**GOVERNMENT COLLEGE FOR MEN(A), KADAPA**
**B.Sc. (HONOURS) PHYSICS Single Major**
**w.e.f. 2024-25 (Revised in CBCS )**
**SEMESTER-V**
**COURSE 12: APPLICATIONS OF ELECTRICITY AND MAGNETISM**

Theory Credits: 3 3 hrs/week

**COURSE OBJECTIVE:**

The objective of the course on Applications of Electricity and Magnetism is to provide students with a comprehensive understanding of the practical applications of electricity and magnetism in various fields. The course aims to develop students' knowledge and skills in applying electrical and magnetic principles to real-world problems and technologies.

**LEARNING OUTCOMES:**

Students after successful completion of the course will be able to:

1. Identify various components present in Electricity& Electronics Laboratory.
2. Acquire a critical knowledge of each component and its utility (like resistors, capacitors, inductors, power sources etc.).
3. Demonstrate skills of constructing simple electronic circuits consisting of basic circuit elements.
4. Understand the need & Functionality of various DC & AC Power sources.
5. Comprehend the design, applications, and practices of various electrical & Electronic devices and their trouble shooting.

**Unit-I: Introduction to Passive Elements**

**a) Passive elements**

Resistor - Types of Resistors, Color coding, Combination of Resistors – Series combination (Voltage division), Parallel combination (Current division), Ohms Law and its limitation. Inductor - Principle, EMF induced in an Inductor, Energy stored in Inductor, Phase relation between V and I, Combinations of Inductors, Types of Inductors. Capacitor - Principle, Charging and discharging of a Capacitor, Types of Capacitors, Color coding

**b) Applications of Passive elements:**

Applications of a Resistor as a heating element in heaters and as a fuse element. Open circuit, Short circuit, Applications of Inductors, Application of choke in a fan and in a radio tuning circuit, Series resonance circuit as a Radio tuning circuit. Applications of Capacitor in power supplies, motors (Fans) etc**.**

**Unit-II Power Sources (Batteries)**

**a) Power sources:**

Types of power sources-DC & AC sources, Different types of batteries, Rechargeable batteries –Lead acid batteries, Li-ion batteries **Series, Parallel & Series-Parallel configuration of batteries**,



**b) Network Theorems for DC circuits**

Thevenin’s theorem, Norton’s theorem, Maximum Power transfer theorem, Constant Voltage source-

Constant Current Source-Applications of Current sources & Voltage sources, SMPS used in computers.

**Unit-III Alternating & Direct Currents**

A.C Generator, Construction and its working principle, Types of AC Generators, DC Generator, Construction and its working principle, advantages and disadvantages, Applications, Types of DC Generators, Losses associated with DC generators, Differences between DC and AC generators

a) Transformers- Construction and its working principle, EMF equation, Open circuit and short circuit tests, Types of Transformers - Step-down and Step-up Transformers, Relation between primary turns and secondary turns of the transformer with emf, Use of a Transformer in a regulated Power supplies, Single phase motor – working principle, Applications of motors (like water pump, fan etc).

**Unit-IV Modulation Circuits**

a) Need for modulation, Types of modulation, Amplitude modulation, modulation index, Waveforms, Power relations, Demodulation, Diode detector, AM transmitter, AM Receiver, Frequency modulation, modulation index, Waveforms, FM Transmitter, FM Receiver

**b) Transmitters and Receivers:**

AM transmitter, AM Receiver, Frequency modulation, modulation index, Waveforms, FM Transmitter, FM Receiver

**Unit-V Applications of EM Induction & Power Supplies**

a) DC motor – Construction and operating principle, Calculation of power, voltage and current in a DC motor, Design of a simple Motor (for example Fan) with suitable turns of coil

b) Working of a DC regulated power supply, Construction of a 5 volts regulated power supply, Design of a step-down (ex:220-12V) and step-up (ex:120-240V) transformers-Simple Design of FM Radio circuit using LCR series resonance (tuning) circuit, Checking the output voltage of a battery eliminator using a Multimeter. (Trouble shooting), Design of a simple 5 volts DC charger, Power supply for computers (SMPS)

**References:**

1. Grob's Basic Electronics by Mitchel Schultz , TMH or McGraw Hill
2. Electronic and Electrical Servicing by Ian Robertson Sinclair, John Dunton, Elsevier Publications
3. Troubleshooting Electronic Equipment by R.S.Khandapur ,TMH
4. Web sources suggested by the teacher concerned and the college librarian including reading material

**MODEL QUESTION PAPER**
**GOVERNMENT COLLEGE FOR MEN (AUTONOMOUS), KADAPA**

**B.Sc. V SEMESTER END EXAMINATION**

**SUBJECT: PHYSICS**

**Title of the Paper: 12: Applications of Electricity & Electronics**

***Time: 3 hr.*** ***Max. Marks: 60***

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**Section A**

**Answer any *FIVE* of the following. Each carries 4 marks. 5X4 = 20 marks**

1. Write different types of Resistors and its Color coding.
2. Derive the expression for EMF induced in an Inductor.
3. Briefly explain about Rechargeable batteries.
4. Explain working principle of single phase motor.
5. Explain the measurement of output voltage of eliminator using Multimeter.
6. What are the Differences between DC and AC generators?
7. Explain about the Power supply (SMPS) used in computers.
8. Four batteries each of e.m.f 1.5 V and internal resistance 0.5 Ω are connected in series to a 4 Ω resister. Calculate the current pass through the resister if one of the battery is reversed.

**SECTION B**

**Answer any *FIVE* of the following. Each carries 8 marks. 5X8 = 40 marks**

9. Explain the effect of dielectric on energy stored, charge and potential.
10. Explain Series and Parallel configuration of batteries.
11. Explain construction and working principle of transformers
12. Explain the design of FM Radio circuit using LCR series circuit.
13. Explain the DC motor Construction and operating principle.
14. Write the applications of a Resistor in heaters and as a fuse element.
15. Explain the role of a Transformer in a regulated Power supplies
16. Explain A.C Power generator Construction and its working principle.

**SEMESTER-V**

**COURSE 12: APPLICATIONS OF ELECTRICITY AND MAGNETISM**

Practical Credits: 1 2 hrs/week

**COURSE OBJECTIVE:**

The objective of the practical course on Applications of Electricity and Magnetism is to provide students with hands-on experience and practical skills in applying electrical and magnetic principles to real-world applications. The course aims to develop students' proficiency in working with electrical circuits, electromagnetic devices, and related technologies through practical experimentation and project-based activities**.**

**LEARNING OUTCOMES:**

On successful completion of this practical course, studentshall be able to:

1. List out, identify and handle various equipment in Electrical & Electronics laboratory.
2. Learn the procedures of designing simple electrical circuits.
3. Demonstrate skills on the utility of different electrical components and devices.
4. Acquire the skills regarding the operation, maintenance and troubleshooting of various Devices in the lab.
5. Understand the different applications of Electromagnetic induction.

**Practical (Laboratory) Syllabus:**

1. Acquainting with the soldering techniques
2. Design and Construction of a 5 Volts DC unregulated power supply
3. Construction of a Step-down Transformer and measurement of its output voltage. And to compare it with the calculated value.
4. Connect two or three resistors or capacitors or inductors and measure the Series, Parallel Combination values using a Multimeter and compare the values with the Calculated values.
5. Use the Digital Multimeter and Analog Multimeter to measure the output voltage of an AC &DC power supply and the voltage and frequency of a AC signal using CRO.
6. 
7. Construct a series electric circuit with R, L and C having an AC source and study the frequency response of this circuit. Find the Resonance Frequency.
8. Construct a Parallel electric circuit with R, L & C having an AC source and study the frequency response of this circuit. Find the resonant frequency.

9. Test whether a circuit is a Open circuit or Short Circuit by measuring continuity witha Multimeter and record your readings.

**I. Lab References:**


1. Laboratory Manual for Introductory Electronics Experiments by Maheshwari, L.K. Anand, M.M.S., New Age International (P) Ltd.
2. Electricity-Electronics Fundamentals: A Text-lab Manual by Paul B. Zbar,Joseph Sloop, & Joseph G. Sloop , McGraw-Hill Education
3. Laboratory Manual Basic Electrical Engineering by Umesh Agarwal, Notion Press
4. Basic Electrical and Electronics Engineering by S.K. Bhattacharya , Pearson Publishers.
5. Web sources suggested by the teacher concerned.


**STUDENT ACTIVITIES**

**Co-Curricular Activities:**

**(a) Mandatory:**(*Training of students by teacher in field related skills: (lab:10 + field: 05*)

1. **For Teacher**: Training of students by the teacher (if necessary, by a local expert) in laboratory/field for not less than 15 hours on the understanding of various electronic &electrical components and devices. And also understand the functional knowledge of these components and devices so that the student can safely handle these electronic components.

2. **For Student**: Students shall (individually) visita local Radio, TV or Mobile repair shopto understand the testing and soldering techniques and different electronic components in the devices that we use daily life. And also to understand the troubleshooting and working of domestic appliances such as cell phone chargers, fan, electric iron, heater, inverter, micro oven, washing machine etc.(Or)Students shall also visit the Physics/Electronics or Instrumentation Labs of nearby local institutions and can get additional knowledge by interacting with the technical people working there. (Or)Students shall also visit the local motor winding shop to understand the motor winding and working of different types of motors. After the observations, a hand- written Fieldwork/Project work not exceeding 10 pages in the given format to be submitted to the teacher.
3. Max marks for Fieldwork/Project work: 05.
4. Suggested Format for Fieldwork/Project work: *Title page, student details, index page, details of place visited, observations, findings and acknowledgements*.
5. Unit tests (IE).

**(b) <u>Suggested Co-Curricular Activities</u>**

1. Training of students by related industrial experts.
2. Assignments (including technical assignments like identifying various electrical and electronic components &devices and their handling, operational techniques with safety and security)
3. Seminars, Group discussions, Quiz, Debates etc. (on related topics).
4. Preparation of videos on tools and techniques in Electrical & Electronic Appliances in daily life.
5. Collection of material/figures/photos related to Electrical products like Heaters, Motors, Fans etc. and writing and organizing them in a systematic way in a file.
6. Visits to nearby electrical or electronic industries or laboratories in universities, research organizations, private firms, etc.
7. Invited lectures and presentations on related topics by field/industrial experts

**SEMESTER-V**
**COURSE 13: ELECTRONIC INSTRUMENTATION**

Theory Credits: 3 3 hrs/week

**COURSE OBJECTIVE:**

The objective of the course on Electronic Instrumentation is to provide students with a comprehensive understanding of various electronic instruments used for measurement, data acquisition, and control applications. The course aims to develop students' knowledge and skills in the design, operation, calibration, and application of electronic instruments.

**LEARNING OUTCOMES:**

Students after successful completion of the course will be able to:

1. Identify various facilities required to set up a basic Instrumentation Laboratory.
2. Acquire a critical knowledge of various Electrical Instruments used in the Laboratory.
3. Demonstrate skills of using instruments like CRO, Function Generator, Multimeter etc. through hands on experience.
4. Understand the Principle and operation of different display devices used in the display systems and different transducers
5. Comprehend the applications of various biomedical instruments in daily life like B.P. meter, ECG, Pulse oximeter etc. and know the handling procedures with safety and security.

**UNIT-I Introduction to Instruments**

( a) Basic of measurements:

Instruments accuracy, precision, sensitivity, resolution, range, errors in measurement, Classification of Instruments, Analog instruments & Digital Instruments, Construction and working of an Analog Multimeter and Digital Multimeter (Block diagram approach), DC Voltmeter and AC Voltmeter, Sensitivity, 3½ display and 4½ display Digital Multimeter, Sources of errors in the Measurement of resistance, voltage and current, Specifications of Multimeter and their significance.

b) Balancing and damping Moving iron instruments & PMMC instruments.

**UNIT-II Oscilloscope** (

a) Cathode ray oscilloscope – Principle and block diagram of CRO - Cathode Ray Tube – functioning – various controls

b) Applications CRO: Measurement of voltage (dc and ac), frequency & time, Different types of oscilloscopes and their uses, Digital storage Oscilloscope

**UNIT-III Transducers and Bridges** (

a) Linear Variable Differential Transformer (LVDT), Resistive, Capacitive & Inductive transducers, Piezo-electric transducer.

b) DC Bridge -Wheatstone's bridge, AC Bridges - Measurement of Inductance and Capacitance – Maxwell's bridge, Schering Bridge, Measurement of frequency – Wien's bridge.

**UNIT-IV ADC and DAC & Display Instruments**

a) A/D & D/A converters - Binary ladder, A/D converters –successive approximation type.

b) Introduction to Display devices, LED Displays, Seven Segment Displays, Construction and operation (Display of numbers), Types of SSDs (Common Anode & Common Cathode type), Limitations of SSDs, Liquid Crystal Displays, Principle and working, Applications of LCD modules.

**UNIT-V Amplifiers, Oscillators & Biomedical Instruments**

a) Amplifiers – Classification of amplifiers, Coupling amplifiers – RC Coupled amplifier – frequency response characteristics (no derivation), Feedback in Electronic circuits – Positive and Negative feedback, expressions for gains, advantages of negative feedback, Barkhausen criteria, RC phase shift oscillator.

**b)** Basic operating principles and uses of (i) ECG machine (ii) Radiography (iii) Ultrasound scanning (iv) Ventilator (v) Pulse oximeter.

**REFERENCE BOOKS:**


1. Electronic Instrumentation by H.S.Kalsi ,TMH Publishers
2. Electronic Instrument Hand Book by Clyde F. Coombs ,McGraw Hill
3. Introduction to Biomedical Instrumentation byMandeep Singh, PHI Learning.
4. Electronic Instrumentation – WD Cooper
5. Electrical and Electronic Instrumentation – AK Sawhany
6. A text book in electrical technology by B.L.Thereja (S.Chand&Co)
7. *Biomedical Instrumentation* and Measurements by Leslie *Cromwell ,Prentice Hall India.*
8. Electronic Measurements and Instrumentation by Kishor, K Lal, Pearson, New Delhi
9. Electrical and Electronic Measurements by Sahan, A.K., Dhanpat Rai, New Delhi
10. Electronic Instruments and Measurement Techniques by Cooper, W.D. Halfrick, A.B., PHI Learning, New Delhi
11. Web sources suggested by the teacher concerned and the college librarian including reading material.

**MODEL QUESTION PAPER**
**GOVERNMENT COLLEGE FOR MEN (AUTONOMOUS), KADAPA**

**B.Sc. V SEMESTER END EXAMINATION**

**SUBJECT: PHYSICS**

**Title of the Paper: 13: ELECTRONIC INSTRUMENTATION**

***Time: 3 hr.*** ***Max. Marks: 60***

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**Section A**

**Answer any *FIVE* of the following. Each carries 4 marks. 5X4 = 20 marks**

1. Differentiate between analog and digital instruments.
2. Write brief note on function generator.
3. Explain time-based operation of CRO.
4. Write advantages of digital oscilloscope over CRO
5. What is a transducer? Explain classification of transducers
6. Write a short note on fibre optic sensors
7. Explain construction of seven segment display..
8. Explain function of ventilator

**SECTION B**

**Answer any *FIVE* of the following. Each carry 8 marks. 5X8 = 40 marks**

9. Explain construction and working of digital multimeter with the help of block diagram
10. Explain construction and working of digital oscilloscope.
11. Explain the principle and working of piezoelectric transducer and write their applications
12. Describe the construction of LVDT, and illustrate its working mechanism
13. Elucidate the construction and operation of seven segment display
14. Write down principle and working of 4x16 LCD modules and write applications of LCD modules.
15. Explain working of digital clinical thermometer and sphygmomanometer
16. Discuss the working of ultrasound scanning.

**SEMESTER-V**
**COURSE 13: ELECTRONIC INSTRUMENTATION**

Practical Credits: 1 2 hrs/week

**COURSE OBJECTIVE:**

The objective of the practical course on Electronic Instrumentation is to provide students with hands-on experience in using electronic instruments for measurement, data acquisition, and control applications. The course aims to develop students' practical skills in operating, calibrating, and troubleshooting electronic instruments commonly used in scientific, engineering, and industrial settings.

**LEARNING OUTCOMES:**

1. Familiarize students with a range of electronic instruments, including multimeters, oscilloscopes, signal generators, and data acquisition systems.
2. Learn the basic operation, functions, and features of each instrument.
3. Gain hands-on experience in connecting, configuring, and using different instruments for various measurement tasks.
4. Develop proficiency in performing common electrical measurements, such as voltage, current, resistance, frequency, and temperature measurements.
5. Learn specialized measurement techniques, including impedance measurements, time and frequency measurements, and power measurements.
6. Gain practical experience in selecting appropriate measurement techniques and instruments for specific applications.

**PRACTICAL SYLLABUS**

1. Familiarization of digital multimeter and its usage in the measurements of (i) resistance (ii) current, (iii) AC & DC voltages
2. Measure the AC and DC voltages, frequency using a CRO and compare the values measured with other instruments like Digital multimeter.
3. Formation of Sine, Square wave signals on the CRO using Function Generator and measure their frequencies. Compare the measured values with actual values.
4. Display the numbers from 0 to 9 on a single Seven Segment Display module by applying voltages.
5. Displacement transducer-LVDT
6. A.C - Impedance and Power Factor.
7. Maxwell's Bridge – Determination of Inductance.
8. Measurement of body temperature using a digital thermometer and list out the error and corrections.
9. Measurement of Blood Pressure of a person using a B.P. meter and record your values and analyze them.
10. Display the letters **a** to **h** on a single Seven Segment Display module by applying voltages.

11. Get acquainted with an available ECG machine and study the ECG pattern to understand the meaning of various peaks
12. Observe and understand the operation of a Digital Pulseoxymeter and measure the pulse rate of different people and understand the working of the meter.

**VI. Lab References:**


1. Electronic Measurement and Instrumentation by J.P. Navani. ,S Chand & Co Ltd
2. Principles of Electronic Instrumentation by A De Sa, Elsevier Science Publ.
3. Electronic Measurements and Instrumentation by S.P.Bihari, YogitaKumari, Dr. Vinay Kakka, Vayu Education of India .
4. Laboratory Manual For Introductory Electronics Experiments by Maheshwari, New Age International (P) Ltd., Publishers.
5. Electricity-Electronics Fundamentals: A Text-lab Manual by Paul B. Zbar ,Joseph Sloop, & Joseph G. Sloop , McGraw-Hill Education.
6. Web sources suggested by the teacher concerned.


STUDENT ACTIVITIES

**Co-Curricular Activities**

**(a) Mandatory:**(*Training of students by teacher in field related skills: (lab:10 + field:05*)

1. **For Teacher**: Training of students by the teacher in the in the laboratory/field for notless than 15 hours on the field techniques/skills of understanding the operation, Maintenance and utility of various electrical and electronic instruments both in the Laboratory as well as in daily life.

   **For Student**: Students shall (individually)visit a local electrical and electronics shop or small firm to familiarize with the various electrical and electronic instruments available in the market and also to understand their functionality, principle of operation and applications as well as the troubleshooting of these instruments.(Or) Student shall visit a diagnostic centre and observe the ECG machine and the ECG pattern(Or) Student shall visit a diagnostic centre and observe the CT scan and MRI scan.(Or) Student shall visit a mobile smart phone repair shop and observe the different components on the PCB(Motherboard), different ICs (chips) used in the motherboard and trouble shooting of touch screen in smart phones.

   Observations shall be recorded in a hand-written Fieldwork/Project work not exceeding 10 pages in the given format to be submitted to the teacher.
2. Max marks for Fieldwork/Project work: 05.
3. Suggested Format for Fieldwork/Project work: *Title page, student details, index page, details of place visited, observations, findings and acknowledgements*.
4. Unit tests (IE)

**(b) Suggested Co-Curricular Activities**



1. Training of students by related industrial / technical experts.
2. Assignments (including technical assignments like identifying different measuring

instruments and tools and their handling, operational techniques with safety and security.

3. Seminars, Group discussions, Quiz, Debates etc. (on related topics).
4. Making your own stethoscope at home.
5. Making seven segment display at home.
6. Preparation of videos on tools and techniques in various branches of instrumentation.
7. Collection of material/figures/photos related to products of Measuring Instruments, Display Modules and Biomedical Instruments and arrange them in a systematic way ina file.
8. Visits to Instrumentation Laboratories of local Universities or Industries like Cement, Chemical or Sugar Plants etc. or any nearby research organizations, private firms, etc.
9. Invited lectures and presentations on related topics by Technical /industrial experts

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**SEMESTER-V**
**COURSE 14A: OPTICAL INSTRUMENTS AND OPTOMETRY**

Theory Credits: 3 3 hrs/week

**COURSE OBJECTIVE**:
The objective of the course on Optical Instruments and Optometry is to provide students with a comprehensive understanding of the principles, design, and application of optical instruments used in various fields, with a specific focus on optometry

**LEARNING OUTCOMES:**
Students at the successful completion of the course will be able to:

1. Understand the construction and working principles of various optical instruments usedin daily life.
2. Acquire a critical knowledge on the various defects of eye and their correcting methodswith suitable lenses.
3. Demonstrate skills of using biological microscope through hands on experience.
4. Understand the various techniques used in optometry and computer based eye testing.
5. Comprehend the various applications of microscopes and telescopes.

**UNIT-I Optical Microscopes**

Simple Microscope-Construction, Magnifying power, normal adjustment; Compound Microscope-Construction, Magnifying power, normal adjustment, Phase contrast microscope-Operating principle, travelling microscope-Construction, workingand uses

**UNIT-II Telescopes**

Refracting Telescopes and Reflecting telescopes, Construction, working and magnifying power of Astronomical Telescope and Terrestrial Telescopes, Binoculars – working principle and applications.

**UNIT-III Applications Of Optical Instruments**

Introductory ideas and applications of various microscopes *viz*., (i) Optical microscopes (Compound microscope, Stereo microscope, Confocal microscope) (ii) Electron microscopes (TEM, SEM), (iii) Scanning Probe microscope (iv) Scanning Acoustic microscope and (v) X-ray microscope. Introductory ideas and applications of various telescopes *viz*., (i) Optical telescopes (ii) Radio telescopes (iii) Solar telescopes (iv) Infrared telescope (v) Ultraviolet telescope



**UNIT-IV Optical Vision**

Introduction to optical Vision, Eye as an optical instrument, Formation of image in the eyeand

the camera, Ophthalmic lenses, Myopia and Hypermetropia defects, Removal of defects in vision using ophthalmic lenses, Contact lenses-Working principle, Different types of Contact lenses.

**UNIT-V Ophthalmic Techniques and Optometry**

Ophthalmoscope and keratometer and their working principles, Evaluation of eye disorders, Guidelines for standardized eye chart preparation, Simple phoropter and its working principle and its uses, Principles of Computer based eye testing

**Reference Books**


1. Optics and Optical Instruments: An Introduction by B. K. Johnson, Dover Publications.
2. Modern Optical Instruments and their construction by or ford Henry-Publisher: Biblio Life, LLC.
3. A Text Book of Optics by Brj Lal and N.Subramanyam, S.Chand & Co.
4. Practical Optics by Menn Naftly, Elsevier Science Publishing.
5. Applications of Optics in daily life | CK-12 Foundation. https://flexbooks.ck12.org ›
6. Web sources suggested by the teacher concerned and the college librarian including Reading material.

**MODEL QUESTION PAPER**
**GOVERNMENT COLLEGE FOR MEN (AUTONOMOUS), KADAPA**
**B.Sc. V SEMESTER END EXAMINATION**
**SUBJECT: PHYSICS**
**Title of the Paper: 14A: Optical instruments and Optometry**

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**Time: 3 hr.** **Max. Marks: 60**

**Section – A**

Answer any Five questions. Each carry 4 marks. (5 ×4 = 20 Marks)

1. Define magnifying power of a simple microscope. Derive its expression under normal adjustment.
2. Differentiate between refracting and reflecting telescopes.
3. Write a short note on binoculars and their applications.
4. Write the principle and applications of a scanning electron microscope (SEM).
5. Explain myopia and hypermetropia with neat ray diagrams.
6. Write the working principle of contact lenses and mention their types.
7. Briefly describe the ophthalmoscope and its applications.
8. Write short notes on guidelines for standardized eye chart preparation.

**Section – B**

Answer any Five questions. Each carry 8 marks. (5 × 8 = 40 Marks)

1. Explain the construction, magnifying power, and normal adjustment of a compound microscope with neat diagrams.
2. Describe the principle and working of a phase contrast microscope. Mention its applications.
3. With neat diagrams, explain the construction, working, and magnifying power of an astronomical telescope.
4. Explain the working of a terrestrial telescope. Compare it with an astronomical telescope.
5. Discuss the construction, principle, and applications of (a) confocal microscope and (b) X-ray microscope.
6. Write notes on different types of telescopes: (a) Radio telescope (b) Infrared telescope (c) Solar telescope.
7. Explain the image formation in the human eye. Compare it with a camera.
8. Describe the principle, construction, and uses of a simple phoropter.

**SEMESTER-V**
**COURSE 14 A: OPTICAL INSTRUMENTS AND OPTOMETRY**

Practical Credits: 1 2 hrs/week

**COURSE OBJECTIVE:**

The objective of the practical course on Optical Instruments and Optometry is to provide students with hands-on experience and practical skills in the operation, calibration, and application of optical instruments used in optometry

**Learning Outcomes:**

On successful completion of this practical course, student shall beable to:

1. List out, identify and handle various equipment like binoculars, telescopes and microscopes.
2. Learn the procedures of operation of various optical instruments.
3. Demonstrate skills on testing the power of lenses, improving the resolution of telescopes and microscopes.
4. Acquire skills in observing and measuring the power, focal length and different refractive errors of eye.
5. Perform some techniques related to testing the blood and other biological samples.
6. Understand the technique of operation of Computer eye testing and evaluation.

**Practical (Laboratory) Syllabus:**

1. Evaluation of magnifying power of simple microscope.
2. Measurement of reflection and transmission coefficient of certain materials using a microscope.
3. Resolving power of telescope
4. Determination of radii of different capillary tubes using travelling microscope.
5. Refractive index of a liquid (water) using (i) concave mirror and (ii) convex lens and a plane mirror.
6. Removal of refractive errors of eye using combination of lenses.
7. Determination of power of a convex lens by finding its focal length.

**Lab References:**

1. A Practical Guide to Experimental Geometrical Optics byYuriy A. Garbovskiy- Cambridge Univ. Press
2. https://physics.columbia.edu/sites/default/files/content/Lab%20Resources/1292%20Lab%20Manual.pdf
3. https://www.lnmiit.ac.in/Department/Physics/uploaded_files/lab-manual.pdf
4. Basic Optics Experiments -http://www.phys.unm.edu › Optics Lab › Basics

5. A Practical Guide to Experimental Geometrical Optics by Yuriy A. Garbovskiy, Anatoliy V. Glushchenko, Cambridge Univ. Press

6. Web sources suggested by the teacher concerned. http://www.phy.olemiss.edu/~thomas/weblab/Optics_lab_Items/Telescop e_Microscope _PROCED_Spring_2018.pdf

**STUDENT ACTIVITIES**

**Co-Curricular Activities**

**(a) Mandatory:** (*Training of students by teacher in field related skills: (lab:10 + field:05*)

1. **For Teacher**: Training of students by the teacher (if necessary, by a local expert) in laboratory/field for a total of not less than 15 hours on the field techniques/skills on the familiarization of various optical instruments available in the laboratory; construction of different types of telescopes and their comparison in construction, operation and their utility and limitations; the details of construction of eye and various defects in the eye sight, emerging techniques in the design of eye lenses including contact lenses and making the student to understand on the testing of a biological sample using a clinical microscope

**For Student**: Students shall (individually) visit and observe the functioning of optical instruments at any one of the following places /centres like (a) pathological laboratory **or**
(b) a local ophthalmologist **or** (c) a local optician to understand the various types of eye lenses **or** (d) a local computer-based eye testing centre **or** (e) an optician, who fixes contact lenses **or** (f) a local cinema theatre **or** (g) a planetarium. Student shall write the observations and submit a hand-written Fieldwork/Project work not exceeding 10 pages in the given format to the teacher.

2. Max marks for Fieldwork/Project work: 05.
3. Suggested Format for Fieldwork/Project work: *Title page, student details, index page, details of place visited, observations, findings and acknowledgements*.
4. Unit tests (IE).

**(b) <u>Suggested Co-Curricular Activities</u>**

1. Training of students by related industrial experts.
2. Assignments (including technical assignments like identifying tools in the lens grinding, frame fitting, lens cleaning culture and other operational techniques with safety and security, IPR)
3. Seminars, Group discussions, Quiz, Debates etc. (on related topics).
4. Preparation of videos on tools and techniques in optical instruments and optical lenses, contact lenses.
5. Making a model microscope and measuring its magnification.
6. Making a simple astronomical telescope using two convex lenses.
7. Checking the power of your spectacles or lenses at home.
8. Students shall take up making their own (i) Telescope and (ii) Binoculars with the accessories available at home.

*https://paksc.org/pk/science-experiments/physics-experiments/how-to-make-astronomical- telescope*

*https://kids.nationalgeographic.com/nature/article/make-a-telescope*

*https://learning-center.homesciencetools.com/article/how-to-make-a-telescope-optical- science-project/*

*http://scipop.iucaa.in/Amateurs/telemaking.html*

9. Collection of material/figures/photos related to various types of lenses and their power.
10. Visit to any eye research laboratories, if available
11. Invited lectures and presentations on related topics by field/industrial experts

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## COURSE 15A: LOW TEMPERATURE PHYSICS & REFRIGERATION

Theory Credits: 3 3 hrs/week

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**COURSE OBJECTIVE:**

The objective of the course on Low Temperature Physics & Refrigeration is to provide students with a comprehensive understanding of the fundamental principles, concepts, and applications of low-temperature physics and refrigeration systems. The course aims to develop students' theoretical knowledge and practical skills in working with low temperatures, understanding cryogenic phenomena, and operating refrigeration systems.

**LEARNING OUTCOMES:**

Students after successful completion of the course will be able to

1. Identify various methods and techniques used to produce low temperatures in the Laboratory.
2. Acquire a critical knowledge on refrigeration and air conditioning.
3. Demonstrate skills of Refrigerators through hands on experience and learns about refrigeration components and their accessories.
4. Understand the classification, properties of refrigerants and their effects on environment.
5. Comprehend the applications of Low Temperature Physics and refrigeration.

**UNIT-I Production Of Low Temperature**

Production of low temperatures-Introduction, Freezing mixtures, Joule-Thomson effect, Regenerative cooling, Different methods of liquefaction of gases, liquefaction of air, Production of liquid hydrogen and nitrogen, Adiabatic demagnetization, Properties of materials at low temperatures

**UNIT-II Measurement of Low Temperature**

Gas thermometer and its correction and calibration, Secondary thermometers resistance thermometers, thermocouples, Vapour pressure thermometers, Magnetic thermometers, Advantages and drawbacks of each type of thermometer.

**UNIT-III Principles of Refrigeration**

Introduction to Refrigeration- Natural and artificial refrigeration , Stages of refrigeration, Types of refrigeration - Vapor compression and vapor absorption refrigeration systems, Refrigeration cycle and explanation with a block diagram, Introductory ideas on air-conditioning.

Refrigerants-Introduction, Ideal refrigerant, Properties of refrigerant, Classification of refrigerants, commonly used refrigerants, Eco-friendly refrigerants

**UNIT-IV Components of Refrigerator**

Refrigerator and its working, Block diagram, Coefficient of Performance (COP), Tons of refrigeration (TR) and Energy Efficiency Ratio (EER), Refrigerator components: Types of compressors, evaporators, condensers, and their functional aspects, defrosting in a refrigerator, Refrigerant leakage and detection

**UNIT-V Applications of Low Temperature & Refrigeration**

*Applications of Low temperatures*: Preservation of biological material, Food freezing, liquid nitrogen and liquid hydrogen in medical field, Superconducting magnets in MRI- Tissue ablation (cryosurgery) - Cryogenic rocket propulsion system.

*Applications of refrigeration*: Domestic refrigerators, Water coolers, Cold storages, Ice plants, Food preservation methods, Chemical and Process industries, Cold treatment of metals, Construction field, Desalination of water, Data centers.

**References**

1. Heat and Thermodynamics by Brij Lal &N.Subramanyam, S.Chand Publishers.
2. Thermal Physics by S C Garg, R M Bansal & C K Ghosh, McGrawHill Education, India
3. Heat and Thermodynamics by M MZemansky,McGrawHill Education (India).
4. Low-Temperature Physics by Christian E. & Siegfried H., Springer.
5. Thermal Engineering by S. Singh, S.Pati, Ch:18 Introduction to Refrigeration.

6. The Physics Hyper Text Book. Refrigerators.https://physics.info/refrigerators/
7. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, New Delhi
8. A course in Refrigeration and Air Conditioning by S.C. Arora and S. Domkundwar, Dhanpatrai and sons, Delhi
9. https://trc.nist.gov/cryogenics/Papers/Review/2017-Low_Temperature_Applications_and_Challenges.pdf
10. https://nptel.ac.in/content/storage2/courses/112105129/pdf/RAC%20Lecture%203.pdf
11. Other Web sources suggested by the teacher concerned and the reading material. https://nptel.ac.in

**MODEL QUESTION PAPER**
**GOVERNMENT COLLEGE FOR MEN (AUTONOMOUS), KADAPA**
**B.Sc. V SEMESTER END EXAMINATION**
**SUBJECT: PHYSICS**
**Title of the Paper: 15A: Low temperature Physics & Refrigiration**

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**Time: 3 hr.** **Max. Marks: 60**

**Section – A**

**Answer any Five questions. Each carry 4 marks.** **(5 ×4 = 20 Marks)**

1. Explain the Joule–Thomson effect and mention the conditions required for cooling during expansion.
2. Describe the method of liquefaction of air using the Linde process.
3. Explain the working principle of a gas thermometer with its correction procedure.
4. Distinguish between vapour pressure thermometers and magnetic thermometers (any four points).
5. Define COP of a refrigerator. Derive the expression for COP in a simple refrigeration cycle.
6. Write short notes on refrigerant leakage and detection methods.
7. List any four important properties required for an ideal refrigerant.
8. Mention four applications of refrigeration in the chemical and process industries.

**Section – B**

**Answer any Five the following questions.** **(5 × 8 = 40 Marks)**

9. Describe adiabatic demagnetization and explain how extremely low temperatures are achieved using this method.
10. With a neat block diagram, explain the vapour compression refrigeration system and describe its working cycle.
11. Describe the refrigerator components—compressor, condenser, evaporator—and explain their functional roles in detail.
12. Discuss the eco-friendly refrigerants, their properties, and advantages over conventional refrigerants.
13. Explain the applications of low temperatures in food freezing, cryosurgery, and superconducting magnets used in MRI.
14. Describe the applications of refrigeration in cold storage, water coolers, ice plants, and desalination of water.
15. Explain cryogenic rocket propulsion systems and describe the role of liquid hydrogen and liquid oxygen.
16. Discuss the energy performance parameters of a refrigerator—COP, TR, and EER—with suitable examples.

**SEMESTER-V**

**COURSE 15A: LOW TEMPERATURE PHYSICS & REFRIGERATION**

Practical Credits: 1 2 hrs/week

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**COURSE OBJECTIVE**:

The objective of the practical course on Low Temperature Physics & Refrigeration is to provide students with hands-on experience and practical skills in working with low temperatures, operating refrigeration systems, and conducting experiments in the field of low temperature physics. The course aims to develop students' proficiency in handling cryogenic equipment, performing temperature measurements, and conducting experiments at low temperatures.

**LEARNING OUTCOMES:**

On completion of practical course, student shall be able to

1. List out, identify and handle equipment used in refrigeration and low temperature lab.
2. Learn the procedures of preparation of Freezing Mixtures.
3. Demonstrate skills on developing various Freezing mixtures and materials and their applications in agriculture, medicine and day to day life.
4. Acquire skills in observing and measuring various methodologies of very low temperatures
5. Perform some techniques related to Refrigeration and Freezing in daily life.

**Practical (Laboratory) Syllabus**: *(30 hrs. Max marks: 50*))

Record the Principles and applications of Refrigerators and Freezers.

1. Measure the temperatures below Melting point of Ice using a thermometer available in the Lab.
2. Make a freezing mixture by adding different salts viz., Sodium chloride, Potassium Hydrate (KOH), Calcium chloride to ice in different proportions and observe the temperature changes.
3. Study the operation of a refrigerator and understand the working of different parts.
4. Study the properties of refrigerants like chlorofluorocarbons-hydrochlorofluoro- carbons and record the lowest temperatures obtained.
5. Consider a simple faulty refrigerator and try to troubleshoot the simple problems by understanding its applications
6. Understand the practical problem of filling the Freon Gas into the Refrigerator.
7. Get the Liquid Nitrogen or Liquid Helium from nearby Veterinary Hospital and measure their temperatures using chromel-alumel thermocouple or mercury thermometer and observe their physical properties like colour, smell etc and precautions to be taken for their safe handling.
8. Preparation of freeze drying food with Dry ice and liquid nitrogen
9. Preparation of freeze drying food with liquid nitrogen

**STUDENT ACTIVITIES**

**Co-Curricular Activities**:

**(a) Mandatory:**(*Training of students by teacher in field related skills: (lab:10 + field: 05*)

1. **For Teacher**: Training of students by the teacher in the in the laboratory/field for a total of not less than 15 hours on the techniques/skills of Low Temperature Production, methods used and applications of Low temperatures and refrigeration in day to day life and other applications in medicine and industry.

2. **For Student**: Student shall (individually) visit (i) a small ice plant or a cold storage plant (ii) Air Conditioner (AC) repair shop or (iii) Refrigerator repair shop to understand the construction, working principle and the trouble shooting of these devices after interacting with the technicians. **Or** Student shall observe the various thermodynamic processes taking place while working with the refrigerator and observe the leak detection in refrigeration system by different methods, air removal and charging of a refrigeration unit and testing of a refrigeration system to find out the Refrigerating capacity/Ton of refrigeration (TR) and the Power input. **Or** Student shall identify the refrigerant cylinder by color coding and standing pressure. **Or** Student shall visit the freezer aisle of a supermarket and observes the bags of different frozen fruits. Student shall write the observations and submit a hand-written Fieldwork/Project work not exceeding 10 pages in the given format to the teacher.
3. Max marks for Fieldwork/Project work: 05.
4. Suggested Format for Fieldwork/Project work: *Title page, student details, index page, details of place visited, observations, findings and acknowledgements*.
5. Unit tests (IE).

**(b) Suggested Co-Curricular Activities**

1. Training of students by related Factory, industrial experts.
2. Assignments (including technical assignments like identifying tools in Refrigerators, Freezers and their handling, operational techniques with safety and security )
3. Seminars, Group discussions, Quiz, Debates etc. (on related topics).
4. Preparation of videos on tools and techniques in Low Temperatures and applications.
5. Collection of material/figures/photos related to substances used in Freezing Mixtures, their Properties and availability etc., writing and organizing them in a systematic way in a file.
6. Visits to Ice plants and labs in universities, research organizations, private firms, etc.
7. Making your own mini refrigerator at home
8. Build your own water cooler with the materials available at home.
9. Making hand launched liquid nitrogen rockets
10. Experiments with Liquid nitrogen and strawberry/ banana/ lemon/ onion/ mushroom/ egg etc. (*To be tried under professional supervision only*).
11. Invited lectures and presentations on related topics by field/industrial experts
12. Identification of different Ozone-depleting substances (ODS) that damage the ozone layer in the upper atmosphere.
13. Demonstration to illustrate the greenhouse effect and the role of carbon dioxide as a greenhouse gas using plastic water bottles, flood light lamp, beakers and temperature sensors and observe the temperature changes.

https://edu.rsc.org/experiments/modelling-the-greenhouse-effect/1543.article
https://sealevel.jpl.nasa.gov/files/archive/activities/ts1hiac1.pdf

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