Laboratory Techniques in Physics

Faculty: Science

Department: Physics

This vocational course is intended for students aspiring for employment as laboratory technicians in school or college laboratories. At present, no academic programme is available in our University to train students the laboratory techniques through the regular Physics curriculum. This vocational programme has been designed to train laboratory supporting staff in appropriate procedures for organizing and maintaining school/college Physics laboratories.

The broad objectives of this programme are to: familiarize the learners with the basic facilities available in school and college level Physics laboratories; impart knowledge of the basics of organization and management of laboratories; train the learners in the operation and maintenance of simple instruments used in laboratories; enable them to develop skills in common laboratory techniques; train them in the procedures of procurement and storage of laboratory equipment and materials; enable them to adopt appropriate disposal procedures and safety methods suitable for laboratories.

The aim of this vocational programme is to train the prospective Laboratory Technicians / Assistants to work in a Physics laboratory, especially at the School or College level, more efficiently and productively. Therefore, after studying the course as per the following syllabus, learners will be able to identify the tools/ apparatus/ equipment/instruments used in a typical Physics laboratory, understand the basic working principles (without going into details), learn how to use them for setting up experiments, carry out minor repairs and ensure their proper maintenance and up keeping.

Credits: 3	Programme: Vocational
Max. Marks: 100	Min. Passing Marks: 35
Department Name: Physics	Course Code:
Duration of Programme: 4 semester	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 1-0-2	

	Unit	Topics	No. of Lectures
Sem 1	I (Theory)	Introduction to Physics Laboratory: Know your physics laboratory Laboratory arrangements, Dark room arrangements; General utilities in the physics laboratory Electric and Water supplies; Maintenance of utilities; Broad classification of the apparatus in a physics laboratory Basic/General apparatus (used for experiments in mechanics, heat and sound), Optical apparatus and Electrical and Electronic apparatus. e.g. physical balance sensitive thermometer, stopwatch, telescope optical lever, concave & convex lenses (F-15-20 cum) and mirrors, spectrometer, prism. ½ kg hanger, ½ kg slotted weight, metallic wires needle, weight Box. Common Laboratory Tools: Some common tools — hammer, vise, screwdriver, spanner, pliers, cutter, wire stripper, hacksaw, hand drill, files, sand paper, soldering iron; Methods of joining materials — Adhesive, Mechanical means and Soldering.	15

	(Practical)	Experiment: Using and Maintaining Basic Mechanical Tools (a set of five activities which will require using most of the common tools discussed in the Theory course	30
Sem2	**Unit**	**Topic**	**Topics**
	I (Theory)	Basic Apparatus: Length and Time Measurements - Vernier calipers, Screw gauge spherometer Stop watch, Stop clock and Digital timer; Measurement of Mass — Beam balance and Spring balance; Measurement of Atmospheric Pressure —barometer; Measurement of Temperature — Mercury thermometer; calorimeter with heating coil, sensitive thermometer Measurement of heat capacity — Calorimeter; Measurement of Frequency and Speed of Sound Waves — Sonometer, Resonance tube apparatus, Tuning fork; Permanent magnets and Electromagnets. Turning fork of unknown frequency ; coefficient of linear expansion apparatus lamp and scale arrangement. **Optical Apparatus**: following this of concave & convex lenses and mirrors. Laws of Reflection and Refraction; Image formation by Reflecting surfaces — Plane mirror, Spherical mirrors; Image Formation by Refracting surfaces — Glass slab, Prism, Lenses; Grating; Polaroid; Optical bench; Optical Instruments — Simple Microscope, Travelling Microscope, Telescopes; speetrometer Sources of Light - Incandescent sources, I-EDS, Lasers..	15
	II (Practical)	**Experiment 1:** Length Measurements (Vernier Calipers, Screw Gauge and spherometer). **Experiment 2:** Mass Measurement (Spring Balance and Beam Balance). **Experiment 3:** Stationary Waves (Sonometer and resonance Tube). Exp **Experiment 4:** Investigations with Glass slab, Prism, Mirrors and Lenses. **Experiment 5**: Working with Sources of Light and Optical Instruments. Exp 6 : experiment spectrometer.	30
Sem 3	**Unit**	**Topic**	**Topics**
	(Theory)	**Electrical Components and Circuits:** Ammeters (milli & normal) voltmeter galvanometer Direct Current, Alternating Current, Potential difference, Resistance, Impedance, Power; Components of Electrical Circuits — carbon Resistors (with colour code), Rheostat, Resistance Coil, Resistance Box, One Way and Two-Way Keys, Tap Key, Capacitors, Inductors; Transformers; Primary and Secondary Cells; Electric Supply in the Physics Laboratory. DC power supply.	15

		Handling and maintenance of multimeter. Electrical and Electronic Apparatus: Electrical Instruments Galvanometers, Ammeters and Voltmeters; Analog and Digital Multimeters; Wheatstone bridge, Post-Office box, Metre bridge and Potentiometer; Electronic Devices — The p-n Junction Diode and their biasing, Zener Diode, Bipolar Junction Transistors; Identification of npn- and pnp- transistor; DC and AC Power Supply.	
	(practical)	Experiment 1: Using a Multimeter (Analog and/or Digital). Experiment 2: Fabrication of an Extension Board. Experiment 3: Assembling a Laclanche Cell. & denial cell. Experiment 4: Use of Potentiometer/Meter Bridge/PO Box. Experiment 5: Simple Current and Voltage Measurements. Experiment 6: current and voltage measurement Experiment 5: experiment on Oscilloscope	30
Sem 4	**Unit**	**Topic**	**Topics**
	I (Theory)	**Use of Computers in Laboratory**: Component of a Computer — Central processing unit, memory, input and output devices, Application software — MS Word, MS Excel, Internet. Stock Control and Purchase: Arranging Stock - Locating and Referencing, Shelf Arrangement of Stock; Order Books, Inventory, Service Register; Maintenance of Stock Register; Receipt of Goods Taking Delivery, Processing of Bills; Accounting: Records of Expenditure; Information about Equipment Serial Number, Maintenance Record, and Miscellaneous Records, Orders and Accounts. Files and Records: Maintaining Files, Filing Methods - Filing System for Equipment, Filing System for Chemicals; Filing of Printed and Written Material; Work sheets/Instruction for Experiment, Instruction for Use of Apparatus, Records - Stock Records, Record of Breakages.	15
	II (practical)	Assignment 1: Organization of Laboratory Store. Assignment 2: Procedure for Purchase of Laboratory Related Items, Inventory Management. Assignment 3: Procedure for Stock Verification and Maintenance of Apparatus. Assignment 4: Prepare a worksheet/instruction for a experiment on MS-Word. Assignment 5: Prepare Stock Register on MS-Excel.	30
Suggested Readings:			

1. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London.
2. C.L. Arora, "B Sc Practical Physics", S. Chand & Company, New Delhi.
3. G. L. Squires, "Practical Physics", Cambridge University Press, London
4. l. Prakash, R. Krishna, A.K. Jha, "A Textbook of Practical Physics" Kitab Mahal, Allahabad
5. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd. 6. R.K. Agrawal, G. Jain, R. Sharma, "Practical Physics", Krishna Prakashan Media (Pvt.) Ltd.
7. S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut
8. NCERT Physics Lab Manual Class 11th and 12th
9. Virtual Labs at Amrita Vishwa Vidyapeetham https://vlab.amrita.edu/?sub=l
10. Virtual Labs at Amrita Vishwa Vidyapeetham http://(www.olabs.edu.in/?pg=topMenu&id=40
11. Virtual Labs an initiative of MHRD Govt. of India http:///(/vlabs.iitkgp.ac.in/psac/#

Suggested Continuous Evaluation Methods:

Theory

20 marks for Test / Quiz, 05 marks for Class Interaction

Practical

15 marks for Record File / Assignment, 05 marks for Viva Voce, 05 marks for Class Interaction

Eligibility (Subject specific):

A student must have had the subject Physics in class 12th.

Suggested equivalent online courses:

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearmng.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/userlnptelhrd
3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.ln/SearchContent.aspx
4. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/currenthe/8