of the Equinox,Celebrations of Equinox | 2 |
| Chapter 3 | Medieval & Modern Astronomy<br>Invention of Telescopes, Models of the Solar System & Universe, Observations by Tycho Brahe, Kepler, Galileo, Herschel and Other,Modern Astronomy | 2 |
| Chapter 4 | Optical tools for Astronomy<br>Pin Hole, Binoculars, Telescopes & Imaging. | 1 |
| Chapter 5 | Mathematical Methods of Observations<br>Angular Measurement, Trigonometric functions, Stellar Parallax | 1 |
| Chapter 6 | Observational Terminologies<br>Cardinal Directions, Azimuth, Altitude, Measurements using Compass and Hand. Equatorial Co-ordinates, Light years, Magnitude, Colors etc. | 2 |
| **Unit – 2: Unit 2: Observations of the Solar System** | | |
| **Chapter 7.** | The Sun<br>Ecliptic and the Orientation of the Earth, Seasons - Solstices and Equinox, Observations of the Sun from Earth during seasons. Eclipses, Zero-shadow day, Sunspots | 1 |
| Chapter 8 | The Moon<br>Earth-Moon system – Phases, Lunar Eclipses, Ecliptic and Lunar Orbital Plane – Nodes, Lunar Month, Full Moon Names | 1 |
| Chapter 9. | Inner Planets: Mercury & Venus<br>Observational History, Observational Windows, Appearance, Apparitions, Elongations, Superior Conjunctions, Inferior Conjunctions, Transits. | 2 |
| Chapter 10 | **Outer Planets**<br>**Outer Planets: Mars, Jupiter & Saturn**<br>Observational History.Observational Windows, Appearance, Frequency of Oppositions Oppositions, Conjunctions, Moons Eclipses.Galilean Moons, Saturn's Rings | 2 |

| Unit III Major Astronomy Observations | | |
|---|---|---|
| **Chapter 11** | March to June<br>Prominent Stars and Constellations Visible during this period,<br>Methods of Spotting. | 2 |
| **Chapter 12** | June to September<br>Prominent Stars and Constellations Visible during this period,<br>Methods of Spotting. | 2 |
| **Chapter 13** | September to December<br>Prominent Stars and Constellations Visible during this period,<br>Methods of Spotting. | 2 |
| **Chapter 14** | December to March<br>**Pr**ominent Stars and Constellations Visible during this period,<br>Methods of Spotting. | 2 |

## Reference Books:

1.The Stargazer's Guide - How to Read Our Night Sky by Emily Winterburn
2. A guide to the Night Sky – Beginner's handbook by P.N. Shankar
3. The Complete Idiot's guide to Astronomy by Christopher De Pree and Alan Axelrod

## Text Books

1. P. N. SHANKAR A GUIDE TO THE NIGHT SKY
   https://www.arvindguptatoys.com/arvindgupta/nightskyshankar.pdf
2. BimanBasu , Joy of Star Watching , National Book Trust of India 2013

## References Books

Christopher De Pree :The Complete Idiot's Guide to Astronomy, Penguin USA, 2008

Emily Winterburn ,The Stargazer's Guide: How to Read Our Night Sky, Constable and Robinson, 2008

## Activities

| Sl No | Experiment |
|---|---|
| 1 | Measuring Seasons using Sun's Position. |
| 2 | Measuring Distance using Parallax |
| 3 | Estimation of the Stellar Diameter using Pin Hole |
| 4 | Measuring Height of an Object Using Clinometer. |
| 5 | Star spotting using constellation maps |
| 6 | Constellation spotting using Skymaps |
| 7 | Estimation of 'Suitable Periods' to observe deep sky objects using Planisphere. |
| 8 | Estimation of the Size of the Solar System in using Light Years. |
| 9 | Identification of Lunar Phases across a year. |
| 10 | Measuring Constellation of the Sun using Night Skymaps or Planispheres. |

# Medical Physics

**Time: 2 hrs./week + 01 Hr tutorial** **Max Marks:**

| | | |
|---|---|---|
| **Unit I:** | **Human Anatomy and Physiology**<br><br>Overview of human anatomy - cells, cell structure, type of cells and their functions, tissues, organs, and their functions. Different systems in the human body, their structure and function, physiological properties of the circulatory system, digestive system, respiratory system, reproductive system, excretory system, endocrine system and nervous system | (13 hours) |
| **Unit II:** | **Physics of Medical Diagnostics**<br><br>Principle of production of X-rays. Use of X-rays in medical diagnosis, X-ray imaging systems. Computed Tomography (CT): principle and generation of CT. Magnetic Resonance Imaging (MRI): basic principle and image characteristics. Ultrasound Imaging: Interaction of sound waves with body tissues, production of ultrasound, transducers, acoustic coupling, image formation, modes of image display and color Doppler. | (13 hours) |
| **Unit III:** | **Physics of Radiotherapy**<br><br>Clinical aspects of radiation therapy: Biological basis of radiotherapy, radiation sources, radiation dose, time dose fractionation. External beam radiation therapy, radiation therapy modalities, production of radioisotopes, use of radioisotopes in therapy, particle and ion beam radiotherapy. Brachytherapy - principle of brachytherapy and classification of brachytherapy techniques. | (13 hours) |
| | **Class Room Activities**<br><br>Unit I: Students can demonstrate the shape, size, positions and functions of different organs in the body with the help of models.<br>Unit II: The use of X-rays in the diagnosis of the fractured bone can be demonstrated with the help of a gamma source and a gamma ray survey meter. As the density of materials between the source and the detector changes the reading on the meter (or intensity of the beefing sound) changes.<br>Unit III: (i) Students can be asked to list out different type of cancers and possible causative factors. They can be asked to list out the healthy practices to reduce the risk of cancers.<br>(ii) As there will be students from different disciplines in the OE course, group discussion can be arranged to discuss about their programme and outcome. This will be an opportunity for the students to know about other disciplines.<br><br>**Other related activities/projects:**<br>1. Visit to nearby hospitals/diagnostic centers to study the working of X-ray machines.<br>2. Visit to ultrasound diagnostic centers to study the principle and use of ultrasound in diagnosis.<br>3. Project on principle and use of X-ray films in imaging.<br>4. Visit to radiotherapy centers to study the modalities of radiotherapy. | |

## Text Books

1. C. H. Best and N. B. Taylor. A Test in Applied Physiology. Williams and Wilkins Company, Baltimore, 1999.

2. C. K. Warrick. Anatomy and Physiology for Radiographers. Oxford University Press, 2001.

3. Jerrold T. Bushberg. The Essential Physics for Medical Imaging (2nd Edition). Lippincott Williams & Wilkins, 2002.

4. Jean A. Pope. Medical Physics: Imaging. Heinemann Publishers, 2012.

5. Faiz M. Khan and Roger A. Potish. Treatment Planning in Radiation Oncology. Williams and Wilkins, USA, 2003.

6. D. Baltas. The physics of modern brachytherapy for oncology. Taylor and Francis, 2007.

## Reference Books

1. J. R. Brobek. Physiological Basis of Medical Practice. Williams and Wilkins, London, 1995.

2. Edward Alcamo, Barbara Krumhardt. Barron's Anatomy and Physiology the Easy Way. Barron's Educational Series, 2004.

3. Lippincott, Anatomy and Physiology. Lippincott Williams & Wilkins, 2002.

4. W. E. Arnould Taylor. A textbook of anatomy and physiology, Nelson Thornes, 1998.

5. G. S. Pant. Advances in Diagnositc Medical Physics. Himalaya Publishing House, 2006.

6. Sabbahaga, Diagnositc Ultrasound applied to OBG. Maryland, 1980.

7. Faiz M Khan. The Physics of Radiation Therapy (3rd edition). Lippincott Williams & Wilkins, USA, 2003.

8. Jatinder R. Palta and T. Rockwell Mackie. Intensity Modulation Radiation Therapy. Medical Physics publishing, Madison, Wisconsin, 2003.

9. AAPM Report No. 72. Basic Applications of Multileaf collimators, AAPM, USA, 2001.

10. AAPM Report No. 91. Management of Respiratory motion in radiation oncology, 2006.

11. CA Joslin, A. Flynn, E. J. hall. Principles and Practice of Brachytherapy. Arnold publications, 2001.

12. Peter Hoskin, Catherine Coyle. Radiotherapy in Practice. Oxford University Press, 2011.

13. W. R. Handee. Medical Radiation Physics. Year Book Medical Publishers Inc., London, 2003.

14. Donald T. Graham, Paul J. Cloke. Principles of Radiological Physics. Churchill Livingstone, 2003.

15. Thomas S. Curry. Christensen',s Physics of Diagnostic Radiology (4th Edition). Lippincott Williams & Wilkins, 1990.

16. Madison. MRI – Perry Sprawls – Medical Physics Publishing. Wisconsin, 2000.

| | | |
|---|---|---|
| | 17. Steve Webb. The Physics of Three–Dimensional Radiotherapy. Institute of Physics Publishing, Bristol and Philadelphia, 2002.<br>18. Radiation oncology physics: A Handbook for teachers and students. IAEA publications, 2005.<br>19. F. M. Khan. The Physics of Radiation Therapy (3rd Edition), Lippincott Williams and Wilkins, U.S.A., 2003. | |

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# OPTICAL INSTRUMENTS

**Time: 2 hrs./week + 01 Hr tutorial** **Max Marks:**

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|---|---|---|
| Unit 1. | **Basics of Optics** Scope of optics, optical path, laws of reflection and refraction as per Fermat's principle, magnifying glass, Lenses (thick and thin), convex and concave lenses, Lens makers formulae for double concave and convex lenses, lens equation. Focal and nodal points, focal length, image formation, combination of lenses, dispersion of light: Newton's experiment, angular dispersion and dispersion power. Dispersion without deviation. (Expressions need not be derived, but have to be discussed qualitatively). | 13 |
| Unit 2. | **Camera and microscopes** Human eye (constitution and working), Photographic camera (principle, construction and working), construction, working and utilities of Simple microscopes, Compound microscope, Electron microscopes, Binocular microscopes **Self study** Experimental determination of magnifying power of a microscope. (Construction part can be discussed through block diagrams) | 14 |
| Unit 3. | **Telescopes and Spectrometer** Construction, working and utilities of Astronomical telescopes Terrestrial telescopes Reflecting telescopes, Construction, working and utilities of Eyepieces or Oculars (Huygen, Ramsden's, Gauss) Spectrometer - Construction, working and utilities, measurement of refractive index. **Self study** Telescopes used at different observatories in and outside India. | 13 |
| | **Activities:** Find position and size of the image in a magnifying glass and magnification. Observe rain bows and understand optics. Create a rainbow. Find out what makes a camera to be of good quality. Observe the dispersion of light through prism. Make a simple telescope using magnifying glass and lenses. Learn principle of refraction using prisms. Check bending of light in different substances and find out what matters here. Learn about different telescopes used to see galaxies and their ranges. Many more activities can be tried to learn optics by going through you tubes and webistes such as https://spark.iop.org, http://www.yenka.com, https://publiclab.org etc. | |

# Sports Science

**Time: 2 hrs./week + 01 Hr tutorial** **Max Marks:**

| Content (Use maths of 10th Std only – Only qualitative discussion) | | Hrs |
|---|---|---|
| **Unit - 1** | | |
| **Chapter No. 1** | **Measurement**: Physical quantities. Standards and Units. International system of Units. Standards of time, length and mass. Precision and significant figures. | o4 |
| **Chapter No. 2** | **Newton's laws of motion**: Newton's first law. Force, mass. Newton's second law. Newton's third law. Mass and weight. Applications of Newton's laws. | 03 |
| **Chapter No. 3** | **Projectile motion**: Shooting a falling target.<br>Physics behind Shooting, Javelin throw and Discus throw. | 03 |
| **Topics for self study ( If any)** | **https://www.real-world-physics-problems.com/physics-of-sports.html** | |
| **Unit - 2** | | |
| **Chapter No. 4.** | **Conservation laws**: Conservation of linear momentum, collisions – elastic and inelastic. Angular momentum. (Physics behind Carom, Billiards, Racing) | 04 |
| **Chapter No. 5.** | **Centre of mass**: Physics behind Cycling, rock climbing, Skating, | 02 |
| **Chapter No. 6.** | **Gravitation**: Origin, Newton's law of gravitation.<br>Archimedes's principle, Buoyancy (Physics behind swimming) | 04 |
| **Topics for self study ( If any)** | Archimedes' Principle: Made EASY \| Physics in You tube | |
| **Unit - 3** | | |
| **Chapter No.7** | **Food and Nutrition:** Proteins, Vitamins, Fat, Blood pressure. Problems due to the deficiency of vitamins. | 04 |
| **Chapter No. 8** | **Energy:** Different forms of Energy, Conservation of mass-energy. | 03 |
| **Chapter No . 9** | **Physical exercises:** Walking, Jogging and Running, Weight management. | 03 |
| **Topics for self study ( If any)** | 10 Best Exercises for Everyone – Healthline | |
| | **Suggested Activities** | |
| **Activity No. 1** | Identify the methods of measurement of time, length and mass from ancient time and build models for them. | 02 |
| | Reference : History of measurement - Wikipedia<br>*https://en.wikipedia.org › wiki › History_of_measurem* | |

| | | |
|---|---|---|
| **Activity No. 2** | Identify Physics principles behind various Sports activities. | 01 |
| | **https://www.real-world-physics-problems.com/physics-of-sports.html** | |
| **Activity No. 3** | List the difficulties experienced in Gymnastics, Cycling and weight lifting. | 02 |
| **Activity No. 4** | List the difficulties experienced in swimming. | 01 |
| **Activity No. 3** | List the difficulties experienced in Gymnastics, Cycling and weight lifting. | 02 |
| **Activity No. 4** | List the difficulties experienced in swimming. | 01 |
| **Activity No. 5** | Learn breathing exercises. | 02 |
| | Reference : 1)Simple Breathing Exercise for Beginners \| Swami Ramdev *2) https://www.yogajournal.com* | |
| **Activity No.6** | Write an essay on Physical health v/s Mental health or conduct a debate on Physical health v/s Mental health. | 01 |

## Text Books

| Sl No | Title of the Book | Authors Name | Publisher | Year of Publication |
|---|---|---|---|---|
| 1 | Physics for Entertainment | Yakov Perelman | Createspace Independent Pub. | |
| 2 | Physics Everywhere | Yakov Perelman | Prodinnova | 2014 |
| 3 | Mechanics for Entertainment | Yakov Perelman | Prodinnova | 2014 |
| 4 | Handbook of Food and Nutrition | M.Swaminathan | Bangalore Press 2012 | 2012 |
| 5 | Food Science | B. Srilakshmi | New Age International Pub | 2015 |

## References Books

| Sl No | Title of the Book | Authors Name | Publisher | Year of Publication |
|---|---|---|---|---|
| **1** | Physics | Resnick, Halliday and Krane, Vol 1 | Wiley Student Edition. | |
| **2** | For the love of Physics | Walter Lewin | Taxmann Publications Private Limited | 2012 |
| 3 | An Introduction to the Physics of Sports | VassiliosMcInnesSpathopoulos | CreateSpace Independent Publishing Platform | 2013 |

**Internet resources**

**https://www.topendsports.com/biomechanics/physics.htm**

**https://www.real-world-physics-problems.com/physics-of-sports.html**

**https://www.healthline.com/**
**https://www.mayoclinic.org/**
**https://www.who.int/news-room/**

# NANOTECHNOLOGY

**Time: 2 hrs./week + 01 Hr tutorial** **Max Marks:**

| | | |
|---|---|---|
| Unit 1: | Introduction to nanomaterials<br>Length scales in physics, Nanostructures: 1D, 2D and 3Dnanostructures (nano dots, thin films,nanowires, nanorods), Band structure and density of states of materials at nanoscale, Size Effects in nano systems, Quantum confinement: Applications of Schrodinger equationInfinite potential well, potential step, potential box, quantum confinement of carriers in 3D,2D, 1D nanostructures and its consequences. | ( 13hours) |
| Unit 2: | Synthesis and Characterization of nanostructure materials<br>Top down and Bottom up approach, Photolithography. Ball milling. Gas phase condensation.Vacuum deposition. Physical vapor deposition (PVD): Thermal evaporation, E-beamevaporation, Pulsed Laser deposition. Chemical vapor deposition (CVD). Sol-Gel. Electrodeposition. Spray pyrolysis. Hydrothermal synthesis. Preparation through colloidal methods.MBE growth of quantum dots. X-Ray Diffraction. Optical Microscopy. Scanning ElectronMicroscopy. Transmission Electron Microscopy. Atomic Force Microscopy. ScanningTunneling Microscopy. | (13 hours) |
| Unit 3: | Properties and applications of nanomaterials<br>Coulomb interaction in nanostructures. Concept of dielectric constant for nanostructures andcharging of nanostructure. Quasi-particles and excitons. Excitons in direct and indirect bandgap semiconductor nanocrystals. Quantitative treatment of quasiparticles and excitons,charging effects. Radiative processes: General formalization-absorption, emission andluminescence. Optical properties of heterostrctures and nanostructures. Applications ofnanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solarcells). Nanomaterial Devices: Quantum dots heterostructure lasers, optical switching andoptical data storage. Magnetic quantum well; magnetic dots - magnetic data storage. | (13 hours) |
| References Books:<br>➢ C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.).<br>➢ S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publishing Company)<br>➢ K.K. Chattopadhyay and A. N. Banerjee, Introduction to Nanoscience and Technology(PHI Learning Private Limited).<br>➢ Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).<br>➢ M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama, Nanoparticle Technology Handbook(Elsevier, 2007).<br>➢ Introduction to Nanoelectronics, V.V. Mitin, V.A. Kochelap and M.A. Stroscio, 2011,Cambridge University Press.<br>➢ Bharat Bhushan, Springer Handbook of Nanotechnology (Springer-Verlag, Berlin, 2004). | | |

| | |
|---|---|
| **Student Activities:**<br>1. Synthesis of metal nanoparticles by chemical route.<br>2. Synthesis of semiconductor nanoparticles.<br>3. XRD pattern of nanomaterials and estimation of particle size.<br>4. To study the effect of size on color of nanomaterials.<br>5. Growth of quantum dots by thermal evaporation.<br>6. Prepare a disc of ceramic of a compound using ball milling, pressing and sintering, and study its XRD.<br>7. Fabricate a thin film of nanoparticles by spin coating (or chemical route) and study transmittance spectra in UV-Visible region.<br>8. Prepare a thin film capacitor and measure capacitance as a function of temperature or frequency.<br>9. Visit to nearby research labs to study the working of XRD, SEM, UV-Visible<br>Spectrophotometer instruments<br>10. Visit to nearby research labs for project work and interaction with scientists at IISC, JNCSR, Universities etc. | |

# ELECTRICAL INSTRUMENTS

**Time: 2 hrs./week + 01 Hr tutorial** **Max Marks:**

| Content | | Hrs |
|---|---|---|
| **Unit - 1** | | |
| **Chapter No. 1** | Voltage and current sources, Kirchoff's current and voltage laws, loop and nodal analysis of simple circuits with dc excitation. Ammeters,voltmeters: (DC/AC) | 03 |
| **Chapter No. 2** | Representation of sinusoidal waveforms, peak and rms values, power factor. Analysis of single-phase series and parallel R-L-C ac circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections. Wattmeters: Induction type, single phase and three phase wattmeter, Energy meters: AC. Induction type single phase and three phase energy meter | 05 |
| **Chapter No. 3** | Instrument Transformers: Potential and current transformers, ratio and phase angle errors, phasor diagram, methods of minimizing errors; testing and applications. | 05 |
| **Topics for self study ( If any)** | Types of switches and Circuits, Safety precautions and rules in handling electrical appliances, Electric shock, first aid for electrical shocks, Fuses, MCB, ELCB and Relays, Filament lamp, Tube light, CFL and LED | |
| | **Suggested Activities** | |
| **Activity No. 1** | Identify variety of electrical switches and note down their applications/utility. | |
| | Reference: Weblink/Youtube/Book | |
| **Activity No. 2** | Identify the hazards involved in handling electrical circuits and instruments, make a list of safety precautions as well as first aid for electrical shocks. | |
| | Reference : Weblink/Youtube/Book | |
| **Unit - 2** | | |
| **Chapter No. 4.** | Galvanometers: General principle and performance equations of D'ArsonvalGalvanometers, Vibration Galva nometer and Ballistic Galvanometer. | 03 |
| **Chapter No. 5.** | Potentiometers: DCPotentiometer, Crompton potentio meter, construction, standardization, application. AC Potentio meter, Drysdalepolar potentio meter; standardization, application. | 03 |
| **Chapter No. 6.** | DC/AC Bridges: General equations for bridge balance, measurement of self inductance by Maxwell's bridge (with variable inductance & variable capacitance), Hay's bridge, Owen's bridge, measurement of capacitance by Schearing bridge, errors, Wagner's earthing device, Kelvin's double bridge. | 07 |
| **Topics for self study ( If any)** | Importance of grounding and Earthing, Methods for Earthing, | |

| | Suggested Activities | |
|---|---|---|
| **Activity No. 3** | Make a study of importance of grounding in electrical circuits. | |
| | Reference : Weblink/Youtube/Book | |
| **Activity No. 4** | Prepare a detailed account of various methods of earthing and their utility/applications | |
| | Reference : Weblink/Youtube/Book | |
| **Unit - 3** | | |
| **Chapter No.7** | Transducer: Strain Gauges, Thermistors, Thermocouples, Linear Variable Differential Transformer (LVDT), Capacitive Transducers, Peizo-Electric transducers, Optical Transducer, Hall Effect Transducer | 06 |
| **Chapter No. 8** | CRO: Block diagram, Sweep generation, vertical amplifiers, use of CRO in measurement of frequency,phase, Amplitude and rise time of a pulse. Digital Multi-meter: Block diagram, principle of operation | 03 |
| **Chapter No. 9** | Basics of lead acid batteries, Lithium Ion Battery , Battery storage capacity, Coulomb efficiency, Numerical of high and low charging rates, Battery sizing. | 04 |
| **Topics for self study ( If any)** | Fuses, MCB, ELCB and Relays, Filament lamp, Tube light, CFL and LED | |
| | **Suggested Activities** | |
| **Activity No. 5** | Prepare a document on evolution of incandescent bulbs to the present day LED lights | |
| | Reference : Weblink/Youtube/Book | |
| **Activity No.6** | Make a comparative study of Fuses, MCB, ELCB and Relays highlighting their use and applications | |
| | Reference : Weblink/Youtube/Book | |

## Text Books

| |
|---|
| AK.Sawhney, ACourse inElec.&Electronics Measurements&Instrumentation **,Dhanpatrai& Co. 1978** |
| A.D. Helfrick& W.D. Cooper, Modern Electronic Instrumentation and Measurement Techniques **PHI,2016** |

## References Books

| | |
|---|---|
| **1.** | D C Kulshreshtha, Basic Electrical Engineering, Mc Graw Hill Publications,**2019** |
| **2.** | David G Alciatore and Michel B Histand, Introduction to Mechatronics and Measurement Systems, 3rd, Tata McGraw Hill Education Private Limited, New Delhi., 2005 |
| **3.** | Vincent Del Toro, Electrical Engineering Fundamentals Prentice Hall India**2009** |

## List of Experiments to be performed in the Laboratory

| Sl No | Experiment |
|---|---|
| **1** | Introduction to Lab Equipment |
| **2** | Voltmeter Design |
| **3** | Ammeter Design |
| **4** | Ohmmeter Design |
| **5** | Multimeter Design |
| **6** | Measurement of Resistance using Wheatstone Bridge |
| **7** | Measurement of Capacitance using Schering Bridge |
| **8** | Measurement of Inductance using Maxwell Bridge |
| **9** | Measurement of Light Intensity |
| **10** | Measurement of Temperature |
| | **Reference Book for Laboratory Experiments** |
| | AK.Sawhney ACourse inElec.&Electronics Measurements&Instrumentation: |
| | Helfrick& Cooper, Modern Electronic Instrumentation and Measurement Techniques: |

# PHYSICS FOR ALL

**Time: 2 hrs./week + 01 Hr tutorial** **Max Marks:**

| | | |
|---|---|---|
| **Unit I** | **Energy and Power**<br>Explosions and energy; Energy, heat and its units; Energy table and discussions; Discussion of cost of energy; Measuring energy; Power; Different power sources; Kinetic energy. | (13 Hours) |
| **Unit II** | **Gravity, Force and Space**<br>The force of Gravity; Newton's third law; Weightlessness; Low earth orbit; Geosynchronous satellites; Spy satellites; Medium Earth Orbit satellite; Circular Acceleration; momentum; Rockets; Airplanes, helicopters and fans; Hot air and helium balloons; angular momentum and torque. | (13 Hours) |
| **Unit III** | **Nuclei and radioactivity**<br>Radioactivity; Elements and isotopes; Radiation and rays; Seeing radiation; The REM – The radiation poisoning; Radiation and cancer; The linear hypothesis; Different types of radiation; The half-life rule; Smoke detectors; measuring age from radioactivity; Environmental radioactivity; Glow of radioactivity; Nuclear fusion. | (13 Hours) |
| **Unit IV** | **Climate change**<br>Global warming; IPCC; A brief history of climate; carbon dioxide; The greenhouse effect; Enhancement of Greenhouse effect; Hurricane and tornadoes; Antarctica; Fluctuations; Paleoclimate; Global warming vs Human caused global warming; Can we stop global warming?, Fossil Fuel Resources; Energy security; Energy efficiency and conservation; Bio-fuels; Nuclear, Wind and Solar power. | (13 Hours) |
| | **References**<br>This course is extracted from the book titled "Physics and Technology for Future Presidents: An Introduction to the Essential Physics Every World Leader Needs to Know" by Richard A Muller, WW Norton and Company, 2007. (Unit-1 to 4 are from chapters 1, 3, 4 and 10, respectively). | |

# SPACE MISSIONS

**Time: 2 hrs./week + 01 Hr tutorial** **Max Marks:**

| | | |
|---|---|---|
| **Unit 1:** | **Introduction to Space Missions :**<br><br>Rockets, types and their applications, Different types of orbits, Artificial satellites – basic idea and their applications, Introduction to Space Missions, Beginning of Space Missions - World and India, Applications of Space Research, Space crafts, Launching Vehicles. | **13 Hours** |
| **Unit 2:** | **National Aeronautics and Space Administration (NASA)**<br><br>About NASA and its Goals, History of Creation.<br>Foundational human spaceflight: X-15 program (1954–1968), Project Mercury (1958–1963), Project Gemini (1961–1966), Project Apollo (1960–1972), Skylab (1965–1979), Apollo-Soyuz (1972–1975).<br><br>Modern human spaceflight programs: Space Shuttle program (1972–2011), International Space Station (1993–present), Constellation program (2005–2010), Commercial Crew Program (2011–present), Journey to Mars (2010–2017), Artemis program (2017–present). | **13 Hours** |
| **Unit 3:** | **Indian Space Research Organisation (ISRO)**<br><br>About ISRO and its Goals, History of Creation.<br>General Satellite Programmes: The IRS series, The INSAT series. Gagan Satellite Navigation System, Navigation with Indian Constellation (NavIC), Other satellites.<br><br>Launch vehicles: Satellite Launch Vehicle (SLV), Augmented Satellite Launch Vehicle (ASLV), Polar Satellite Launch Vehicle (PSLV), Geosynchronous Satellite Launch Vehicle (GSLV).<br>Experimental Satellites: Details and applications (Any Five)<br>Earth Observation Satellites: Details and applications (Any Five)<br>Communication satellites: Details and applications (Any Five) | **13 Hours** |
| | **Self Study:**<br><br>Major Space Centres in the World (at least 10) – brief idea about their location, establishment, capabilities and achievements. People behind space programs – at least 2 from India. Successful Missions (Any Five).<br><br>**Activities*:**<br><br>• Design of working model of Rocket launching.<br>• Preparation of report and presentation on application of satellites in agriculture, communication, weather forecasting, exploration of natural resources and Global positioning system (GPS).<br><br>* Faculty may suggest any other relevant activity as well.<br>Preparation of report and presentation onApollo 11: A Success story | |

| | | |
|---|---|---|
| | **Activities:**<br><br>• Preparation of report and presentation on the recent space missions of NASA.<br>• Preparation of report on any one proposed space programmeof NASA.<br><br>* Faculty may suggest any other relevant activity as well.<br>Chandrayaan 1: Details and applications. Mars Orbiter Mission: Details and applications.<br><br>**Activities:**<br><br>• Preparation of report and presentation on the recent space missions of ISRO.<br>• Preparation of report and presentation on any one proposed space programmeof ISRO.<br>• Preparation of report and presentation on the contributions of Scientists from Karnataka to Indian Space Program and use of space technology in the local district.<br><br>* Faculty may suggest any other relevant activity as well. | |

# Activity Based Pedagogy:

## (Design, Activity and Assessment)

Conducting activity based teaching-leaning experience for students empower students with several graduate attributes by addressing several Outcomes at different levels of the Cognitive Blooms Taxanomy of Learning: like Clarity of Concept, ability to apply knowledge, evaluate and analyse the results, while they are also learn through the Affective and Psycho-motor domains of Learning through self-learning, group dynamics and team work, communication and presentation skills, ethics, life-long learning, etc. These experiments must be ones that do not involve sophisticated instrumentation and should be able to be performed outside laboratories.

## Example 1: Elastic Properties of Solids:

The most important concept of studying elastic properties of solids is the Hooke's Law, which defines the stress-strain relationship.

**Class 1:** Defining problems, forming groups and giving instructions:

- The students should be made into forced groups of 6 to 8 members, depending on the class strength, consisting of diverse kinds of students in cognition, cultural, sex, behaviour, etc.
- Different materials of varying elastic properties should be given to each group, and should be asked to plot a graph of stress-strain of these materials in 8-10 days.
- Give clear instructions and clarify doubts, but not giving the procedure for the experiments. Students should discuss among themselves and consult books and internet to identify the procedure to obtain the Stress-strain graph. They should use only house-hold items or other commonly available tools to perform all the experiments.

**Class 2:** Presentation and discussion by students (max 8-10 mins each)

- Each group will be asked to make a presentation of 2 power point slides, where the first one explains the process they went through to arrive at the results and the second one shows their measured graph and an ideal text book plots. This slide should also contain two or three explanations of why both the plots differ.
- The student who will make the presentation on behalf of the group will be randomly selected just before the presentations. This will ensure that all group members will be mutually train each other for the presentation.
- The teacher should give equal marks to each member of a group depending on the methods adopted and clarity of concepts and results obtained and ability to analyse.

The following Program Outcomes will be attained by the students in such an activity based learning:

P.O. 1 : Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.
P.O. 3 : Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.
P.O. 5 : Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.
P.O. 6 : Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

## Example 2: Periodic and Non-Periodic Motions

Most important aspect of understanding this topic is to distinguish them with the amplitude versus distance and amplitude versus time plots.

**Class 1:** Defining problems and giving instructions

- Each student will be asked to list as many observations as possible, under the two types of motion as they observe in the external world (home, market, college, etc) in 8-10 days.
- The student will be asked to identify any one motion in each of the lists and plot graphs of amplitude versus distance and amplitude versus time for each of them in the 8-10 days.

**Class 2:** Peer evaluation by students and defending self

- Each student is asked to submit the lists of periodic and non-periodic motions observed in everyday life.
- Each student is also asked to submit the amplitude versus distance and amplitude versus time of one periodic motion and one non-periodic motion of his/her choice among his/her list.
- The submissions are randomly distributed among other students. Teacher now discusses the two types of motions in the lists of students and shows how the graphs will ideally look like.
- Now students are asked to evaluate and mark the submissions of other students they have with them and then the marked papers are returned to the respective students.
- Each student should be given an opportunity to question the marks he has got and each student who has given the marks should be able to defend his choice or marks.
- While observing the lists, marks obtained and the plots made, the teacher can assign marks to each student.

The following Program Outcomes will be attained by the students in such an activity based learning:

P.O. 1. Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.
P.O. 4. Ethics: Apply the professional ethics and norms in respective discipline.
P.O. 6. Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

## Continuous Formative Evaluation/ Internal Assessment:

Total marks for each course shall be based on continuous assessments and semester end examinations. The pattern of 40 : 60 for IA and Semester End theory examinations respectively and 50 : 50 for IA and Semester End practical examinations respectively.

Total Marks for each Course = 100 marks
Continuous assessment (C1) = 20 marks
Continuous assessment (C2) = 20 marks
Semester End Examination (C3) = 60 marks

## Evaluation process of IA marks shall be as follows:

a) The first component (C1) of assessment is for 20% marks. This shall be based on test, assignment, seminar, case study, field work, project work etc. This assessment and score process should be completed after completing 50% of syllabus of the course/s and within 45 working days of semester program
b) The second component (C2) of assessment is for 20% marks. This shall be based on test, assignment, seminar, case study, field work, internship / industrial practicum / project work etc. This assessment and score process should be based on completion of remaining 50 percent of syllabus of the courses of the semester.
c) During the 17th – 19th week of the semester, a semester end examination shall be conducted by the University for each Course. This forms the third and final component of assessment (C3) and the maximum marks for the final component will be 60%.
d) In case of a student who has failed to attend the C1 or C2 on a scheduled date, it shall be deemed that the student has dropped the test. However, in case of a student who could not take the test on scheduled date due to genuine reasons, such a candidate may appeal to the Program Coordinator / Principal. The Program Coordinator / Principal in consultation with the concerned teacher shall decide about the genuineness of the case and decide to conduct special test to such candidate on the date fixed by the concerned teacher but before commencement of the concerned semester end examinations.
e) For assignments, tests, case study analysis etc., of C1 and C2, the students should bring their own answer scripts (A4 size), graph sheets etc., required for such tests/assignments and these be stamped by the concerned department using their department seal at the time of conducting tests / assignment / work etc.
f) The outline for continuous assessment activities for Component-I (C1) and Component-II (C2) of a course shall be as under.
g)

| **Activities** | **C1** | **C2** | **Total Marks** |
|---|---|---|---|
| Session Test | 10 marks | 10 marks | 20 |
| Seminars/Presentations/Activity | 10 marks | | 10 |
| Case study /Assignment / Field work / Project work etc. | | 10 marks | 10 |
| Total | 20 marks | 20 marks | 40 |

- For practical course of full credits, Seminar shall not be compulsory. In its place, marks shall be awarded for Practical Record Maintenance.(the ratio is 50 (25 + 25) : 50)
- Conduct of Seminar, Case study / Assignment, etc. can be either in C1 or in C2 component at the convenience of the concerned teacher.
- The teachers concerned shall conduct test / seminar / case study, etc. The students should be informed about the modalities well in advance. The evaluated courses / 29 assignments during component I (C1) and component II (C2) of assessment are immediately provided to the candidates after obtaining acknowledgement in the register by the concerned teachers(s) and maintained by the Chairman in the case of a University Post-Graduate Department and the Principal / Director in the case of affiliated institutions. Before commencement of the semester end examination, the evaluated test, assignment etc. of C1 and C2 shall be obtained back to maintain them till the announcement of the results of the examination of the concerned semester.

h) The marks of the internal assessment shall be published on the notice board of the department / college for information of the students.

i) The Internal assessment marks shall be communicated to the Registrar (Evaluation) at least 10 days before the commencement of the University examinations and the Registrar (E) shall have access to the records of such periodical assessments.

j) There shall be no minimum in respect of internal assessment marks.

k) Internal assessment marks may be recorded separately. A candidate who has failed or rejected the result, shall retain the internal assessment marks.

## Scheme of Valuation for Practicals

C1 and C2 are internal tests to be conducted during 8th and 16th weeks respectively of the semester. C3 is the semester-end examination conducted for 3 hours. The student will be evaluated on the basis of skill, comprehension and recording the results. The student has to compulsorily submit the practical record for evaluation during C1 and C2. For C3, the record has to be certified by the Head of the Department.

• The student is evaluated for 25 marks in C1 and C2 as per the following scheme:

Experiment: 20, Record: 05 for C1 (25 marks)

Experiment: 20, Record: 05 for C2 (25 marks)

• The student is evaluated for 50 marks in C3 as per the following scheme:

Experiment: 35, Viva: 15 for C3 (50 marks)

The experimental portion of evaluation (C3) is carried out as per the following scheme:

| | |
|---|---|
| Formula with proper units and explanation | 08 |
| Setting up the apparatus / circuit connections | 07 |
| Taking readings and tabulating | 10 |
| Calculations and Graph | 10 |
| Viva | 15 |
| Total | 50 |

## QUESTION PAPER PATTERN

### DSC Courses and similar courses

Max Marks: Time: 3 hours

**Unit 1**

Long answer questions; Answer 1 out of 2 $1 \times 10 = 10$

**Unit 2**

Long answer questions; Answer 1 out of 2 $1 \times 10 = 10$

**Unit 3**

Long answer questions; Answer 1 out of 2 $1 \times 10 = 10$

**Unit 4**

Long answer questions; Answer 1 out of 2 $1 \times 10 = 10$

**Numerical problems;** Six numerical problems (one each from unit); 4 to be answered $4 \times 5 = 20$