ज्ञानगंगा घरोघरी

ACCREDITED WITH GRADE A NAAC

Yashwantrao Chavan Maharashtra Open University

School of Sciences

(Formerly School of Architecture, Science & Technology)

Laboratory Equipments & Instruments List - 2026





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School of Sciences, YCMOU, Nashik - 422 222, MH, India

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MESSAGE FROM THE DIRECTOR OF THE SCHOOL

Greetings to all!!!

The School of Sciences (Formerly School of Architecture, Science and Technology) was established in 1989 to provide innovative and high quality cost effective education in Sciences disciplines relevant to present needs of Society and Learners with better academic quality and student support services. This School currently, do not offer programmes from Architecture and Technology Disciplines.

Presently, this School offers Diploma, UG, PG and PhD Programmes in Science Discipline with the challenge of imparting good quality theoretical and practical education in science disciplines, namely, Physics, Chemistry, Mathematics, Statistics and Life Sciences. These programmes from Science disciplines are approved by the UGC-DEB, New Delhi. **All Undergraduate and Postgraduate programmes offered by the School are aligned with NEP guidelines and fully comply with "UGC (ODL and Online Programmes) Regulations 2020".**

All the programmes of this School are designed and developed with comprehensive approach from the renowned subject experts to ensure the quality, norms and standards of the education and examinations. Self-Learning Material (SLM)/ Textbooks/ Lab Manuals, Audio-Video Lectures etc in easy to understand format is developed by the School for the learners and is made available in soft copy format from day one at our University website. This School has adopted this policy for the conservation of our global environment. Due to this policy, this School have kept lower fees for the academic programmes.

Teaching-learning for theory, practical conduction and project work, etc for the learners is held as per the UGC norms in face-to-face mode by the qualified and experienced counsellors working at the recognized Learner Support Centers; which are mainly Senior Science Colleges for the programmes from Science Discipline. Periodical Evaluation and Grading of the Study Centers/ Learner Support Centers is done by this School to ensure academic quality to impart teaching-learning to the learners by them.

Nearly 25,000 learners are enrolled for Science programmes of this School and the quality of our pass-out students is highly satisfactory with regards to the purpose of education.

Prof. Chetana Kamlaskar
Director,
School of Sciences

ACADEMIC PROGRAMMES OPEN FOR NEW LEARNER SUPPORT CENTRE AND RENEWAL OF EXISTING LSC

The **School of Sciences** offers Diploma, UG, PG and PhD Programmes in Science Discipline with the challenge of imparting good quality theoretical and practical education in science disciplines, at the HEIs mainly **Senior Science** Colleges as recognized Learner Support Centers [LSCs] to offer the programme in the respective subject. **This School fully comply "UGC (ODL and Online Programmes) Regulations 2020". Before applying all the interested HEIs shall go through the specified "Institutional Eligibility Criteria'' mentioned in this LSC Manual. Applications of the eligible HEIs as per the UGC (ODL and Online Programme) Regulation 2020 will be considered.**

University has opened/started "Online Learner Support Centre Recognition Process" for the following Programmes as mentioned in the Table for the **Year 2026**. Applications are invited online from the **eligible** applicant institutes/ HEIs.

SN	Level	To conduct/identify	Programme Code & Name & Student Intake
1.	**Dipl.**	**Renewal / New** ❑ Online Renewal Process ❑ Online New LSCs process **Note: Existing LSCs** will have to fulfill all conditions as mentioned in this LSC Manual.	❑ **V137:** Diploma in Statistics {2021 pattern} ❑ Student Intake: 60
2.	**UG** **(4.5)**	**Renewal / New** ❑ Online Renewal Process ❑ Online New LSCs process **Note: Existing LSCs** will have to fulfill all conditions as mentioned in this LSC Manual.	❑ **UGV01:**B.Sc.(Honours)(Physics){2025 Pattern} ❑ Student Intake: 120
3.	**UG** **(4.5)**	**Renewal / New** ❑ Online Renewal Process ❑ Online New LSCs process **Note: Existing LSCs** will have to fulfill all conditions as mentioned in this LSC Manual.	❑ **UGV02:** B.Sc. (Honours)(Chemistry){2025 Pattern} ❑ Student Intake: 120
4.	**UG** **(4.5)**	**Renewal / New** ❑ Online Renewal Process ❑ Online New LSCs process **Note: Existing LSCs** will have to fulfill all conditions as mentioned in this LSC Manual.	❑ **UGV03:**B.Sc.(Honours)(Mathematics) {2025 Pattern} ❑ Student Intake: 120
5.	**UG** **(4.5)**	**Renewal / New** ❑ Online Renewal Process ❑ Online New LSCs process **Note: Existing LSCs** will have to fulfill all conditions as mentioned in this LSC Manual.	❑ **UGV04:**B.Sc.(Honours)(Botany){2025 Pattern} ❑ Student Intake: 120
6.	**UG** **(4.5)**	**Renewal / New** ❑ Online Renewal Process ❑ Online New LSCs process **Note: Existing LSCs** will have to fulfill all conditions as mentioned in this LSC Manual.	❑ **UGV05:**B.Sc.(Honours)(Zoology){2025 Pattern} ❑ Student Intake: 120

SN	Level	To conduct/identify	Programme Code & Name & Student Intake
7.	**UG** **(4.5)**	**New** ❑ Online New LSCs process **Note: Existing LSCs** will have to fulfill all conditions as mentioned in this LSC Manual.	❑ **UGV06:**B.Sc.(Honours)(Environmental Science) {2025 Pattern} ❑ Student Intake: 120
8.	**PG** **(6.0)**	**Renewal / New** ❑ Online Renewal Process ❑ Online New LSCs process **Note: Existing LSCs** will have to fulfill all conditions as mentioned in this LSC Manual.	❑ **V151:** M.Sc. (Mathematics) {2023 Pattern} ❑ Student Intake: 60
9.	**PG** **(6.0)**	**Renewal / New** ❑ Online Renewal Process ❑ Online New LSCs process **Note: Existing LSCs** will have to fulfill all conditions as mentioned in this LSC Manual.	❑ **V152:** M.Sc. (Environmental Science) {2023 Pattern} ❑ Student Intake: 60
10.	**PG** **(6.0)**	**Renewal / New** ❑ Online Renewal Process ❑ Online New LSCs process **Note: Existing LSCs** will have to fulfill all conditions as mentioned in this LSC Manual.	❑ **V153:** M.Sc. (Physics) {2023 Pattern} ❑ Student Intake: 60
11.	**PG** **(6.0)**	**Renewal / New** ❑ Online Renewal Process ❑ Online New LSCs process **Note: Existing LSCs** will have to fulfill all conditions as mentioned in this LSC Manual.	❑ **V154:** M.Sc. (Chemistry) {2023 Pattern} ❑ Student Intake: 60
12.	**PG** **(6.0)**	**Renewal / New** ❑ Online Renewal Process ❑ Online New LSCs process **Note: Existing LSCs** will have to fulfill all conditions as mentioned in this LSC Manual.	❑ **V155:** M.Sc. (Zoology) {2023 Pattern} ❑ Student Intake: 60
13.	**PG** **(6.0)**	**Renewal / New** ❑ Online Renewal Process ❑ Online New LSCs process **Note: Existing LSCs** will have to fulfill all conditions as mentioned in this LSC Manual.	❑ **V156:** M.Sc. (Botany) {2023 Pattern} ❑ Student Intake: 60
14.	**PG** **(6.0)**	**New** ❑ Online New LSCs process **Note: Existing LSCs** will have to fulfill all conditions as mentioned in this LSC Manual.	❑ **V157:** M.Sc. (Mathematics with Computer Applications) {2025 pattern} ❑ Student Intake: 60

GUIDELINES

APPENDIX XII: CHECK LIST OF LABORATORY REQUIREMENTS FOR PROGRAMMES OFFERED UNDER SCHOOL OF SCIENCES

This Appendix presents the detailed laboratory requirements for the Major and Minor courses of the Undergraduate programmes (UGV01 to UGV06) and Postgraduate programmes (V151 to V157). The requirements are organized in a systematic manner, specifying semester-wise and course-wise laboratory needs for each programme.

The Appendix is structured as follows:

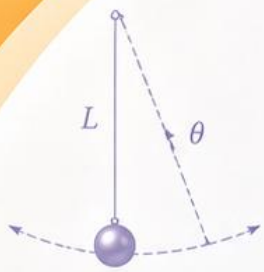
I. **Section A:** Undergraduate Programmes (**UGV01 to UGV06)** Major & Minor Courses Laboratory Requirements (Semester-wise and Course-wise)
II. **Section B:** Postgraduate Programmes (**V151 to V157**) Laboratory Requirements (Semester-wise and Course-wise)

Following Table shows the Major Discipline along with their related Minor Disciples:

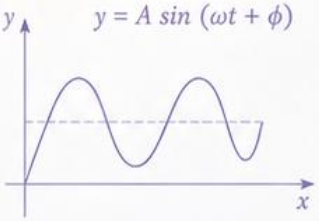
SN	4 Year B.Sc. (Honours) Programme	
	Major in:	**Minor in (Anyone of the following other than Major):**
1	**Physics**	Chemistry, Mathematics, Botany, Zoology, Environmental Science
2	**Chemistry**	Physics, Mathematics, Botany, Zoology, Environmental Science
3	**Mathematics**	Physics, Chemistry, Botany, Zoology, Environmental Science
4	**Botany**	Physics, Chemistry, Mathematics, Zoology, Environmental Science
5	**Zoology**	Physics, Chemistry, Mathematics, Botany, Environmental Science
6	**Environmental Science**	Physics, Chemistry, Mathematics, Botany, Zoology

SECTION A:

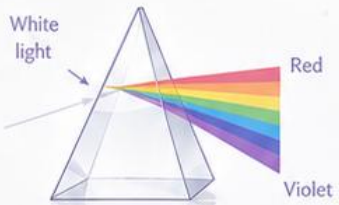
List of Laboratory Requirements for UG Programmes Offered Under School of Sciences



$$T = 2\pi\sqrt{\frac{L}{g}}$$



$$y = A\sin(\omega t + \phi)$$



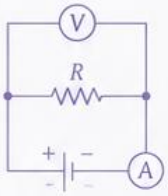
$$s = ut + \frac{1}{2}at^2$$

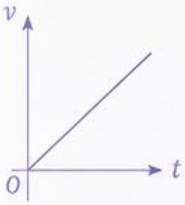
$$v^2 = u^2 + 2as$$

$$F = ma$$

PHYSICS LAB

EQUIPMENTS/INSTRUMENTS







TIME MEASUREMENT | LENGTH MEASUREMENT | FORCE & MOTION | WAVES & OSCILLATIONS | OPTICS & LIGHT | ELECTRICITY & ELECTRONICS

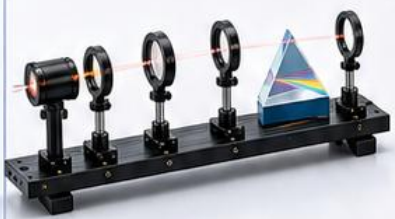










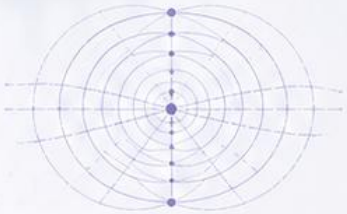


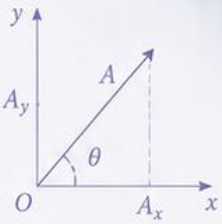




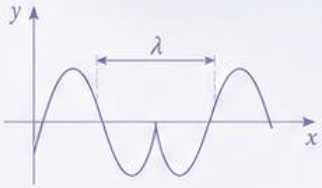








$$E = mc^2$$



I. Recommended Quantities of Miscellaneous Instruments for All Semesters, Including Major and Minor Courses for Batch of 15 Students.

Sr. No	Required Equipments / Instruments	Recommended Quantities
1.	Flywheel mounted on a shaft	01
2.	String Weight hanger & Set of known weights	02
3.	Stopwatch	05
4.	Vernier calliper	05
5.	Meter scale	05
6.	Digital balance	02
7.	Suspension wire	02
8.	Beakers (with Different Volume)	02 each
9.	Thermometer	06
10.	Torsion pendulum (disc)	01
11.	Stand with clamps to hold the wire and pendulum	03
12.	Protractor or angular scale	02
13.	Compound pendulum (any rigid body, e.g., a metal bar with multiple holes for suspension)	02
14.	Ballistic pendulum setup Projectile	01
15.	Weighing balance	01
16.	Collision ball apparatus Protractor	01
17.	Projectile launcher Protractor	01
18.	Computer software or calculator	02
19.	Height-adjustable platform	01
20.	Micrometre screw gauge	05
21.	Travelling microscope	02
22.	metal or wooden bar	02
23.	Support stands and clamps, Pins	02
24.	Cylindrical rod	02
25.	Torsion apparatus	01
26.	Telescope	02
27.	Simple pendulum setup,	02
28.	Free-fall apparatus (if using the free-fall method)	01
29.	Tangent Galvanometer	02
30.	Spirit level	02
31.	Ammeter (0-1 A ,0-5 A, 0-10mA, 0-25mA, 0-100mA,0-250mA, 500microA)	03 each

32.	Rheostat	02
33.	Power Supply	02
34.	connecting wires	01 bundle
35.	Resistance Box(0.1 to 1 ohm)	01
36.	Commutator	01
37.	key (4 way key)	02
38.	Circular coil + compass (Setup)	01
39.	weighing machine	01
40.	Deflection magnetometer	01
41.	Box type Vibration Magnetometer	01
42.	Bar magnet	02
43.	Van de graph generator	01
44.	Insulating stand	02
45.	Electroscope	01
46.	Neon bulb/ fluorescent tube	01
47.	light Wight material (tinsel)	01
48.	Step down transformer	02
49.	AC voltmeter	03 each
50.	Inductor Circuit board	02
51.	Inductor (1H-3)	02
52.	CRO (Cathode Ray Oscilloscope)	02
53.	Function generator	02
54.	Ferromagnetic material	01
55.	Circular coil	02
56.	Strong bar magnet	01
57.	Amplifier	01
58.	Sonometer set	01
59.	Fe wire	01 bundle
60.	Step down transformer	02
61.	LCR Kit	01
62.	Capacitor (with different values)	10 each
63.	signal generator	01
64.	inductance coil	02
65.	Connection wires	01 bundle
66.	U-tube with one limb narrow and the other wide (Quincke's tube)	01
67.	Electromagnet with power supply	01
68.	Analytical balance	02
69.	Manganese Sulphate(MnSO4) solutions of different concentrations	As per Requirement

70.	Travelling microscope or cathetometer	02
71.	Measuring cylinder	02
72.	Searle's Thermal Conductivity Apparatus (Cu)	01
73.	cooling wire	02
74.	Steam Generator or Hot Water Bath	01
75.	Cold Water Circulator	02
76.	Lee’s Apparatus(Two metal discs)	01
77.	Weighing machine	01
78.	Heating Element	01
79.	Copper rod	01
80.	Insulation materials	01
81.	Constant flow calorimeter	01
82.	Flow rate control	01
83.	Black Body Source	01
84.	Monochromator or Filters	03
85.	Photodetector	01
86.	Light Source Power Supply	01
87.	Optical System	01
88.	Wavelength Scale or Reference Data	01
89.	Radiation Sensor (Bolometer or Photodiode)	01
90.	Water Calorimeter	01
91.	Insulating Enclosure	01
92.	Platinum Resistance Thermometer (PRT)	01
93.	Wheatstone Bridge	01
94.	Mercury thermometer	05
95.	Water Bath	02
96.	Stand	02
97.	DC power supply(0-15V)	01
98.	Resistors (with different values)	10 each
99.	Digital Multimeter	03
100.	Bread board	10
101.	DC power supply(0-30V)	01
102.	DC power supply(10 and 15V)	01
103.	Digital LCR meter	01
104.	AC source	01
105.	Step down transformer(12vAC)	01
106.	Resistance box = upto 10 kohm	01
107.	PN Diode	04
108.	Single phase autotransformer -230 v	01

109.	Inductor (with different values)	05 each
110.	Power factor meter	01
111.	Step up transformer	01
112.	Bar pendulum	01
113.	Kater's Pendulum	01
114.	Clamp stand	02
115.	Thread	01 bundle
116.	Two identical masses (m) with small spring constants (k)	01set
117.	Two springs (with the same spring constant, k)	01set
118.	Two rigid supports Clamp stand	01
119.	Specific stand Electromagnet	01
120.	Weight with hanger	01
121.	Electrically maintained tuning fork	01 set
122.	Melde's apparatus Clam	01
123.	Digital oscilloscope	01
124.	Measuring tape	01
125.	Kundt's tube or impedance tube	01
126.	Microphone	02
127.	sound level meter	02
128.	Acoustic materials	01
129.	Prism	05
130.	Spectrometer	02
131.	Sodium vapor lamp	01
132.	Mercury vapor lamp	01
133.	Michelson's interferometer setup	01
134.	Newton's Rings setup	01
135.	Plane Diffraction Grating(15000/600 line)	02
136.	ESR setup which includes Helmholtz coils	01
137.	R.F. oscillator	01
138.	Resonant cavity	01
139.	Polarizer	01
140.	Discharge lamp	01
141.	CCD camera / detector + computer	01
142.	Optical bench with alignment accessories	01
143.	Gaussmeter	01
144.	Tunnel diode	01
145.	Optical filters	02
146.	Lens system	02
147.	Reference photodetector / photodiode	02
148.	Computer with data acquisition software	01
149.	Solid sample (paramagnetic/diamagnetic material)	01

150.	Stand and support arrangement	01
151.	Piezoelectric crystal (e.g., quartz crystal)	01
152.	Dielectric sample (capacitor with known dielectric material)	01
153.	Parallel plate capacitor setup (if sample not pre-mounted)	01
154.	Surface Plasmon Resonance (SPR) setup	01
155.	Laser source (monochromatic light, e.g., He–Ne laser)	01
156.	Prism (Kretschmann configuration)	01
157.	Metal thin film (e.g., gold-coated slide)	01
158.	Optical rotation stage (goniometer)	01
159.	Photodetector	01
160.	Ferroelectric sample	01
161.	Sawyer–Tower circuit	01
162.	Reference capacitor	01
163.	Iron core (Fe) with solenoid (primary & secondary coils)	01
164.	Variac (autotransformer)	01
165.	Integrator circuit (RC circuit)	01
166.	Four probe setup (with probes arrangement)	01
167.	Germanium (Ge) sample	01
168.	Constant current source	01
169.	Hall effect setup	01
170.	Semiconductor sample (Ge/Si)	01
171.	X-ray diffractometer (XRD setup)	01
172.	X-ray tube (e.g., Cu target)	01
173.	Sample holder	01
174.	Goniometer	01
175.	P-N junction Diode 1N4007 or 1N4148	05 each
176.	Zener Diode (1N 4732A or 1N 4733A)	01
177.	Dual D.C Power Supply	02
178.	Transistor (NPN type) (BC147/ BC547/ 2N2222)	03 each
179.	JFET(BFW10/ BFW11 or BF245, 2N5457)	02 each
180.	Light Emitting Diode (Different colors)	10 each
181.	Different gate IC (Quad 2 Input) , NAND gate IC 7400 AND gate IC 7408 OR gate IC 7432 XOR gate IC 7486 NOR gate IC 7402 NOT gate IC 7404	05 each

182.	Vacuum diode	01
183.	Variable DC supply	01
184.	Oven / heater	01
185.	Hydrogen discharge tube	01
186.	Prism table	01
187.	Collimated light source (tungsten/halogen lamp)	01
188.	Single slit and double slit	01
189.	Photoelectric tube	01
190.	Helmholtz coils / bar magnet	01
191.	Millikan oil drop apparatus	01
192.	Microscope with scale	01
193.	Oil sprayer	01
194.	Capacitor plates arrangement	01
195.	Two polarizers (polarizer & analyzer)	01
196.	Babinet's compensator	01
197.	Dipole antenna setup	01
198.	Receiver antenna	01
199.	Ultrasonic generator	01
200.	Ultrasonic transducer	01
201.	Liquid cell (kerosene/xylene)	01
202.	Microwave source (Gunn diode)	01
203.	Microwave bench	01
204.	Horn antenna	01
205.	Detector	01
206.	Reflector plates	01
207.	Dielectric slab	01
208.	Double slit arrangement (microwave)	01
209.	Wollaston's air-film setup	01
210.	Glass plates	01
211.	Spectrometer with Gaussian eyepiece	01
212.	Reading lens	01
213.	Spectrometer with Gaussian eyepiece	01
214.	Hollow prism (for liquid)	01
215.	Mechanical dial gauge with a plunger	01
216.	Potentiometer (variable resistor)	01
217.	BNC Cables and Connectors	02 set
218.	AC Mains Input (220V AC)	01
219.	Rectifier Bridge	01
220.	Switching Transistor (e.g., MOSFET)	02

221.	Control IC (e.g., PWM Controller)	01
222.	Output Voltage Regulation Circuitry	01
223.	Heat Shrink Tubing and Insulation Materials	01
224.	Soldering Iron and Solder	01
225.	Seven-segment display (common cathode)	01
226.	Temperature sensor (e.g., LM35 or LM75)	02
227.	Clock pulse source (e.g., 555 timer or crystal oscillator)	01
228.	Mechanical dial gauge with a plunger	01
229.	Stand with a base for Dial Gauge	01
230.	Bezel Clamp (for zeroing the gauge)	01
231.	Plunger Lifting Lever (optional, for easy insertion of workpieces)	01
232.	Cleaning Cloth or Brush (for cleaning the gauge before and after use)	01
233.	Stroboscope	01
234.	Rotating object (e.g., a disc with a marked point or pattern)	01
235.	Ticker tape timer	01
236.	Clock pulse source (e.g., 555 timer or crystal oscillator)	01
237.	Computer Systems with installed 'C' Programming kit	15

II. Laboratory Requirement for Major Discipline of Physics:

Semester I

Course Code & Course Name	Sr. No	Required Equipments / Instruments
PHYC102:Lab Activities on PHYC101	1.	Flywheel mounted on a shaft
	2.	String Weight hanger & Set of known weights
	3.	Stopwatch
	4.	Vernier calliper
	5.	Meter scale
	6.	Digital balance
	7.	Suspension wire
	8.	Beakers
	9.	Thermometer
	10.	Torsion pendulum (disc)
	11.	Stand with clamps to hold the wire and pendulum
	12.	Protractor or angular scale
	13.	Compound pendulum (any rigid body, e.g., a metal bar with multiple holes for suspension)
	14.	Ballistic pendulum setup Projectile
	15.	Weighing balance
	16.	Collision ball apparatus Protractor
	17.	Projectile launcher Protractor
	18.	Computer software or calculator
	19.	Height-adjustable platform
	20.	Micrometre screw gauge
	21.	Travelling microscope
	22.	metal or wooden bar
	23.	Support stands and clamps Pins
	24.	Data recording sheet
	25.	Cylindrical rod
	26.	Torsion apparatus
	27.	Telescope
	28.	Simple pendulum setup,
	29.	Free-fall apparatus (if using the free-fall method)

	30.	Multimeter

Semester II

PHYC104: Lab Activities on PHYC103	1.	Tangent Galvanometer
	2.	Spirit level
	3.	Ammeter
	4.	Rheostat
	5.	Power Supply
	6.	connecting wires
	7.	Resistance Box(0.1 to 1 ohm)
	8.	Commutator
	9.	key (4 way key)
	10.	Circular coil + compass (Setup)
	11.	Stop watch
	12.	Vernier calliper
	13.	weighing machine
	14.	Deflection magnetometer
	15.	Box type Vibration Magnetometer
	16.	Bar magnet
	17.	Van de graph generator
	18.	Insulating stand
	19.	Electroscope
	20.	Neon bulb/ fluorescent tube
	21.	light Wight material (tinsel)
	22.	Step down transformer
	23.	AC voltmeter
	24.	Inductor Circuit board
	25.	Inductor (1H-3)
	26.	CRO(Cathode Ray Oscilloscope)
	27.	Function generator
	28.	Ferromagnetic material
	29.	Circular coil
	30.	Strong bar magnet
	31.	Amplifier
	32.	Sonometer set
	33.	Fe wire
	34.	Step down transformer
	35.	LCR Kit
	36.	Screw gauge

	37.	capacitor
	38.	signal generator
	39.	inductance coil
	40.	Connection wires
	41.	U-tube with one limb narrow and the other wide (Quincke's tube)
	42.	Electromagnet with power supply
	43.	Analytical balance
	44.	Manganese Sulphate(MnSO4) solutions of different concentrations
	45.	Travelling microscope or cathetometer
	46.	Measuring cylinder

Semester III

PHYV201: Electrical Circuits & Network Skills	1.	DC power supply(0-15V)
	2.	Resistor= 100/1k ohm
	3.	Digital Multimeter
	4.	Bread board
	5.	Resistor- Different value
	6.	DC power supply(0-30V)
	7.	DC power supply(10 and 15V)
	8.	Resistor- 330, 1k ohm=06
	9.	Resistor- 1k, 2k, 3k ohm =03
	10.	Function Generator
	11.	Capacitor = 0.1 uF
	12.	Resistor = 1k ohm
	13.	CRO
	14.	Digital LCR meter
	15.	AC source
	16.	Step down transformer(12vAC)
	17.	Capacitor = 1000 uF
	18.	Resistance box = upto 10 kohm
	19.	PN Diode = 04
	20.	Rheostat
	21.	Single phase autotransformer -230 v
	22.	Inductor= 50m, 150m, 200m Hendry
	23.	Power factor meter
	24.	Step up transformer
PHYC203: Lab	25.	Searle's Thermal Conductivity Apparatus (Cu)
	26.	cooling wire
	27.	Thermometer

Activities on PHYC201	28.	Stopwatch
	29.	Vernier Calliper
	30.	Steam Generator or Hot Water Bath
	31.	Cold Water Circulator
	32.	Lee's Apparatus(Two metal discs)
	33.	Insulating Stand
	34.	Weighing machine
	35.	Heating Element
	36.	Ammeter
	37.	Voltmeter
	38.	Copper rod
	39.	Insulation materials
	40.	Constant flow calorimeter
	41.	Flow rate control
	42.	Black Body Source
	43.	Monochromator or Filters
	44.	Photodetector
	45.	Light Source Power Supply
	46.	Optical System
	47.	Wavelength Scale or Reference Data
	48.	Radiation Sensor (Bolometer or Photodiode)
	49.	Water Calorimeter
	50.	Insulating Enclosure
	51.	Platinum Resistance Thermometer (PRT)
	52.	Wheatstone Bridge
	53.	Mercury thermometer
	54.	Water Bath
	55.	stand (to hold Thermometer)

Semester IV

PHYC207: Lab	1.	Bar pendulum
	2.	Stop clock
	3.	Meter scale
	4.	Vernier calliper
	5.	Protractor
	6.	Graph paper
	7.	Kater's Pendulum
	8.	Clam stand
	9.	Thread

Activities on PHYC205	10.	Two identical masses (m) with small spring constants (k)
	11.	Two springs (with the same spring constant, k)
	12.	Two rigid supports Clam stand
	13.	Free-fall apparatus
	14.	Specific stand Electromagnet
	15.	Weight with hanger
	16.	Electrically maintained tuning fork
	17.	Melde's apparatus Clam
	18.	Signal generator
	19.	Digital oscilloscope
	20.	Measuring tape
	21.	Power supply
	22.	Kundt's tube or impedance tube
	23.	Microphone
	24.	sound level meter
	25.	Acoustic materials
	26.	Prism
	27.	Spectrometer
	28.	Sodium vapor lamp
	29.	Mercury vapor lamp
	30.	Michelson's interferometer setup
	31.	Newton's Rings setup
	32.	Traveling microscope
	33.	Plane Diffraction Grating(15000/600 line)
	34.	Mercury (Hg) Light Source

Semester V

PHYC303:Lab Activities on PHYC301 & PHYC302	1.	ESR setup which includes Helmholtz coils
	2.	R.F. oscillator
	3.	the test sample
	4.	cathode ray oscilloscope (CRO)
	5.	Power supply
	6.	Spectrometer
	7.	Electromagnet
	8.	Resonant cavity
	9.	Polarizer
	10.	Discharge lamp
	11.	CCD camera / detector + computer
	12.	Optical bench with alignment accessories
	13.	Gaussmeter
	14.	Tunnel diode

	15.	Regulated DC power supply
	16.	Voltmeter
	17.	Milliammeter / microammeter
	18.	Series resistor / rheostat
	19.	Breadboard / circuit setup
	20.	Connecting wires
	21.	CCD camera / sensor
	22.	Monochromatic light source (LED / laser / monochromator)
	23.	Optical filters
	24.	Optical bench
	25.	Lens system
	26.	Reference photodetector / photodiode
	27.	Power meter
	28.	Computer with data acquisition software
	29.	Dark Room
	30.	Quincke's tube
	31.	Travelling microscope
	32.	Beaker with paramagnetic solution
	33.	Stand with leveling arrangement
	34.	Analytical balance
	35.	Sample tube
	36.	Solid sample (paramagnetic/diamagnetic material)
	37.	Stand and support arrangement
	38.	Piezoelectric crystal (e.g., quartz crystal)
	39.	Function generator
	40.	Oscillator circuit
	41.	Amplifier
	42.	LCR meter
	43.	Dielectric sample (capacitor with known dielectric material)
	44.	Parallel plate capacitor setup (if sample not pre-mounted)
	45.	AC power supply
	46.	Temperature controller
	47.	Surface Plasmon Resonance (SPR) setup
	48.	Laser source (monochromatic light, e.g., He–Ne laser)
	49.	Prism (Kretschmann configuration)
	50.	Metal thin film (e.g., gold-coated slide)
	51.	Optical rotation stage (goniometer)
	52.	Photodetector
	53.	Optical bench

	54.	Ferroelectric sample
	55.	Sawyer–Tower circuit
	56.	Reference capacitor
	57.	Iron core (Fe) with solenoid (primary & secondary coils)
	58.	Variac (autotransformer)
	59.	Integrator circuit (RC circuit)
	60.	Four probe setup (with probes arrangement)
	61.	Germanium (Ge) sample
	62.	Constant current source
	63.	Hall effect setup
	64.	Semiconductor sample (Ge/Si)
	65.	X-ray diffractometer (XRD setup)
	66.	X-ray tube (e.g., Cu target)
	67.	Sample holder
	68.	Goniometer
	69.	Standard reference sample (optional)
PHYV301: Lab Activities on Basic Electronic Devices	70.	DC Regulated Power Supply 0 – 30 volts
	71.	P-N junction Diode 1N4007 or 1N4148
	72.	Resistor 1k-ohm,100 k-ohm (1⁄4watt each)
	73.	D.C Ammeters 0–100mA, 0–500μA
	74.	D.C Volt meters 0–20V, 0–10V
	75.	Bread Board and connecting wires
	76.	Zener Diode (1N 4732A or 1N 4733A)
	77.	Resistor 1k-ohm, 470k-ohm
	78.	Step-down Transformer
	79.	Dual Trace CRO
	80.	Transformer
	81.	Dual D.C Power Supply
	82.	Transistor (NPN type) (BC147/ BC547/ 2N2222)
	83.	JFET(BFW10/ BFW11 or BF245, 2N5457)
	84.	Resistors (47 k-ohm, 2.2 k-ohm, 10k-ohm, 680k-ohm, 820k-ohm)
	85.	Capacitors
	86.	Function or Signal Generator
	87.	Light Emitting Diode (Different colors)
	88.	Different gate IC (Quad 2 Input) , NAND gate IC 7400 AND gate IC 7408 OR gate IC 7432

		XOR gate IC 7486 NOR gate IC 7402 NOT gate IC 7404

Semester VI

PHYC311: Lab Activities on PHYC309 & PHYC310	1.	PN junction diode
	2.	Regulated DC power supply
	3.	Voltmeter (high sensitivity)
	4.	Microammeter / milliammeter
	5.	Resistor (for current limiting)
	6.	Temperature control setup (water bath / heater, if required)
	7.	Thermometer
	8.	Digital multimeter
	9.	Connecting wires
	10.	Vacuum diode
	11.	Regulated DC power supply
	12.	Variable DC supply
	13.	Rheostat
	14.	Mercury vapour tube
	15.	Oven / heater
	16.	Temperature controller
	17.	LEDs (at least 4 different colours)
	18.	Breadboard / circuit board
	19.	Hydrogen discharge tube
	20.	Spectrometer
	21.	Diffraction grating
	22.	Telescope and collimator
	23.	Prism table
	24.	Reading lens
	25.	Iodine vapour cell
	26.	Spectrometer / spectrograph
	27.	Collimated light source (tungsten/halogen lamp)
	28.	Prism / diffraction grating
	29.	Optical bench
	30.	Laser source
	31.	Sodium (Na) lamp (incoherent source)
	32.	Single slit and double slit
	33.	Screen
	34.	Photoelectric tube

	35.	Monochromatic light source / mercury lamp
	36.	Filters (different wavelengths)
	37.	Cathode ray tube (CRT)
	38.	Helmholtz coils / bar magnet
	39.	Voltmeter
	40.	Ammeter
	41.	Millikan oil drop apparatus
	42.	Microscope with scale
	43.	Oil sprayer
	44.	Stopwatch
	45.	Capacitor plates arrangement
	46.	Light source
	47.	Two polarizers (polarizer & analyzer)
	48.	Rotating mount with angular scale
	49.	Babinet's compensator
	50.	Dipole antenna setup
	51.	RF signal generator
	52.	Receiver antenna
	53.	Ultrasonic generator
	54.	Ultrasonic transducer
	55.	Liquid cell (kerosene/xylene)
	56.	Microwave source (Gunn diode)
	57.	Microwave bench
	58.	Horn antenna
	59.	Detector
	60.	Reflector plates
	61.	Dielectric slab
	62.	Double slit arrangement (microwave)
	63.	Wollaston's air-film setup
	64.	Microscope / travelling microscope
	65.	Liquid sample
	66.	Glass plates
	67.	Spectrometer with Gaussian eyepiece
	68.	Glass prism
	69.	Reading lens
	70.	Spectrometer with Gaussian eyepiece
	71.	Hollow prism (for liquid)
	72.	Mechanical dial gauge with a plunger

Semester VII

PHYC404: Physics-I Practical	1.	Resistors (various values)
	2.	Capacitors (various values, electrolytic and ceramic)
	3.	Breadboard or PCB for circuit assembly
	4.	Connecting wires
	5.	Power supply
	6.	Oscilloscope
	7.	Digital multimeter
	8.	Push-button switch
	9.	LEDs
	10.	Other passive components
	11.	Function generator for the modulating signal
	12.	Frequency counter
	13.	Probes
	14.	Potentiometer (variable resistor)
	15.	Dual Power Supply
	16.	Jumper Wires
	17.	BNC Cables and Connectors
	18.	AC Mains Input (220V AC)
	19.	Transformer
	20.	Rectifier Bridge
	21.	Filter Capacitors
	22.	Switching Transistor (e.g., MOSFET)
	23.	Control IC (e.g., PWM Controller)
	24.	Inductors
	25.	Output Voltage Regulation Circuitry
	26.	Output Capacitors
	27.	Voltage and Current Measurement Tools
	28.	Heat Sink (for MOSFET or other heat-generating components)
	29.	Heat Shrink Tubing and Insulation Materials
	30.	Soldering Iron and Solder
	31.	Safety Gear (gloves, safety glasses, etc.)
	32.	Electrical Loads (resistors, LEDs, etc.)
	33.	DC Power Supply
	34.	Cathode Ray Oscilloscope (Analog type) (20/30/100 MHz Frequency)
	35.	Analog IC tester
	36.	Operational Amplifiers (Op-Amps)
	37.	Diodes (e.g., 1N4001, etc)
	38.	Inductor (coil)

	39.	Transistor (e.g., MOSFET)
	40.	Load resistor
	41.	Seven-segment display (common cathode)
	42.	Temperature sensor (e.g., LM35 or LM75)
	43.	Sevensegment display driver IC (e.g., 7447 or CD4511)
	44.	Clock pulse source (e.g., 555 timer or crystal oscillator)

Semester VIII

PHY412: Physics - II Practical (Computational Methods Using 'C' Program)	1.	Computer Systems with installed 'C' Programming kit

I. Laboratory Requirement for Minor Discipline of Physics:

Semester III

Course Code & Course Name	Sr. No	Required Equipments / Instruments
PHYM202: Lab Activities on PHY201	1.	Searle's Thermal Conductivity Apparatus (Cu)
	2.	cooling wire
	3.	Thermometer
	4.	Stopwatch
	5.	Vernier Calliper
	6.	Steam Generator or Hot Water Bath
	7.	Cold Water Circulator
	8.	Lee's Apparatus(Two metal discs)
	9.	Insulating Stand
	10.	Weighing machine
	11.	Heating Element
	12.	Ammeter
	13.	Voltmeter
	14.	Copper rod
	15.	Insulation materials
	16.	Constant flow calorimeter
	17.	Flow rate control
	18.	Black Body Source
	19.	Monochromator or Filters
	20.	Photodetector
	21.	Light Source Power Supply
	22.	Optical System
	23.	Wavelength Scale or Reference Data
	24.	Radiation Sensor (Bolometer or Photodiode)
	25.	Water Calorimeter
	26.	Insulating Enclosure
	27.	Platinum Resistance Thermometer (PRT)
	28.	Wheatstone Bridge
	29.	Mercury thermometer
	30.	Water Bath
	31.	stand (to hold Thermometer)
	32.	Multimeter

Semester IV

PHYM204: Lab Activities on PHYM203	1.	Bar pendulum
	2.	Stop clock
	3.	Meter scale
	4.	Vernier calliper
	5.	Protractor
	6.	Graph paper
	7.	Kater's Pendulum
	8.	Clam stand
	9.	Thread
	10.	Two identical masses (m) with small spring constants (k)
	11.	Two springs (with the same spring constant, k)
	12.	Two rigid supports Clam stand
	13.	Free-fall apparatus
	14.	Specific stand Electromagnet
	15.	Weight with hanger
	16.	Electrically maintained tuning fork
	17.	Melde's apparatus Clam
	18.	Signal generator
	19.	Digital oscilloscope
	20.	Measuring tape
	21.	Power supply
	22.	Kundt's tube or impedance tube
	23.	Microphone
	24.	sound level meter
	25.	Acoustic materials
	26.	Prism
	27.	Spectrometer
	28.	Sodium vapor lamp
	29.	Mercury vapor lamp
	30.	Michelson's interferometer setup
	31.	Newton's Rings setup
	32.	Traveling microscope
	33.	Plane Diffraction Grating(15000/600 line)
	34.	Mercury (Hg) Light Source

Semester V

PHYM302: Lab Activities on PHYM301	1.	Computer Systems with installed 'C' Programming kit

Semester VI

PHYM304: Lab Activities on PHYM303	1.	Mechanical dial gauge with a plunger
	2.	Stand with a base for Dial Gauge
	3.	Specimen or Work pieces (sample objects for measurement)
	4.	Bezel Clamp (for zeroing the gauge)
	5.	Plunger Lifting Lever (optional, for easy insertion of work pieces)
	6.	Cleaning Cloth or Brush (for cleaning the gauge before and after use)
	7.	Stroboscope
	8.	Rotating object (e.g., a disc with a marked point or pattern)
	9.	Stopwatch (optional)
	10.	Power source (if applicable)
	11.	Measurement scale (optional for verifying dimensions)
	12.	Ticker tape timer
	13.	Ticker tape
	14.	Spring balance
	15.	Set of Standard weights (e.g., 100g, 200g, etc.)
	16.	Hook or stand to hang objects
	17.	Measuring tape or ruler (optional)
	18.	Stand or clamp to support the spring balance
	19.	Masses of known value
	20.	Beam balance
	21.	Weights of known mass (e.g., 50g, 100g, etc.)
	22.	Meter scale or ruler
	23.	Knife-edge
	24.	String or hook
	25.	Masses of known value
	26.	Graduated cylinder (transparent and long)
	27.	Steel or glass ball of known radius
	28.	Liquid (e.g., glycerol, oil, or water with additives)
	29.	Tongs or tweezers
	30.	U-tube manometer
	31.	Manometric fluid (e.g., mercury, water, or oil)
	32.	Pressure source (air pump, vacuum pump, or other pressure systems)
	33.	Connecting tubes
	34.	Ruler or measuring scale
	35.	Bourdon tube pressure gauge
	36.	Hand-operated pressure pump

	37.	Dead-weight tester (for calibration)
	38.	Wrenches and spanners
	39.	Safety goggles
	40.	Mechanical vibration setup (e.g., spring-mass system or beam vibration setup)
	41.	Oscilloscope or frequency analyzer
	42.	Accelerometer or displacement sensor
	43.	Tuning fork of known frequency
	44.	Resonance tube
	45.	Water container (to adjust the length of the air column)
	46.	Rubber mallet (to strike the tuning fork)
	47.	Wet and dry bulb hygrometer
	48.	Hydrometer

CHEMISTRY LAB

INSTRUMENTS, GLASSWARE & CHEMICALS



I. Recommended Quantities of Miscellaneous Instruments for All Semesters, Including Major and Minor Courses for Batch of 15 Students.

Sr. No	Instrument Name	Required Quantity
1.	IR Lamp	01
2.	Bunsen burner	10
3.	Hot air oven	01
4.	Dryer	01
5.	Weighing balance	01
6.	Colorimeters	02
7.	Hot water bath	01
8.	Water activity meter	01
9.	Sample containers	20
10.	Desiccator	02
11.	pH meter	02
12.	pH electrode	02
13.	Thermometer	10
14.	Calomel glass electrode	02
15.	UV light chamber	01
16.	Stopwatch	10
17.	Mortar and pestle	05
18.	Cuvettes	02
19.	Distillation unit	01
20.	Thermostat	02
21.	Abbe’s refractometer	02
22.	Magnetic Stirrer	05
23.	Magnetic Stirrer with hot plate	05
24.	Conductometer	02
25.	Conductivity cell	02
26.	SCE	02
27.	Potentiometer	02
28.	Pt electrode	02
29.	Soxhlet extractor	01
30.	Flame photometer	01
31.	Conductivity meter	02
32.	UV-Vis spectrophotometer	01

33.	Molecular model kit	02
34.	Traube's Stalagmometer	01
35.	Centrifuge Machine	01
36.	Centrifuge tubes	20
37.	FT-IR Spectrometer	01
38.	Kjedahl apparatus	02
39.	Muffle Furnace	01
40.	Conductometer with Cell Magnetic Stirrer	02
41.	Copper electrode	02
42.	Ag/AgCl reference electrode	02
43.	Silver and calomel electrodes	02
44.	KNO_3 salt bridge	02
45.	Polarimeter	02
46.	Platinum electrode	02
47.	D. C. source (battery)	01
48.	Ammeter	02

II. Laboratory Requirement for Major Discipline of Chemistry:

Semester	Course Code and Course Name	Laboratory Materials	
I	**CHEC102: Lab Activities on CHEC101**	**Chemicals**	Hydrochloric acid, Sodium thiosulphate, Sulphuric acid, Potassium dichromate, Diphenylamine indicator solution, Tin(II) chloride, Mercury(II) chloride, Phosphoric acid, Ferrous ammonium sulphate, Potassium permanganate, Sodium oxalate, Ammonium iron(II) sulfate hexahydrate, Sodium thiosulfate, Potassium iodide, Starch indicator, Nitric acid, Acetic acid, Ethylenediamine tetraacetic acid, Eriochrome Black-T indicator, Buffer solution (pH-10), Magnesium sulphate, Oxalic acid, Sodium hydroxide solution, Phenolphthalein indicator, Tetrachlorocobaltate(II),Tetrachloridocuprate(II), Tetrachloridonickelate(II), Benzoic acid, Naphthalene, Sodium nitroprusside, Lead acetate, ammonium hydroxide, Bromine, Ethyl benzoate, Phenol, Aspirin, Silver nitrate, Sodium metal.

		Glassware	Pipette, Burette, Conical flasks, 100 ml, Volumetric flask, Funnel, Beaker 250ml,100ml, Glass rod, Stand & clamp, Measuring cylinder, Watch glass, White glazed tile, Glass chamber, Capillary tube, Stand & clamp, Tripod stand, Sodium fusion tube, Porcelain dish, Test tube stand, Test tube holder, Test tubes, Round bottom flask
		Instruments	Bunsen burner, IR Lamp
	CHEV101: Food Chemistry	**Chemicals**	Conc. sulfuric acid, Copper sulfate, Potassium sulfate, Sodium hydroxide, Boric acid, Hydrochloric acid, Methyl red indicator, Fehling's A solution, Potassium sodium tartrate, Lactose solution, Methylene blue indicator, Phenaphthalene indicator, Benedict's solution, Glucose, Sucrose, Ninhydrin, Glycine, Casein hydrolysate, Albumin, Iodine solution, Sodium chloride, magnesium chloride, Oxalic Acid, Sodium carbonate, Potassium Permanganate, Potassium hydrogen phthalate, Iodine, Potassium iodide, Sodium thiosulfate, Strach indicator, Copper(II) sulfate pentahydrate, Potassium sodium tartrate, Potassium dihydrogen phosphate, Sodium carbonate.
		Glassware	Burette, Pipette, Conical flask, Measuring cylinder, Kjeldahl distillation unit, Test tubes, Cuvettes, Beakers, Volumetric flask, Water bath, Funnel, Reflux condenser, Dropper, Filter paper, Test-tube holder, Crucible, Glass rod.
		Instruments	Colorimeters, Hot water bath, Water Activity meter, Sample containers, Weighing balance, Hot air oven (100-105°C), Desiccator, Muffle furnace, pH meter, pH electrode.
II	**CHEC104: Lab Activities on CHEC103**	**Chemicals**	hydrochloric acid, Sodium hydroxide, Acetic acid, Potassium nitrate, ammonium chloride, Anhydrous copper sulphate, Copper sulphate pentahydrate, Benzoic acid, ammonium hydroxide, Sodium acetate, Phenolphthalein indicator, o-nitrophenol, p-nitrophenol, 2,4 dinitrophenyl hydrazine, Methanol, 2,4 DNP, Benzaldehyde, Aniline, acetic

			anhydride, Zn dust, Nitrobenzene, Chlorobenzene, Iodine, Ethanol.
		Glassware	Beaker, Conical Flask, Glass rod, Hard glass test tube, Wire gauze stand, Burette Pipette, Test tube stand, Test tubes, Watch glass, TLC plates, Capillary tube, Round bottom flask, Water condenser, Measuring cylinder, Dropper, Air condenser.
		Instruments	Calorimeter, Thermometer, Thermos flask, Dewar flask, pH meter, Calomel glass electrode, IR lamp, Buchner funnel, UV light chamber, Digital balance.
	CHEV102: Chemistry of Biomolecules	**Chemicals**	Fehling's A, Fehling's B Solutions, copper(II) sulfate, Sodium potassium tartrate, Sodium hydroxide, carbohydrate sample, silver nitrate, Ammonia, Benedict's reagent, Molisch's reagent, conc. sulfuric acid, Barfoed's reagent, Seliwanoff's reagent, Glacial acetic acid, Glucose, Fructose, Maltose, Sodium potassium tartrate, Copper sulfate, Sodium Sulfate, Nelson's reagent, Ammonium molybdate, Trichloroacetic acid, Bovine serum albumin, picrate reagent, Creatinine solution, Fiske-Subbarow reagent, Standard phosphate solution, sodium acetate, Sodium diethyl barbiturate, Sodium citrate, Sodium carbonate, Sodium dihydrogen phosphate, Butanol, Aniline, Diphenylamine, Ninhydrin reagent, Hexane, Ethyl acetate, Sodium sulphate, Sodium carbonate, Calcium carbonate, Sodium chloride, Ether, Acetic anhydride, Anthrone reagent, Glucose stock solution, DNS reagent, Acetate buffer.
		Glassware	Test tubes, Test tube holder, Dropper, Measuring Cylinder, Beaker, Pipettes, Volumetric flasks, Funnel, Whatman filter paper, Capillary tubes, Conical flask, TLC plate.
		Instruments	Spectrophotometer, Stopwatch, pH Meter, Mortar and pestle, Colorimeter,
		Chemicals	Solid Iodine, sodium thiosulfate, Carbon tetrachloride, Potassium iodide, Copper(II) sulfate pentahydrate, Ammonium hydroxide, Ammonia,

III	**CHEC203: Lab Activities on CHEC201**		copper(II) sulfate, Phenol, Sodium chloride, Acetic acid, Benzoic acid, Chloroform, Cyclohexane, Sodium hydroxide, Phenolphthalein indicator, Ammonium hydroxide, Quinhydrone, Mohr's salt, Potassium dichromate, Sodium bicarbonate, Bromine, Ammonia, Potassium permanganate, Sodium nitroprusside, Sodium ferrocyanide, Ferric ferrocyanide, Silver nitrate, Chloroform, Iron(III) chloride, 2,4 DNP, Naphthol, Sulfuric acid, Calcium chloride, Ar-NO_2, Sodium nitrite, Ethanol, Potassium hydroxide, Glycine, Formaldehyde, Buffer solution.
		Glassware	Stoppered bottles, Separating funnels, Burette, Pipette, Conical flask, Volumetric flasks (100,50,25 ml), Glass-Rod, Test tubes, Tripod stand, Hard glass test tube, Measuring cylinder, Constant temperature bath, Micro burette, Beakers, Porcelain dish.
		Instruments	Spectrophotometer, Cuvettes, Distillation unit, Thermometer, Thermostat, Abbe's refractometer, Magnetic Stirrer, Conductometer, Conductivity cell, Potentiometer, SCE , Pt electrode, Weighing balance, pH meter, Stopwatch.
	CHEV201: Introduction to Medicinal Chemistry	**Chemicals**	Sodium hydroxide, Hydrochloric acid, Ethanol, Phenolphthalein indicator, Ibuprofen tablet, Benzoic acid, Benzene, Acetone, Ether, o-phenylene diamine, Formic acid (90%), p-Aminophenol, Acetic anhydride, Ethanol, Phthalic anhydride, Resorcinol, Salicylic acid, conc. sulfuric acid, Phosphoric acid, sodium nitrite, Acetanilide, chlorosulfonic acid, Ammonia, Sodium carbonate, Benzil, Acetylacetone, Methanol, Phenylhydrazine.
		Glassware	Beakers, Conical flasks, Measuring cylinders, Pipettes, Burette, Mechanical shaker, Funnel, Filter paper, Glass Rod, Burette stand, Dropper, Spatula, Perforated container, Hot plate, Evaporating dish, Round bottom flask, Condenser, Volumetric flask, Thermometer.

		Instruments	pH meter, Weighing balance, Oven, Desiccator, Morter pestle, Soxhlet extractor, Flame photometer, UV-Vis spectrophotometer, Cuvettes, Kjeldahl Digestion flask, Distillation unit, Conductivity meter.
IV	**CHEC207: Lab Activities on CHEC205 & CHEC206**	**Chemicals**	Eriochrome black T, EDTA, Ammonia buffer solution, Phenolphthalein indicator, Ethyl alcohol, Methyl orange indicator, Sulfuric acid, Sodium carbonate, Sodium bicarbonate, Ammonium purpurate (murexide) indicator, Ammonium chloride ammonium hydroxide buffer, (pH 10), Hydroxylamine hydrochloride, Ammonium acetate buffer solution, Ferrous ammonium sulphate, Concentrated hydrochloric acid, Monopotassium phosphate, Trisodium phosphate, Ammonium molybdate solution, 0.5 M hydrazine hydrate solution, 0.01M Lead(II) azide, 0.01M Zinc sulfate, Hexamine, pH 10 buffer solution, Xylenol orange, Zinc oxide, Cola beverage, Silver nitrate, Nitric acid, Sodium chloride, Silver nitrate, Ammonium hydroxide, Barium chloride, Ninhydrine, Proline. Lysine, Tryptophan, n-butanol, Glacial acetic acid, Deionized water.
		Glassware	Conical flask, Burette, Funnel, Pipette, Dropper, Measuring cylinder, (50 mL, 100 mL, 250 mL) Beaker, 50ml volumetric flask, glass rod, TLC plates, Capillary tubes, TLC chamber.
		Instruments	pH meter, UV-VisibleSpectrophotometer, Cuvettes, Analytical balance, magnetic stirrer, Blow drier, Flame photometer, Molecular model kit.
	CHEC303 : Lab Activities on CHEC301 & CHEC302	**Chemicals**	Glycerol, Ethanol, Acetone, Potassium persulfate, Potassium iodide, Sodium thiosulfate, Potassium iodate, Starch solution, Methyl acetate, Hydrochloric acid, Sodium hydroxide, Phenolphthalein indicator, Ethyl acetate, Potassium permanganate, Sodium oxalate, Copper(II) sulfate, Hydrogen sulfide, Ammonium hydroxide, Ammonium chloride, Ammonium sulfide, Nitric acid, Silver

V			nitrate, Lead acetate, Barium chloride, Calcium chloride, Sodium nitroprusside, Potassium dichromate, Ferrous sulfate, Ferric chloride, Ammonium molybdate, Carbon tetrachloride, Ammonia solution, Ammonium carbonate, Potassium thiocyanate, Nitroso-β-naphthol, Hydrogen peroxide, Potassium ferrocyanide, Potassium chromate, Dimethylglyoxime, Nessler's reagent, 8-hydroxyquinoline, Acetic acid, Sodium nitrite, Potassium oxalate, Oxalic acid, Zinc salt solution, Ammonia-ammonium chloride buffer solution (pH ≈ 10), Eriochrome Black T, EDTA, Bromine, Carbon tetrachloride, Ceric ammonium nitrate solution, Sodium bicarbonate, 2,4-Dinitrophenylhydrazine, Benzene, Toluene, Chloroform, Polyethylene, nylon, Phenol, Formaldehyde solution.
		Glassware	Specific gravity bottle, Watch glass, Rubber tube, Pinch cock, Clamp stand, Beaker, Thermometer, Glass trough, Glass rod, Pipette, Beaker, Stop watch, Volumetric flask(250 ml & 100ml), Clamps & rubber tubing, Burette (25 ml, 50ml), Thermostat, Water bath, Conical Flasks(250 ml & 100ml), Measuring Cylinder, Burette stand, Funnel, Dark Brown coloured bottle(1000ml), Dropper, Test tube holder, Test tubes, Test tube stand, Platinum wire, Charcoal block, Filter paper, Blow pipe, pH paper, Whatman No.41, Aeration setup, Aspirator, Erlenmeyer flask, Hot plate, Volumetric flask 1 lit, Capillary tube, Thiel's Tube, Sodium fusion tube, Desiccator.
		Instruments	Traube's Stalagmometer Centrifuge Machine, Centrifuge tubes, Bunsen Burner, Ostwald Viscometer, Oven, Buchner funnel, Suction flask, FTIR Spectrometer, UV-Vis spectrometer, Pyrolysis unit, Morter pestle.
	CHEV301: Chemistry of Soils and Agrochemicals	**Chemicals**	p-Nitrophenol, Potassium chromate, Calcium acetate, Triethanolamine, Calcium chloride, Sodium hydroxide, Ammonium acetate solution, EDTA solution, Ammonia buffer solution (pH

			10), Eriochrome Black T indicator, Concentrated sulfuric acid, Potassium dichromate, Ferrous ammonium sulfate, Diphenylamine indicator, Orthophosphoric acid, Sodium fluoride, Acetone, Acetonitrile, Hexane, Petroleum ether, Ethyl acetate, Anhydrous sodium sulfate, Dilute hydrochloric acid, Sodium bicarbonate, Ammonium molybdate, Antimony potassium tartrate, Potassium iodide, Sodium thiosulfate, Starch indicator, Potassium iodate, Sodium carbonate, Phenolphthalein indicator, calcium carbonate, Potassium sulfate, Boric acid.
		Glassware	Beakers, Conical Flasks, Measuring cylinders, Pipette, Burette, Glass rod, Mechanical shaker, Filter paper, Funnel Dropper, Spatula, Perforated container Hot plate, Round bottom Flask, Condenser, Evaporating dish, Thermometer.
		Instruments	pH meter, Weighing balance, Hot air oven, Desiccator, Morter pestle, Soxhlet extractor, Flame photometer, UV-Vis spectrophotometer, Cuvettes, Kjeldahl Digestion Flask, Kjedahl apparatus, Conductivity meter
VI	**CHEC311 : Lab Activities on CHEC309 & CHEC310**	**Chemicals**	Sodium hydroxide, Hydrochloric acid, tea leaves (green tea / black tea), Methanol, Ethanol, Cyclohexene, Bromine, Benzaldehyde, trimethylpropyl ammonium iodide, silver oxide, 1-Propanol, Benzil, Potassium hydroxide, Petroleum ether, hexane, aniline or substituted anilines, Phthalic anhydride, Urea, Copper(II) chloride, Ammonium molybdate, Benzophenone, Isopropyl alcohol, Aspirin tablets, Methyl orange indicator, Sodium bicarbonate, Oxalic acid, hydrogen peroxide, potassium permanganate, silver nitrate, potassium chromate, zinc oxide, EDTA solution, Ammonia-ammonium chloride buffer (pH $\approx$ 10), Eriochrome Black T indicator, phenolphthalein indicator, Antacid tablet, ammonium thiocyanate, ammonium oxalate, Potassium thiocyanate, 1,10-Phenanthroline.

		Glassware	Beakers(100ml,250ml,500ml), Conical Flasks, Measuring cylinders, Glass rods, Funnel, Whatman Filter, Paper Hot plate, Buchner Funnel, Thermometer, Dropper, Pipette, Round bottom Flask, Feflux Condenser, Separating Funnel, Stand with clamps, Filter paper, Water bath, Test tubes, Test tube stand, TLC Chamber, Glass capillary tubes, Evaporating dish, Silica Crucible, Tongs/Crucible holder, White tile, Porcelain dish, Spatula.
		Instruments	Molecular Model Kit, Centrifuge tubes, Centrifuge Machine, pH meter, UV-Vis Spectrophotometer, Cuvettes, Morter Pestle, Weighing Balance, Magnetic stirrer, Oven, Dessicator, Distillation setup, Microwave oven, Microwave safe vessel, Muffle Furnace, Bunsen Burner, Colorimeter
VII	**CHEC404 : Lab Activities on CHEC401, CHEC402 & CHEC403**	**Chemicals**	Sulphuric acid, Nitric acid, Zinc oxide, Potassium permanganate, Sodium oxalate, Ammonium hydroxide, Acetic acid, Disodium hydrogen phosphate, Potassium iodide, Sodium thiosulphate, Starch, Diphenyl amine indicator, Potassium dichromate, Tin(II) chloride, Mercury(II) chloride, Phosphoric acid, Perchloric acid, Dolomite ore, EDTA, Ammonium chloride, Ammonium dihydrogen phosphate, Magnesium ammonium chloride, Lead nitrate, Hydrogen peroxide, Sodium hydroxide, Dimethyl glyoxime, Ammonium acetate, Ethanol sodium acetate, Potassium chromate, Aluminium sulphate, Oxalic acid, Potassium oxalate, Thiourea, Copper powder, Hydrochloric acid, Chloro penta-ammino cobalt (III) chloride, Sodium nitrite, Cobaltous chloride hexahydrate, Zinc sulphate Heptahydrate, Eriochrome Black T indicator, Methanol, Sodium bicarbonate, Sodium carbonate, Bromine, Ferrous sulphate, Sodium nitroprusside, Silver nitrate, Chloroform, Silica powder, Charcoal, Calcium carbonate, Methanol, Petroleum ether, Hexane, Diethyl ether, Ethyl acetate, Acetone, Hydroxylamine hydrochloride, 2, 4-Dinitro phenyl hydrazine, Acetic anhydride Phenol,

			Potassium chloride, Trichloroacetic acid, Monochloroacetic acid, acetic acid, Potassium nitrate, Copper (II) nitrate, Potassium bromate, Ferrous ammonium sulphate, Benzoic acid, p-Nitrobenzoic acid, Aspirin tablet, Phenolphthalein indicator, Glycine, Methyl red, Bromo-phenol blue, Salicylic acid, Ferric nitrate, 1,10-Phenanthroline, Camphor, Benzene, Carbon tetrachloride, D-Glucose, D-Tartaric acid.
		Glassware	Stem-cut Funnel, Silica crucible, 100ml. Volumetric Flask, 100ml. Conical Flask, 25ml. Burettes, 250ml. Beakers, Wire Gauze, Test tube, Water bath, Watch glass, Porcelain Tile Pipettes, Glass rods, 100ml Beakers, Gooch Crucible, 50 ml Measuring Cylinder, 10ml Measuring Cylinder, Whatman Filter paper No.41, Blue litmus paper.
		Instruments	pH meter, Analytical Balance, Buchner Funnel, Weighing Balance, UV cabinet, Conductometer with Cell Magnetic Stirrer, copper electrode, Ag/AgCl reference electrode, silver and calomel electrodes, KNO_3 salt bridge, Potentiometer, platinum electrode, Colorimeter, Cuvettes, Spectrophotometer, Polarimeter.
VIII	**CHEC412 : Lab Activities on CHEC409, CHEC410 & CHEC411**	**Chemicals**	Benzaldehyde, Acetophenone, Sodium hydroxide, Ethanol, Sulphuric acid, Resorcinol, Ethyl acetoacetate, Methanol, Camphor, Sodium borohydride, Benzophenonem,2-propanol, Methanol, Ethyl acetoacetate, Phenyl hydrazine, Diethyl ether, Copper sulphate, Cu-Turning, Sodium chloride, Hydrochloric acid, p-amino benzoic, acid, Sodium nitrite, 2-Methoxy Naphthalene, Phosphorous oxychloride, Sodium acetate, Glycine, Benzoyl chloride, Cyclohexanol, Nitric acid, Cyclohexanone, Hydroxylamine, Petroleum ether, Phthalic anhydride Urea, Bromine, Potassium hydroxide , Glacial acetic acid, Nitrobenzene, Iron filings, Sodium hydroxide, Aniline, Sodium iodide, Nitric acid, Diethyl ether, Sodium borohydride, Isopropyl

			alcohol, Sodium sulphate, Magnesium sulphate, O-phenylenediamine, Formic acid (90%), Calcium hydroxide, Ethanol, Phenolphthalein, Sodium, carbonate, Anhydrous sodium sulphate, Ethyl acetate, Activated charcoal, Dichloromethane, Hexane, petroleum ether, Silica gel, Ethyl acetate,Methanol, Dichloromethane, Acetone, Acetanilide, Potassium bromide, Ceric ammonium nitrate, Benzil, Benzophenone, Iso-Propanol, Glacial Acetic Acid, Benzaldehyde, Lithium Hydroxide, Ethyl acetoacetate, Salicylic Acid, Acetic anhydride, Phosphoric Acid, Sodium Bicarbonate, P-Nitroaniline, Copper(I) Chloride, Sodium Metal, Sodium ethoxide, Potassium Iodide, Starch, Iodine, Potassium Permangante, EDTA, Erichrome Black-T, Tartaric Acid.
		Glassware	Crucible, Beakers, Pipette, Erlenmeyer Flask, Glass rod, 100,250,500ml Volumetric Flask, Hard glass test tube, Tripod Stand, Funnel, Rubber cork, Conical Flask, TLC plate, Watch glass, Round Bottom flask, Air Condenser, Capillary tube, Water Condenser, Burette, Two necked Round Bottom Flask, Porcelain dish, Thiel's tube, Stopper bottles, density bottle, Rubber tube.
		Instruments	Calorimeter Weighing Balance, Magnetic Stirrer, pH meter, Flame Photometer, Spectrophotometer, Cuvettes, Colorimeter, Potentiometer, Conductometer, IR lamp, Dilatometer, thermostat, stop-watch, hair drier, Stalagmometer Cadmium stick electrode, D.C.source (battery), Ammeter, Moving boundary apparatus, Platinum electrode, Thermometer.

III. Laboratory Requirement for Minor Discipline of Chemistry:

Semester	Course Code and Course Name	Laboratory Materials	
III	CHEM202: Lab Activities on CHEM201	**Chemicals**	Paraffin Liquid, Urea, Cinnamic Acid, Ethyl alcohol, benzoic acid, naphthalene, Ethyl benzoate, Sodium hydroxide, Concentrated hydrochloric acid, Acetanilide, Nitric acid, Concentrated sulfuric acid, Acetic acid, Ethanol, Benzaldehyde, Sodium carbonate, Potassium permanganate, Glacial acetic acid, Bromine, 2,4-dinitrophenyl hydrazine, Methanol, m-dinitrobenzene, Sodium sulphide, Iodine solution.
		Glassware	Thermometer, Thiele's Tube, Capillary tubes, Test Tubes, Beaker, Clamp stand, Thermometer, wire gauze, Glass rod, Filter paper, Conical flask, water bath, Whatmann's filter paper, Watch glass, TLC plates, TLC chamber, UV light chamber, Water Condenser, 100 ml measuring flask, 250 ml beaker, Funnel, tripod stand, Hotplate, Round bottom flask, Test tube holder.
		Instruments	IR lamp, Weighing Balance, Burner, Buchner flask.
IV	CHEM204: Lab Activities on CHEM203	**Chemicals**	Chromic acid, anhydrous sodium carbonate, Methyl orange indicator, hydrochloric acid, Potassium dichromate, Potassium iodide, Concentrated hydrochloric acid, Sodium thiosulphate, Starch solution, NaOH, Phenolphthalein indicator, oxalic acid, sodium oxalate, Ferrous Ammonium Sulphate, Potassium Oxalate, Hydrogen peroxide, Ethanol, Cobalt (II) chloride hexahydrate, Ammonia Solution, Ammonium Chloride, Diphenylamine indicator, Tin(II) chloride, Mercury(II) chloride, Phosphoric acid, Ferrous ammonium, Mohr s salt, 5% Potassium Iodide solution, Starch indicator, Ethylenediamine tetraacetic acid, Eriochrome Black-T indicator, Buffer solution (pH-10), Magnesium sulphate, Rubeanic acid.
		Glassware	Pipette, Burette, Conical flasks, 100 ml Volumetric flask, Funnel, Beaker 250ml,100ml, Glass rod, Stand & clamp,

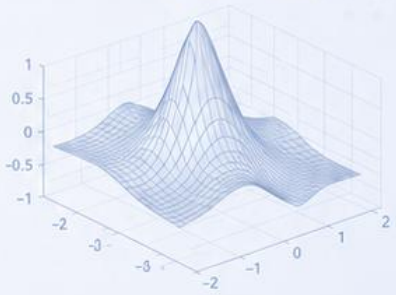
			Measuring cylinder, Watch glass, White glazed tile, Glass Chamber, Capillary tube.
		Instruments	Magnetic stirrer, Analytical balance.
V	**CHEM302 : Lab Activities on CHEM301**	**Chemicals**	Potassium permanganate, Copper sulfate, Methyl orange, Acetic acid, Sodium hydroxide, Hydrochloric acid, Phenolphthalein indicator, Potassium nitrate, Ammonium chloride, Ammonium hydroxide, Glycerol, Benzoic acid, Potassium persulfate, Potassium iodide, Sodium thiosulfate, Ethyl acetate, Hydrogen peroxide, Manganese dioxide.
		Glassware	Thermostat, Beakers, Conical Flasks, Volumetric Flasks, Measuring cylinders, Pipette, Glass Rod, Thermometer, Stop watch, Burettes, Stand with clamps, Rubber tubing, Funnel, Test tube stand.
		Instruments	UV-Vis spectrophotometer, Cuvettes, Weighing balance, Calorimeter, Ostwald viscometer, Colorimeter/Spectrophotometer,
VI	**CHEM304 : Lab Activities on CHEM303**	**Chemicals**	Ethanol, Sodium hydroxide, Hydrochloric acid, Sodium bicarbonate, Sodium carbonate, Sodium metal, Ferrous sulphate, Ferric chloride, Dilute HCl, Nitric acid, Silver nitrate, Lead acetate, Sodium nitroprusside, Bromine, Sodium nitrite, β-naphthol, Carbylamine reagents, Tea powder, Dichloromethane, chloroform, Anhydrous sodium sulfate, Glycine, Formic acid, Acetic anhydride, Phenolphthalein indicator, Aniline, Potassium bromide, m-Dinitrobenzene, N,N-dimethylaniline, Anthranilic acid, Barium chloride solution, Silver nitrate, Lead acetate, Magnesium sulfat, Ammonium hydroxide, Hydrogen peroxide, Ammonium carbonate, Dimethylglyoxime, Ammonium thiocyanate, Sodium bismuthate, Ammonium oxalate, EDTA solution, Eriochrome Black T, Zinc sulfate, Nickel salt solution, Aluminium salt solution, Oxine (8-hydroxyquinoline).
		Glassware	Test tubes, Test tube holder, Hard glass tube, Beakers, Conical Flask, Measuring cylinders, Pipettes, Glass rod, Watch glass, Evaporating dish, Porcelain tile, Funnel, Filter paper, Wire gauze, Water bath, Thermometer, Thiele's Tube,

			Sodium Fusion tube, Capillary tube, Tongs, Tripod stand, Droppers, Round bottom flask, Condenser, Hot plate, Watch glass,
		Instruments	Bunsen burner, Morter pestle, Desiccator, Oven, Magnetic stirrer, Kipp's Apparatus, Centrifuge machine, Centrifuge tubes.

$$\int_a^b f(x)\,dx$$

$$A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$$

$$\sum_{i=1}^{n} i$$



MATHEMATICS LAB



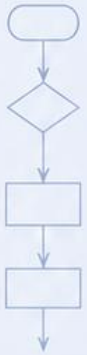
```
import numpy as np
import matplotlib.pyplot as plt

x = np.linspace(0, 2*np.pi, 400)
y = np.sin(x)

plt.plot(x, y)
plt.grid(True)
plt.show()
```

SOFTWARES AND PROGRAMMING LANGUAGES





Python | MATLAB | Scilab | SageMath | MS-Excel with Copilot

```
\documentclass{article}
\usepackage{amsmath}

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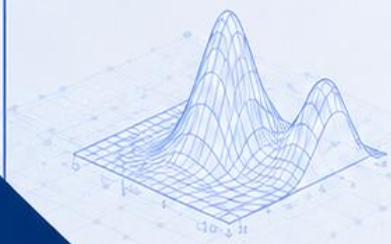
  Euler's Identity:
  $e^{i\pi} + 1 = 0

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```

LaTeX | GeoGebra | C | R

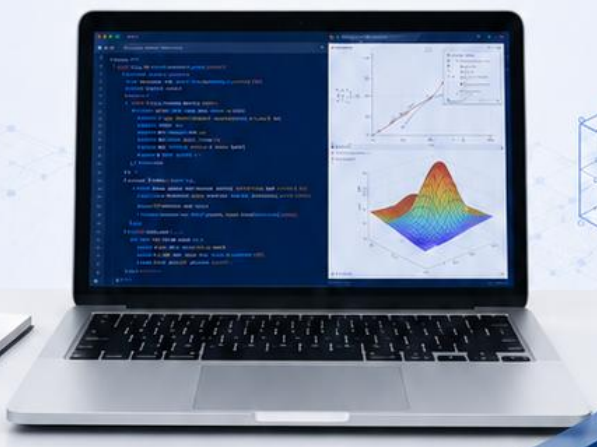
```
x <- c(1,2,3,4,5)
y <- c(2,4,5,4,3)
plot(x, y, type='b')
```







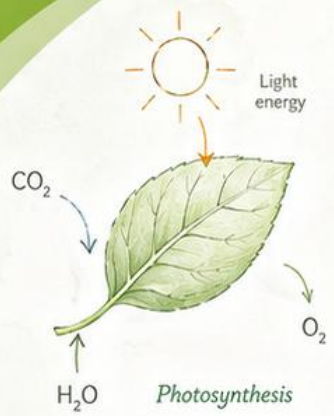


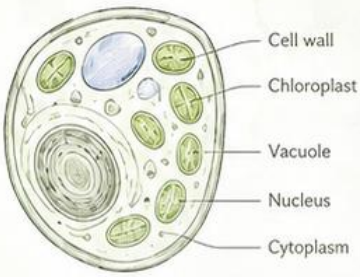


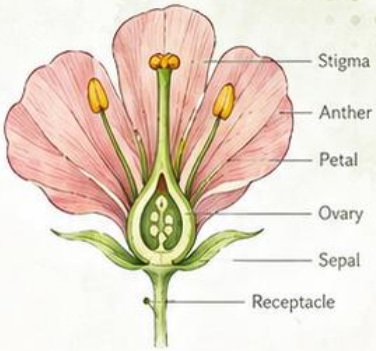
UGV03: B.Sc. (Honours) (Mathematics) {2025 Pattern}

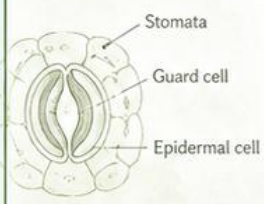
I. Recommended Quantities of Miscellaneous Instruments for All Semesters, Including Major and Minor Courses for Batch of 15 Students.

Semester	Course Code & Course Name	Equipment/ Instrument/ Software/ Programming Language
	Computer Lab of 15 Computers with:	
I	MATV101: Introduction to GeoGebra	1) GeoGebra – Software (Open-source)
II	MATV102: Programming in Python	1) Python - Programming Language (Open-source)
II	SECS102: MS-Excel with AI	1) Microsoft Excel with Copilot - Software Program (At least 1 Microsoft 365 Personal Subscription)
III	MATV201: R Programming	1) R Software (Open-source)
V	MATC303: Programming in MATLAB	1) MATLAB Software
V	MATV301: LaTeX	1) LaTeX - TeXstudio, Overleaf, or MiKTeX. (Open source)
VII	MATC404: Programming in C and Scilab	1) C - Programming Language (Open source) 2) Scilab - Programming Language (Open source)
VIII	MATC412: LaTeX & Programming in SageMath	1) LaTeX - TeXstudio, Overleaf, or MiKTeX. (Open source) SageMath - Software (Open source)



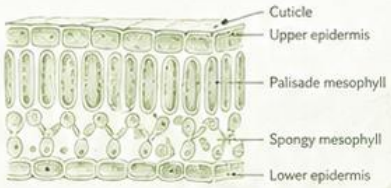






BOTANY LAB

EQUIPMENTS, SPECIMENS & CHEMICALS



UGV04: B.Sc. (Honours) (Botany) {2025 Pattern}

I. Recommended Quantities of Miscellaneous Instruments for All Semesters, Including Major and Minor Courses for Batch of 15 Students.

Sr. No.	Instrument Name	Quantity
1.	Anemometer (Wind Speed Measuring Instrument)	1
2.	Autoclave (Steam Sterilization Unit)	1
3.	Barometer (Atmospheric Pressure Measuring Instrument)	1
4.	Chromatography Chamber	4
5.	Colorimeter Instrument	1
6.	Compound Microscope	10
7.	Deep Freezer (Low Temperature Storage Unit)	1
8.	Desktop Computer System	1
9.	Digital Analytical Weighing Balance	2
10.	Digital Camera	1
11.	Digital Stopwatch or Timer	1
12.	Digital Temperature Probe Sensor	1
13.	Dissecting Microscope	5
14.	Evaporation Pan (Evapotranspiration Measurement Unit)	1
15.	Fermentation Unit (Fermenter)	1
16.	Fluorescence Microscope	1
17.	Ganong's Potometer (Transpiration Measurement Apparatus)	1
18.	Ganong's Respirometer (Respiration Measurement Apparatus)	1
19.	Gel Electrophoresis Unit (DNA Separation System)	1
20.	Hemocytometer (Cell Counting Chamber)	1
21.	Homogenizer (Tissue Grinding Instrument)	1
22.	Hot Air Oven (Dry Sterilization Oven)	1
23.	Hygrometer (Humidity Measuring Instrument)	1
24.	Kjeldahl Digestion Unit	1

25.	Laboratory Centrifuge Machine	1
26.	Laboratory Heater	1
27.	Laboratory Hot Plate	1
28.	Laboratory Incubator	1
29.	Laboratory Mercury Thermometer	4
30.	Laboratory Oven	1
31.	Laminar Air Flow Cabinet (Aseptic Chamber)	1
32.	Light Microscope	8
33.	Magnetic Stirrer with Hot Plate	1
34.	Magnifying Lens (Hand Lens)	4
35.	Micro centrifuge Machine	1
36.	Micropipette (Adjustable Volume Pipette)	4
37.	Microwave Oven	1
38.	Ocular Micrometer (Eyepiece Scale)	2
39.	Polymerase Chain Reaction (PCR) Machine / Thermal Cycler	1
40.	Rotary Microtome (Section Cutting Instrument)	1
41.	Scientific Calculator (CASIO fx-991CW or Equivalent)	2
42.	Soil Moisture Meter	1
43.	Soil Temperature Probe Sensor	1
44.	Soil Testing Kit (Soil Analysis Instrument)	2
45.	UV-Visible Spectrophotometer	1
46.	Ultraviolet (UV) Transilluminator	1
47.	pH Meter (Digital Hydrogen Ion Concentration Meter)	2

II. Laboratory Requirement for Major Discipline of Botany:

Semester	Course Code & Course Name	Category	Details
I	**BOTC102: Lab Activities on BOTC101**	**Specimens / Materials**	Specimen of *Ectocarpus* (Fresh Or Preserved), Fresh Or Preserved Specimen of *Phytophthora* (Infected Plant Tissue Or Culture), Specimen of *Rhizopus* (Fresh Or Cultured), *Penicillium* Specimen (Fresh Or Cultured), *Alternaria* Specimen (Fresh Or Cultured), *Puccinia* Specimen (Fresh Or Infected Plant Material: Black Stem Rust Of Wheat And Infected Barberry Leaves), Lichen Samples (Crustose, Foliose, And Fruticose), Plant Roots For *Mycorrhiza* Study, Permanent Slides (Antheridial Head, Archegonial Head, L.S. Capsule, And *Protonema*), Fresh Or Preserved Sphagnum Specimens, Permanent Slides (L.S. *Strobilus*), Fresh Or Preserved Anthoceros Specimens, *Puccinia* Specimen (Fresh Or Infected Plant Material), *Agaricus* Specimen (Fresh Mushroom or Cultured Sample), Permanent Slides of *Nostoc*, *Chara*, *Oedogonium*, *Vaucheria*, *Andpolysiphonia*, Electron Micrograph Images of *Chara*.
		Equipment / Instruments	Electron Micrographs Or 3d Models of T-Phage And TMV, Light Microscope, Diagrams/Illustrations of Lytic And Lysogenic Cycles, Compound Microscope, Dissecting Microscope, Gps Device (Optional, For Location Tagging), Sterilized Blade Or Scissors, Label Tags And Waterproof Marker, Dissecting Microscope Or Magnifying Lens, Camera (For Habitat Documentation), Kjeldahl Digestion Unit, Distillation Apparatus, Laboratory Thermometer, Digital Temperature Probe, Colorimeter (Optional), pH Meter Or Universal pH.
		Chemicals / Reagents	Hydrazine Suplate, Hexamethylenetetramine, Concentrated Sulfuric Acid (H_2So_4), Sodium Hydroxide

			Solution, Boric Acid Solution, Mixed Indicator (E.G., Methyl Red And Bromocresol Green), Standard Acid (E.G., Hcl Or H_2So_4 For Titration), Catalyst (E.G., Copper Sulfate Or Selenium Tablets), Staining Agents (E.G., Gram Stain, Methylene Blue), Distilled Water, Stains: Safranin, Glycerin, Chemicals: Distilled Water, Acetic Acid, Stains (E.G., Iodine Solution Or Glycerine), Stains (E.G., Lactophenol Cotton Blue Or Iodine Solution), Staining Agents (Fast Green), Mounting Medium (E.G., Glycerin), Fixative Solution (For Permanent Slides), Immersion Oil (For High Magnification).
		Glassware/ Other Materials	Graph Paper (For Plotting Calculations, Prepared (Permanent) Bacterial Slides, Glass Slides And Cover Slips (For Temporary Preparations), Dropper, Inoculating Loop, Bunsen Burner Or Alcohol Lamp, Photographs Or Virtual Images of Bacteria And Root Nodules, Models Or Diagrams of Binary Fission, Conjugation, And Root Nodules, Forceps And Needles, Blotting Paper, Razor Blades Or Scalpel, Needle And Forceps, Brush, Field Notebook And Pen, Collection Jars Or Plastic Bags, Gloves, Seawater For Storage, Newsprint Paper Or Blotting Sheets, Plant Press Or Heavy Books, Labels and Waterproof Markers, Petri Dishes Or Culture Plates, Scalpel Or Dissecting Tools, Microscope Slide Holder, Beaker, Tweezers, Permanent Slide Labels, Turbidity Meter (Nephelometer), Glass Cuvettes (Clean), Stirring Rod, Pipettes, Calibration Standards (E.G., For 0, 10, 100, 1000 Ntu), Flask, Burette And Stand, Conical Flasks, Measuring Cylinders, Heating Mantle Or Burner, Digestion Tubes, Funnel, Safety Goggles, Plant Identification Guide/Books, Quadrats Or Transect Lines, Measuring Tape, Gps Device Or Map, Magnifying Lens, Herbarium Sheets, Polythene Bags (For Sample Collection), Clipboard, Glass Bottles

			With Tight Lids For Odor Evaluation, Indicator Paper.
	BOTV101: Precision Agriculture	**Specimens / Materials**	Maize and bean seeds, Crops, Seeds/Seedlings, Plots of planting both crops and forest trees, Seeds of the desired crop, Kitchen waste, Leaves, Earthworms (*Eisenia fetida*), Fresh plant tissue.
		Equipment / Instruments	Watering cane or irrigation system, Soil testing kit, Camera, Composting bin or container, Mesh or breathable cover, Collection container for vermiwash, pH meter, Weather Station, Computers with Software, Anemometer, Thermometer, Hygrometer, Barometer, Pyranometer, Data loggers, Stevenson screen, Wind vane, Soil temperature probes, Evaporation pans, GPS device, Devices (any of the following) connected with internet: Smartphone, Computer, Laptop, Crop management software- any of the following software: FarmLogs, Cropio, AgriWebb, IoT sensors, Projector, Microcontroller (e.g., Arduino or Raspberry Pi), Wi-Fi Module, The system will require either cloud storage solutions or local database solutions, Computer with data analytics software (e.g., Python, or R), Drones (optional), Micro-Centrifuge, Micropipettes and tips, Microcentrifuge tubes, Water bath or heat block, PCR machine (thermal cycler), PCR tubes, gel tray, Comb, Power supply, DNA ladder, UV trans-illuminator or Geldoc System,
		Chemicals / Reagents	Fertilizers (organic or synthetic), Lysis buffer (SDS and salt), Ethanol (95-100%), Isopropanol, Sterile distilled water, Taq DNA polymerase, dNTPs (dATP, dTTP, dCTP, dGTP), Forward and reverse primers, PCR buffer (with $MgCl_2$), DNA template (extracted DNA), Agarose, Ethidium bromide.
		Glassware/ Other Materials	Hoe, Rake, Trowel, Measuring tape, Label markers, Field Plot, Measuring Tape, Plow, Watering Can or Irrigation System, Weeding Tools, Record-Keeping Material, Protective

			Gear, Pest Control Supplies, Labeling Stakes, Small Plots, Shovels, Rakes for planting and tilling, Pest Control Kit, Watering System, Labels, Data Recording Sheets or Notebook, Shovel, Rake, Measuring tape or rope, Weighing scale, Notebook and pen/pencil, Maps and Charts, Gloves, Rain Gauges, Data Loggers, Power supply Connectors and Wires, Field Guide to Weeds, Quadrant Frame, Mortar and pestle.
II	**BOTC104: Lab Activities on BOTC103**	**Specimens / Materials**	Prepared slides and Preserved material of *Psilotum* (stem, rhizome, gametophyte, synangium), Prepared slides and Preserved material of *Marsilea* and S*porocarp*, Specimen of *Equisetum*, Permanent slides (L.S. *Strobilus*), Specimens of *Selaginella*, Specimen of *Cycas* (whole plant), Permanent slides (L.S. of ovule and reproductive structures), Permanent slides of the *Pinus* needle, male cone, female cone, and microspores, Permanent slides of *Gnetum* male and female strobili, Preserved specimens of *Gnetum*, Single prepared slide of gymnospermic material for comparison (optional), Fossil specimens or detailed models of *Rhynia* and *Cooksonia*, Diagrams or photographs of fossil specimens, Fossil samples or replicas of *Archaeopteris*., Diagrams or models of early vascular plants (e.g., *Rhynia*), Charts illustrating evolutionary processes (overtopping, planation, syngenesis, etc.), Permanent slides of *Selaginella*, *Marsilea*, and other heterosporous pteridophytes.
		Equipment / Instruments	Compound microscope, Watch glass, Dissecting needles, Forceps, Microtome (for sectioning), Dissecting microscope, Magnifying lens or stereomicroscope, Hand lens or stereo microscope, Vernier calipers, Weighing balance, Moisture meter, GPS device, Camera/smartphone, Herbarium sheets, Pressing boards, Calculator,.

		Chemicals / Reagents	Stains (e.g., Safranin, Fast Green), Stains (glycerin, etc.), Safranin-O, Methyl green stain.
		Glassware/ Other Materials	Hand lens, Scalpel, forceps, and needle, Glass slides and cover slips, Blotting paper, Cutting tools (razor blade, scissors), Notebook, Watch glass, Brush, Petri dish, Blotting paper, Drawing sheets and pencils, Dropper, Microscopic slides, Watch glass, Measuring scale or calipers for fossil specimens, Plant samples (if available) with dichotomous branching, Measuring scale (microscopic calibration), Measuring tape, Geological time scale chart, Reference books or virtual resources, Test tube.
	BOTV102: Food Processing	**Specimens / Materials**	Fruits of citrus, tomato, mango, apple, guava, spices, Fresh ripe fruits, vegetables, Yeast starter, yeast (*Saccharomyces cerevisie*), Almond fruits, 2 different samples of white bread slices coded as 001 and 002, spinach, carrot, pear, banana, broccoli, citrus, strawberry, and raspberry and vegetables-root and leafy vegetables, Grains.
		Equipment / Instruments	Pulper, screw type juice extractor, citrus juice extractor or rosing machine, citrus halving machines, fruit mill, basket press or hydraulic press or rack and cloth press, gas burner, double seamer, processing and cooling tank, Stain less steel storage tanks, sterilization equipment, thermometer, aluminium pan, glass containers and closures, bottle filling machines, wooden ladle, and mixing tankFruit washing machine, air jet cleaner, steam cleaner, vibratory cleaner, air cooler, freezer, heater, fermenter, air bubble water sprayer machine, ultrasonic cleaning machine, grading machine, roll crusher, jaw crusher, pressure mill, impact mill, attrition mill,.
		Chemicals / Reagents	Sodium benzoate, Potassium metabisulfite (KMS), Citric acid, Salt, citric acid or vinegar, Sugar, distilled water, Salt solution- 0.5, 0.8, 1.0, 1.2, 1.5%, Sugar solution- 0.05, 0.5, 0.7, 1.0, 1.2%, Citric acid- 0.02, 0.04,

			0.1, 0.5, 1.0%, Sulphuric acid- 0.255 N [1.25% (m/v)], Sodium hydroxide solution- 0.313 N [1.25% (m/v)], hydrochloric acid, Ascorbic acid, potassium metabisulphite, sodium benzoate, Propionic acid, Diacetyl and 2,3-butylene glycol, glucose, and ethyl alcohol.
		Glassware/ Other Materials	Filter cloth or sieve, pans of suitable size, heaters, caps, capping machine, sterilizer or pasteurizer, volumetric flask, measuring cylinder, weighing balance, knives, and choppers, bottles, glass material, and utensil, pilfer proof cap sealing machine, drying tray, Induction, 10-100 ml beakers, graduated cylinders, 2 pipettes, 4 fermentation tubes, 1 grease pencil, Spoons and bowls, beakers, sheet for analysis, napkin, and disposal.
III	**BOTC203: Lab Activities on BOTC201**	**Specimens / Materials**	Plant Specimens: Carrot, Sweet potato, banyan, Mangrove etc., Plants with different types of root modifications., Bryophyte and lichen specimens (capsules and fruiting bodies), Chick pea, Models / Photographs/ Pictures/ slides of different types of ovules, Lateral or Axillary Branching, Dichotomous Branching.
		Equipment / Instruments	Dissecting microscope, Compound microscope.
		Chemicals / Reagents	Concentrated potassium hydroxide, Calcium hyperchlorite (bleach), Phenylenediamine, Ethanol: 50%, 70%, 95%, and 100%, Sodium hypochlorite, Hcl, Acid fuchsin, Glacial acetic acid, Distilled water, Stain Safranin, Stain methylene blue, Stain glycerine.
		Glassware/ Other Materials	Probe, curette and blade for root Inspect ion, Magnifying lens, Slides, Coverslips, Ruler or Measuring Scale, Notebook and Pen/Pencil, Beakers, Labels and Markers, Colour photographs, Hand lens, Fine forceps, Two mounted needles, Sharp scalpel, Razor blade, Droppers, Glass containers (resistant to moderate heat), Nylon screening, Plastic or stainless steel weights, Disposable paper cups, Spatula (metal and wood), Write-on

			acetate, Plastic dropper, Caroplastic, Test tube, Blotting paper, Glass slides, Bowl.
	BOTV201: GI Tagging in Indian Agriculture	**Specimens / Materials**	Computer with internet access, Patent and Trademark filing forms (e.g., Form TM-A for trademarks, Form 1 for patents), Examples of intellectual property documents (e.g., previously filed trademarks/patents), Stationery (notebooks, pens, calculators, ruler, and eraser), Reference materials (books, online resources, or charts), Research materials: articles, case studies, reports on GI-tagging in agriculture.
		Equipment / Instruments	Timer or stopwatch, Projector (if presentations are included), Digital tools: Computers or smartphones with internet access for research, Templates for recording observations and evaluations, Templates or software for tabular data representation and graphical analysis (e.g., Excel), Computer System With Presentation Software (e.g., PowerPoint, Google Slides), Data Reports and Case Studies on GI-tagged products, Statistical Software or Spreadsheet (e.g., Excel) for analysis, Word processing software (e.g., Microsoft Word or Google Docs) for writing slogans and Descriptions, Internet access for research on GI registration and product specifications, Recording Devices: Voice recorders or smartphones (for interviews), Sample Collection Kit (if needed): To collect samples for further analysis (e.g., soil, product samples), Reference materials on GI Act and DPIIT guidelines.
		Glassware/ Other Materials	Blank physical map of India, List of GI-tagged agricultural products in India, Colour pencils or markers, Whiteboard or flip chart for key points, Seed samples, Petri dishes, Filter paper, Weighing scale, Magnifying glass, Germination chamber/room, Markers and labels, Certified seed documentation (e.g., forms and guidelines), Reference seed standards, Information pamphlets or case studies on certified seeds, Visual aids (charts

			or graphs showing yield improvement), Flowcharts or diagrams explaining the certification process, Documentation from certifying agencies, Poster board or digital tools (e.g., Canva, PowerPoint), Research materials: Articles, government guidelines, and reports on GI tagging, Examples of agricultural products with existing GI tags (e.g., Darjeeling Tea, Nagpur Orange), Chart Paper or Poster for Presentation (optional),
IV	**BOTC207: Lab Activities on BOTC205 (P)**	**Specimens / Materials**	Plant material: Leaves of *Rhoeo* discolor or *Tradescantia*, Plant material: Excised twigs or leaves of a common plant (e.g., *Coleus*, or *Spinach*), Plant material: *Fagopyrum* sp. (Mesophyte) and *Opuntia vulgaris* (Xerophyte)., Plant material: Seeds of gram (*Cicer arietinum*), or pea (*Pisum sativum*), or moong (*Vigna radiata*), Plant material: Germinating green bean or maize seeds, Fresh twigs of *Hydrilla*, 2 leafy twigs of plant (*Polyalthia longifolia*), Plant material: Potato tubers, Plant material: flower buds, germinating seeds, and leaf tissue, Plant material: *Coleus* leaf (purple and pink *coleus* plants), Peeled potato tubers, Biological materials: Fresh green leaves (e.g., *Spinach*), Biological materials: Fresh plant parts (roots, stems, leaves), Fresh beetroot slices (or similar pigment-containing plant material), A leafy plant or twig (e.g., *Balsam* or *Hibiscus*), Fresh leaf of an aquatic plant (e.g., *Hydrilla* or *Elodea*), Dry seeds (e.g., Raisins, mustard, gram, or pulses), Onion bulb, Potted plant with an actively growing stem.
		Equipment / Instruments	Compound microscope, Electronic balance, Lamps with adjustable intensity, Stopwatch or timer, Ruler, Thermometer, Light microscope, Ocular meter, Stage micrometer, Microwave oven, Incubator, Germinator unit,, Ganong's potometer,, Ganong's respirometer, Manometer, Hotplate or stove, Thermostated spectrophotometer, Thermometer, Stopwatch, UV lamp, Iodine chamber, Colorimeter (optional), Boiling

			water bath, Retort stand with clamp, Stirring rod, Analytical balance, Hot plate, Pointer and graduated scale, Counterweight, Arc-auxanometer, Microscope, Potometer.
		Chemicals / Reagents	Sucrose solution (0.15, 0.20, 0.25, 0.30, 0.35, and 0.40 M), Distilled water, Replica fluid (nail polish), IAA (Indole-3-acetic acid), Ethanol, Hydroponic growth medium, Gibberellic acid, Benedict's solution, Iodine solution, Sterile starch agar plate, Disinfectant, Rectified spirit, Sodium bicarbonate solution (0.05%, 0.1%, 0.15%, 0.2%, and 0.25%), Eosin stain, Polyethylene glycol-6000 solution, Methylene blue, Cobalt chloride solution, Petroleum ether, 10% potassium hydroxide solution, 1.0 M potassium phosphate monobasic, Dibasic solutions, Potassium hydroxide, Hydrochloric acid, Hydrogen peroxide [30% (w/w)], Acetone, Petroleum ether, Isopropanol, Potassium hydroxide (KOH), Copper (II) sulphate, Sodium potassium tartrate, Sodium hydroxide, Potassium iodide (KI), Bovine serum albumin (BSA), Egg albumin, Amino acid mixture,, Standard amino acid solutions, Butanol, Ninhydrin solution, Standard glucose solution, Somogyi reagent, Sulfuric acid (H_2SO_4), Sodium bicarbonate solution, Sodium arsenite solution, Standard potassium hydroxide solution (0.1 N), Phenolphthalein indicator, Dilute Sugar solution, Colored dye (e.g., eosin or red ink), Sodium chloride, Concentrated salt solution (or sugar solution), Methanol, Petroleum ether, Glycerin, Vaseline.
		Glassware/ Other Materials	Beakers, Measuring cylinder, Petri dishes, Glass slide,, Cover slip, Watch glass, Needle, Forceps, Dropper, Small beakers, Brush, Cello-tape, Measuring scale, Growth chamber, Test tube, Marker pen, Funnel, Glass flasks, Rubber cork, Razor blade, Paper towels, Seeds, Polythene bags, Micro-pipette, Test tube stand, Filter paper, Desiccators,

			Thread, Knife, Mortar and pestle, 35 ml syringe, 100 ml beaker, 2 syringes (3 ml), Cuvettes, Kimwipes, Safety goggles, Spectrophotometer, Small test tube stand, Chromatography paper, Capillary tube, Glass jar/Chromatography Chamber, Filter paper, Graduated test tubes, Delivery tubes, Rubber stoppers, Cotton wool, Whatman filter paper, TLC plates (silica gel or alumina-coated), Paper towels, Thistle funnel, Gloves, Ice bath, Centrifuge, Ph paper or ph meter (optional), Graduated cylinder or gas collection apparatus.
V	**BOTC303: Lab Activities on BOTC301**	**Specimens / Materials**	Fresh flower buds (peferably young anthers) / Grasshopper testes, Fresh onion peel (epidermis), Yeast suspension, Colored beads/seeds (2 types, e.g., yellow and green) OR coins, Fresh onion roots, Permanent slides (onion root tip or other plant tissues), Permanent slides (flower buds / anther / grasshopper testes), Potato, Fresh leaves of *Rhoeo discolour*, Sample (Yeast/Bacteria) Cell suspension at 106 cells/Ml, Bacterial cells (e.g., *Escherichia coli*), Plant tissue (e.g., *Spinach* leaves), Animal tissue (e.g., chicken liver).
		Equipment / Instruments	Analytical balance, Compound microscope, Microscope, Compound microscope, Ocular micrometer (eyepiece micrometer), Stage micrometer, Calculator, Ocular micrometre (eyepiece scale), Stage micrometre (slide with scale), Computer or internet access (for virtual lab simulation), Colling Centrifuge, Homogenizer, Microscope light source or illuminator, Hemocytometer.
		Chemicals / Reagents	Distilled water, Carmine, Borax, Orcein, Formaldehyde solution (37–40%), Sodium phosphate (monobasic – NaH_2PO_4), Sodium phosphate (dibasic – Na_2HPO_4), Saturated aqueous picric acid, Glacial acetic acid, Chloroform, Stain (Acetocarmine / Aceto-orcein), Fixative (Carnoy's solution if required), Stain (iodine solution or methylene blue), 1 N hydrochloric Acid (1N HCL), 8-

			Hydroxyquinoline, Colchicine, Para-dichlorobenzene crystals, Acetone, Ethanol (absolute, 95% or 70%), Carnoy's solution, Carmine powder, Toluidine Blue stain / Methyl Green–Pyronine stain, 2 M NaOH, 1X Mannitol gradient buffer, Percoll gradient, Janus Green B (for staining), Buffer solutions (e.g., Tris-EDTA buffer, lysis buffer), Enzymes (e.g., lysozyme for bacterial cells), Proteinase K (for digesting proteins), Phenol: chloroform alcohol (for extraction), Ethanol (for precipitation), RNase (to degrade RN.
		Glassware/ Other Materials	Beakers, Measuring cylinders, Conical flask, Glass rod, Pipettes, Dropper bottles, Volumetric flask, Labelled reagent bottles, Slides and cover slips, Dropper, Watch glass, Needles and forceps, Blotting paper, Water bath, Paper sheets / chart, Pen or pencil, Punnett square worksheet, Lens cleaning paper, Chart showing Mendelian crosses, Lab notebook, Genetic cross data sheets or experimental datam, Graph paper, Centrifuge tube.
	BOTV301: Basics of Plant Tissue Culture	**Specimens / Materials**	Plant tissues, Plant Material- Datura anther, Pollen grains, Leaf tissue, Plant material: Fenugreek seeds, Plant material (nodal intermodal region, shoot tips), Somatic embryos, Plants, Fruit plant explants, Plant explants.
		Equipment / Instruments	Autoclave, Hot air oven, Laminar airflow, Dissecting microscope, Compound Microscope, scalpels, Hot plate, pH meter, Magnetic stirrer, Electronic balance, Incubator, Culture racks, Microscope,.
		Chemicals / Reagents	Ethanol (70%), Formaldehyde, $KMnO_4$, Mercuric chloride, Distilled water, Peptone, Beef extract, Sodium hydroxide, Laboline Solution, Hydrochloride acid, Sodium chloride, Indole-3-acetic acid (IAA), Indole-3-butyric acid (IBA) and Naphthalene acetic acid (NAA), Macronutrients, sodium hypochlorite, surface sterilant, Micronutrients, Mannitol, Macrozyme,

			Potassium nitrate, Calcium chloride, Magnesium sulphate, Potassium iodide, Vitamins, Agar, Sucrose, NaOH, HCl, Tween 20 (Polysorbate 20), Mercuric chloride, MS media, Growth regulators, Plant hormones, Auxins, Cytokinins, Gibberellins, Cellulase, Pectinase, Mannitol, Culture media, Sodium alginate, Calcium chloride, Fertilizers, Pesticides, Nutrient solutions.
		Glassware/ Other Materials	Glassware, Forceps, Lens, Measuring cylinder, Volumetric flask, Beakers, Pipettes, Greenhouse setup, Irrigation system, Culture racks, Controlled environment system, Sensors, Cotton, Filter paper, Cotton plugs, Conical flask, Culture bottles, Aluminium foil, Petri dishes, Forceps, Blades, Culture tubes.
VI	**BOTC311: Lab Activities on BOTC309**	**Specimens / Materials**	DNA samples, Gel, Filter membrane, Serum sample, Microtiter plate, Sample mixture, Sugar samples, Leaf tissue, Pigment extract, Plant tissue, Protein sample, DNA sample, Plants, Fruits, Explants, Tools.
		Equipment / Instruments	PCR machine, Gel electrophoresis unit, Micropipette, Centrifuge, UV transilluminator, ELISA reader Incubator, Chromatography chamber, Compound microscope Fluorescence microscope, Homogenizer, Microscope, Spectrophotometer, Electrophoresis unit, Gel electrophoresis unit, Calculator, Heater, Laminar airflow, Autoclave, Sprayer, Mixer etc.
		Chemicals / Reagents	Agarose, Ethidium bromide, Taq polymerase, dNTPs, Primers, Buffer, Loading dye, Ethanol, Isopropanol, Antigen, Antibody, TE buffer, Substrate, Wash solution, Solvent, Distilled water, Silica gel, Buffer solution, Sucrose, Auxins (IAA, IBA, NAA), Adsorbent, Stain, Fixative, Folin reagent, Copper sulphate, NaOH, Phosphate buffer, Acrylamide, SDS, Agarose, Oil, Anthrone reagent, Sulfuric acid, Alcohol, Xylene, Fertilizers, Hormones, Sugar, Salt,

			Citric acid, Bradford reagent, Media, Salt, Folin-Ciocalteu reagent.
		Glassware/ Other Materials	Capillary tubes, TLC plate, Chamber, Column Beaker, Slides, Hand lens, Irrigation tools, Knife, Measuring tape, Storage tools, Water bath, Slides.
VII	**BOTC404: Lab Activities on BOTC401, BOTC402 & BOTC403**	**Specimens / Materials**	Infected leaves of tobacco plant, Papaya infected leaf, Culture medium, Soil, Infected plant material (root), *Rhizopus* infected material or culture, Wheat and Rice, Straw, Mushroom spawn (seed), Gram flour, Wheat grains, Infected potato plant, Potato agar culture plates, Infected Jowar Plant, Sterilized agar culture plates, Infected leaf, Infected leaf of mustard, *Spirulina alga*, Microcystis alga material, O*scillatoriaalga* material, *Volvox* alga material, *Hydrodictyon* alga material, *Chara* alga material, *Diatoms*, *Alga Vaucheria*, *Alga Dictyota*, *Alga* Sargassum, *Alga Gracilaria*, Bryophyte- *Porella*, Bryophyte- *Riccia*, *Ricci*a thallus, PTERIDOPHYTES-*Psilotum* and *Lycopodium*, *Equisetum* and *Ophioglossum*, *Osmunda* and *Salvinia Marsilea* , Parts of *Cycas*, Parts of *Cupressus.*
		Equipment / Instruments	Electron microscope, Compound Microscope, Autoclave, Laminar air flow cabinet (aseptic chamber), Culture room, Simple Microscope, Spectrophotometer, Heat Systems-Ultrasonics, and Equipped with a microtip, Beckman Model, DU-6 scanning spectrophotometer, Autoclave / Oven.
		Chemicals / Reagents	Cotton blue stain, Alcohol, Cotton Blue (Lactophenol Cotton Blue), Safranin, Light green stains, Magnesium carbonate, Grade acetone, Milli-Q water, Hydrochloric acid, Magnesium carbonate powder, HCl, Carotenoid, Phycobilin, Chloroform, Ethanol, NaCl, Anhydrous sodium sulfate, peptide nitrogen[s], Copper [II] ions, Phosphomolybdic, Phosphotungstic acid, Heteropolymolybdenum blue, Sodium carbonate, Sodium hydroxide, Sodium-

			potassium alloy, Copper(II) sulphate, BSA, Sulfuric acid, Vanillin, Phosphoric acid, Olive oil, Ammonium molybdate, Stannous, Chloride, Glycerol, AR potassium hydrogen, Phosphate.
		Glassware/ Other Materials	Lenses, Herbarium sheet, Thread, Needle, Herbarium chamber, Plant press, Beakers, Test tubes, Petri plates, Pipettes, Distal Water, Culture racks, Slides, Cotton blue, Razor, Lenses, Hoe, Cover slips, Forcep, Plastic bags, String, Gas burner, Needle, Paint brush, Sclerotia, Filters and Sieves, Isolation Glassware, Plasticware, Utensils, Growth Chambers, Turbidity-meter, PVC pipe mand Nitex netting, Multiwell plates, Syringe with 0.2-mm filter, Pipetteman, Pasteur pipettes, Glass capillary tube, Hemocytometer,, Aluminum foil, Sonicator cell disruptor, Isolation Glassware, Plasticware, Utensils, Growth, Chambers, 2.0 nm slit or narrower, 1.0, 5.0, 10.0 cm spectrophotometer cells, Calibrated 15 ml centrifuge tubes with teflon lined caps, Centrifuge capable of attaining 500 g, Dark box: Light tight box capable of holding a small test tube rack, Standard laboratory glassware including membrane filtration apparatus, Millipore SM 5.0 µm membrane filters (47 mm), Centrifuge tube, Volumetric flask, Conical flask, Nessler's Tube.
VIII	**BOTC412: Lab Activities on BOTC409, BOTC410 & BOTC411**	**Specimens / Materials**	Spinach leaves (*Spinacia olerecia*), *Bacopa monnieri*, *Tinospora cordifolia*, *Eclipta alba*, *Cymbopogon citratus*, *Coleus forskohlii*, *Phyllanthus amarus*, *Centella asciatica*, *Garcinia indica*, *Gymnema sylvestris*, *Vetiveria zizanioides*, *Piper longum*, *Cassia angustifolia* (Tiruven vellisenna), *Morinda citrifolia* (Noni), *Andrographis paniculata*, *Stevia reboudiana*, Guduchi, Kalka, Ashwagandha, Vidhara, Ginger juice (Aardraka swarasa), Juice of Basil leaves, Laksha, Kumkuma kesara, Manjista, Raktachandana, Gorochana, Adraka Rhizome, Pippali, Fruit, Pippalimula Root,

			Marich Fruit, Sunthi Rhizome, Chitrakmula Root, Vidang Fruit, Nagarmotha, Rhizome, Nagekshar Stamen, Twak Bark, Ela Seed, Tejapatra Leaves, Kachur, Seed, Go-ghrita, Go-dugdha, Sharkara, Stick Turmeric, Long dry Ginger, Whole Nutmeg, Coriander seeds, Cumin seeds, Black peppercorns, Fennel seeds, Hole, Cardamom, Cardamom peel, Bay leaf, Geological maps or charts depicting, Gondwana land distribution, Fossil specimens representing different floral divisions of Gondwana land, Slides of *Rhynia* stem sections, Slides of *Rhynia* sporangia sections, Slides of *Sphenophyllum* stem sections, Slides of *Sphenophyllum* root sections, Slides of M*edullosa* stem sections, Slides of *Glossopteris* different sections or photo plate.
		Equipment / Instruments	Spectronic-20, Oven, Colorimeter, Centrifuge, Spectrophotometer, Silica crucibles, Digital weighing balance, Hot plate, Microscope.
		Chemicals / Reagents	Distilled water, Acetone, Copper sulphate, Sodium potassium tartarate, Sodium hydroxide, Potassium iodide, BSA, Ninhydrin, Ethanol, Leucine, Tris (tris(hydroxymethyl)aminomethane), PMS (Peroxymonosulfate)/INT (2-(4-iodophenyl)-3-(4-nitrophenyl)-5-phenyltetrazolium chloride), Lactic Acid, Enzyme (lactate dehydrogenase), 2% ammonia, DMSO (Dimethyl sulphoxide), propan-2-ol, Glycine, Tyrosine, Aspartic acid, HCI, Methanol, Petroleum Ether, Tila Taila (Sesame Oil), Guduchi, Kwatha, Hydrochloric acid, White beeswax, Liquid paraffin, Borax, Perfume, Methyl paraben, Ethyl alcohol, Shatavari, Elaichi/ Cardamom, Sharkara or, Sugar, Honey, Iodine, Potassium iodide, Potassium, Ferro cyanide, Glacial acid, Ferric chloride, Clove oil, Sodium carbonate, Sulfuric acid, Barium hydroxide, Calcium chloride, Potassium dichromate, Sudan III or Sudan IV, Glycerin, Potassium

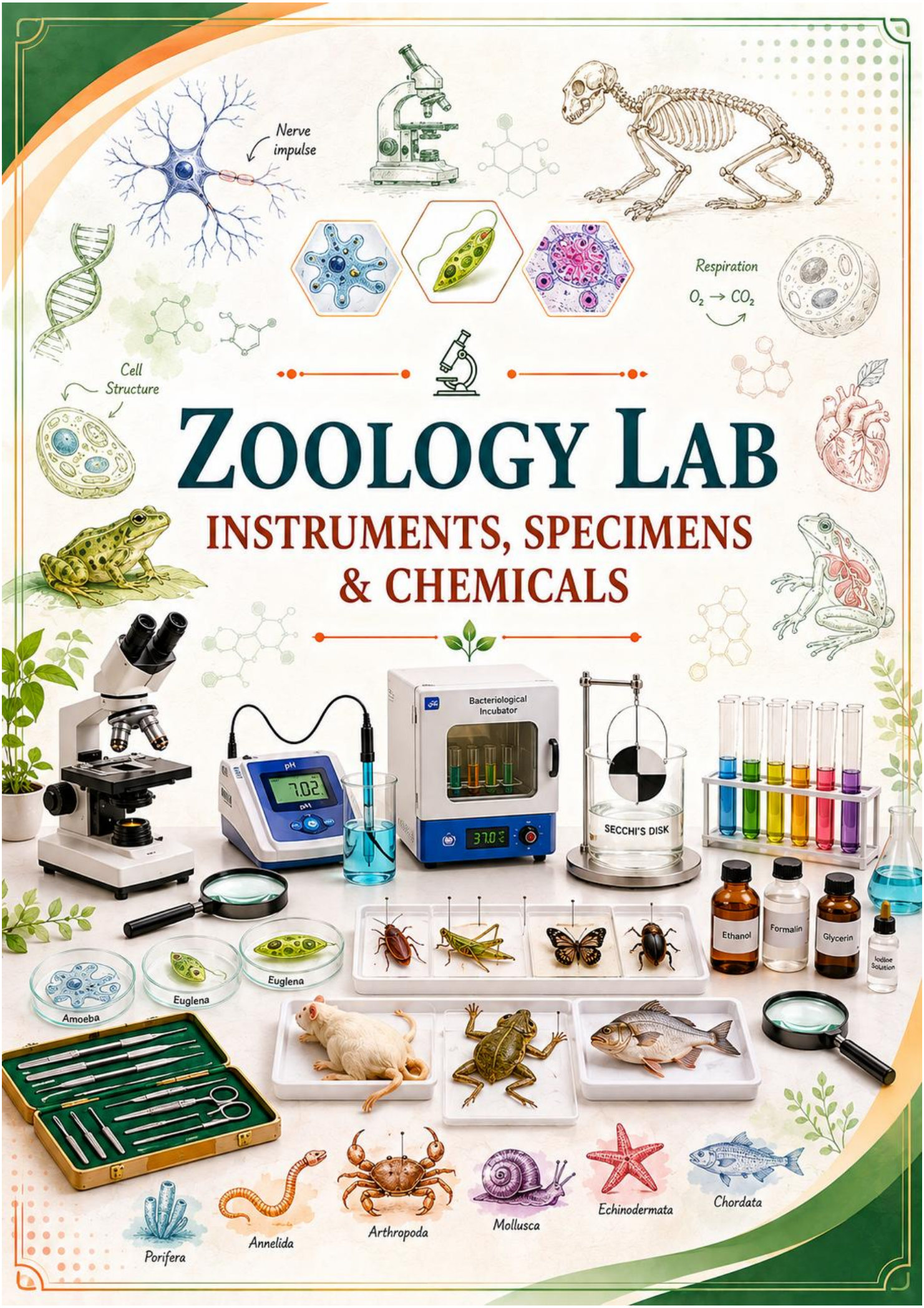
			hydroxide, Potassium mercuric iodide, Mercury(II) chloride, Potassium Iodide, Nitrocellulose solution, Molten resin.
		Glassware/ Other Materials	Whatman filter papers, Funnels, Mortar and pestle, Volumetric flasks (25 ml), Measuring cylinders, Pipettes, Test tubes, Aluminium foil, Test Tube Rack, Capillary tube, Chromatography paper, Filtration apparatus – Buchner funnel, Side -arm flask, Ring -stand, Clamps, Pasteur pipette, TLC chamber, TLC slide, Filter paper, Beaker, Distillation flask, Separating funnel, Heating metal, Water bath, Specific gravity bottle, Vertical steam distillation unit, Boiling flask, Biomass flask, Still head, Condenser and receiver, Lapidary's saw or similar tool, Abrasive material (300 or 400 carborundum), Glass slides, Cellulose acetate film.

III. Laboratory Requirement for Minor Discipline of Botany:

Semester	Course Code & Course Name	Category	Details
III	**BOTM202: Lab Activities on BOTM201**	**Specimens / Materials**	Fresh flowering plants (e.g., Hibiscus, China Rose, Mustard, Maize, Grass), Plant Specimens: Carrot, sweet potato, banyan, mangrove etc., plants with different types of root modifications., Fresh/preserved material of *Pisum sativum* L. root and *Helianthus annuus* L. stem, Fresh *Dracaena* stem and root segments (3–5 mm thick), Permanent slide of L.S. of a typical shoot apex (e.g., Coleus), Permanent slide of L.S. of a typical root apex (e.g., onion or *Zea mays*), Fresh material of sunflower root and stem, Fresh material of maize root and stem, Permanent slides.
		Equipment / Instruments	Compound Microscope, Dissecting microscope etc.
		Chemicals / Reagents	Mounting medium (glycerine/DPX), glycerine, Stain: Safranin solution (common for plant tissues) or methylene blue.
		Glassware/ Other Materials	Hand lens/Magnifying glass, Pencils, eraser, ruler, Beakers, Labels and Markers, Brush, Blotting paper/filter paper, Magnifying lens, Slides and Coverslips, Droppers, Blotting paper, Spatula (metal and wood), Models / Photographs/ Pictures/ slides of different types of ovules, Test tube.
IV	**BOTM204: Lab Activities on BOTM203**	**Specimens / Materials**	Plant material: Leaves of *Rheo discolor* or *Tradescantia*., Plant material: Excised twigs or leaves of a common plant. (e.g., Coleus, or Spinach), Plant material: Seeds of gram (*Cicer arietinum*), or pea (*Pisum sativum*), or Moong (*Vigna radiata*)., Plant material: Germinating green bean or maize seed, Plant Material: fresh twigs of *Hydrilla*., Biological materials: Fresh green leaves (e.g., spinach)., Fresh beetroot slices, Potted plant with an actively growing stem, Plant Materials A leafy plant or twig (e.g., Balsam or Hibiscus),

			Plant Materials: Fresh leaf of an aquatic plant (e.g., *Hydrilla* or *Elodea*).
		Equipment / Instruments	Compound microscope, Weighing balance, Electronic balance, Sprit lamp, Stopwatch or timer, Ruler, Thermometer, Microwave oven, Incubator, Spectrophotometer or colorimeter, Arc-auxanometer, Counterweight, Microscope, Thermometer, Ph paper or ph meter.
		Chemicals / Reagents	Sucrose solution, Distilled water, IAA (Indole-3-acetic acid), Ethanol, Hydroponic growth medium, Gibberellic acid, Benedict's solution, Iodine solution, Sterile starch agar plate, Disinfectant, Rectified spirit, Sodium bicarbonate solution (0.05%, 0.1%, 0.15%, 0.2%, and 0.25%), Agar solution, Gelatin, Potassium permanganate solution, Methylene blue solution, Copper sulphate crystals, Acetone, Petroleum ether, Isopropanol, Dilute Sugar solution, Colored dye (e.g., Eosin or Red ink), Sodium bicarbonate.
		Glassware/ Other Materials	Beakers, Measuring cylinder, Petri dish, Glass slide, Cover slip, Watch glass, Needle, Forceps, Dropper, Small beakers, Measuring scale, Growth chamber, Mortar pestle, Razor blade, Marker pen, Funnel, Test tubes, Plastic straw (or cork borer), Metric ruler, Droppers or pipettes, Capillary tube, Glass jar with lid (Chromatography Chamber), Filter paper, Test tube rack, Water bath, Pipettes, Scissors or scalpel, Petri dish, Thread or fine string, Pointer and graduated scale, Blotting paper, Graduated cylinder or gas collection apparatus.
V	**BOTM302: Lab Activities on BOTM301**	**Specimens / Materials**	Fresh Onion roots, Fresh flower buds (preferably young anthers)/ Grasshopper testes, Permanents slides (onion root tip or other plant tissue), Permanent slides (flower buds/ anther/ grasshopper testes), onion bulb, Spinach leaves, Sample (yeast, Bacteria,cells), Cell suspension at 106 cells/mL etc.

		Equipment / Instruments	Analytical balance, Compound microscope, Simple microscope, Centrifuge, Hemocytometer,
		Chemicals / Reagents	8-Hydroxyquinoline, Colchicine, Para-dichlorobenzene crystals, Acetone, Ethanol (absolute, 95% or 70%), Formaldehyde solution (37–40%), Sodium phosphate (monobasic – NaH_2PO_4), Sodium phosphate (dibasic – Na_2HPO_4), Saturated aqueous picric acid, Glacial acetic acid, Chloroform, Carmine – 1 g, Borax – 4 g, Orcein – 1 g, 1N HCL, Acetocarmine, Fixatives, Colchicine solution, Distilles Water, Sucrose (0.5M, 17% w/v), Buffer solution, Enzymes (Lysozyme), Proteinase K, Ethanol, RNase etc.
		Glassware/ Other Materials	Beakers, Measuring cylinders, Conical flask, Glass rod, Pipettes, Dropper bottles, Volumetric flask, Labelled reagent bottles, Water Bath, Mortar and pestle, Musline cloth, Test tubes, Funnel, Micropipette.
VI	**BOTM304: Lab Activities on BOTM303**	**Specimens / Materials**	Larvae of *Drosophila melanogaster* (or Chironomous larvae), Healthy Onion Bulb, Fresh leaves of *Rheo discolour*, Printed pedigree chart, etc.
		Equipment / Instruments	Computer or internet access (for virtual lab simulation), Compound Microscope.
		Chemicals / Reagents	Acetocarmine stain, Aceto-orcien stain, 45% Acetic acid, Distilled Water, Distilled Water,1N HCL, Iodine solution, Alcohol, etc.
		Glassware/ Other Materials	Chart showing mendelian crosses, Genetic problem sheet, Dissection Box, Beakers, Petri dishes, Hot water bath etc.


Nerve impulse
Respiration
$O_2 \rightarrow CO_2$
Cell Structure
ZOOLOGY LAB
INSTRUMENTS, SPECIMENS & CHEMICALS
Bacteriological Incubator
pH
7.02
37.0
SECCHI'S DISK
Ethanol
Formalin
Glycerin
Iodine Solution
Amoeba
Euglena
Euglena
Porifera
Annelida
Arthropoda
Mollusca
Echinodermata
Chordata

UGV05: B.Sc. (Honours) (Zoology) {2025 Pattern}:

I. Recommended Quantities of Miscellaneous Instruments for All Semesters, Including Major and Minor Courses for Batch of 15 Students.

Sr. No	Instrument Name	Required Quantity
1.	UV Spectrophotometer	01
2.	Colorimeter	01
3.	Dissecting Microscope	10
4.	Compound Microscope	10
5.	Hemoglobinometer	03
6.	Hemocytometer	05
7.	Deep Freezer	01
8.	Distillation Unit	01
9.	Variable Type Power Pack	01
10.	Mini Vertical Gel Electrophoresis	01
11.	Mini Horizontal Gel Electrophoresis	01
12.	Magnetic Stirrer	01
13.	Vortex Mixer	01
14.	pH Meter	02
15.	Micro Pipette Variable	03
16.	Refrigerator	01
17.	Autoclave	01
18.	Dissecting Tray	05
19.	Centrifuge	01
20.	Ocular Stage Micrometer	10
21.	Hot Plate	01
22.	Hot Air Oven	01
23.	Bacteriological Incubator	01
24.	Microtome (With All Accessories)	01
25.	Hot Water Bath	01
26.	Weighing Balance	01
27.	Respirometer	01
28.	Conductivity Meter	01
29.	Turbidity Meter	01
30.	Quadrate	01
31.	Secchi Disk	01

32.	Laminar Air Flow	01
33.	Stopwatch	02
34.	Magnifying Glass	02
35.	Thermometer	02
36.	Sphygmomanometer	01
37.	Specimens (As mentioned in Practicals)	01 Specimen of each species

II. Laboratory Requirement for Major Discipline of Zoology:

Semester	Course Code & Course Name	Category	Details
I	**ZOOC102: Lab Activities on ZOOC101**	**Specimen**	**Museum specimens:** *Amoeba, Euglena, Plasmodium, Paramecium, Sycon, Hyalonema, Euplectella Obelia, Physalia, Aurelia, Tubipora, Metridium, Planaria, Taenia solium, Fasciola hepatica, male* and *female Ascaris lumbricoides, Aphrodite, Nereis, Phereima, Hirudinaria, Palaemon, Cancer, Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis, Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus, Ophioderma, Echinus, Cucumaria, Antedon, Balanoglossus, Herdmania, Amphioxus, Petromyzon Myxine*, Scolidon, Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla Hippocampus, Tetradon, *Ichthyophis/Ureotyphlus*, Salamandra, Bufo, Hyla , *Naja*, Draco, Chelone, Hemidactylus, Chamaeleon, Vipera, Gavialis, Peacock, Pigeon, Sparrow, Eagle, Owl, Penguin various snake species, Permanent slides of T.S. of Male and Female *Ascaris*, T.S. and L.S. of Sycon etc.
		Instrument	Microscope, Hand lens, Magnifying Glass.
		Charts	Diagrams all above mentioned specimens.
		Chemical	Iodine, Methylene Blue.
		Glassware	Slides, Cover Slips.
	ZOOV101: Vermiculture Management	**Specimen / Chart / Samples**	Specimens of Earthworms species *Eudrilus eugeniae* (Night Crawler), *Eisenia foetida* (Red Earthworm)), Mustard Powder, Coconut dry Leaf, Coconut Wastage, Agricultural Wastage, Cow Dung, Biodegradable Wastes etc.

		Chemicals	Ethanol etc.
		Data materials	Keys of Earthworm Identification, Photography of life stages of *E. fetida* and other species,
		Instruments	Spade, Plastic Tubes, Sorting Trays, Labels, Alcohol Resistant Pen/Pencil, Pointed Non-Serrated Forceps, Gloves, Dissecting Microscope, Gunny Bag, Big Bucket, Mug, Stopcock, Broken Brick, Pieces of Stones, Soil, Sand, Shovels, Crowbars, Dung Fork, Bamboo Baskets, Wire Mesh Sieves (3 Mm And 6 Mm), Bag Closer, Culture Trays, Wheel Barrows, Vermicomposting Bin, Watering Jar, Camera etc.
II	**ZOOC104: Lab Activities on ZOOC103**	**Specimen**	**Models/ Specimens/ Chart/Diagrams/Models/Photographs of:** 1. Articulated Skeleton, Dorsal and ventral skull 2. Disarticulated bones of the axial skeleton. 3. Disarticulated bones of the appendicular skeleton of Fowl and Rabbit. 4. Carapace and plastron of a turtle, Herbivorous mammal skull (e.g. rabbit), and Carnivorous mammal skull (e.g. dog). 5. Preserved specimens: species of Aves (birds) and Mammalia (mammals) with integumentary derivatives. 6. Preserved fish intact specimens (fins and scales) 7. Preserved vertebrate brain specimens from different species, Fish (Dogfish), Frog, Lizard, Pigeon, and Rabbit. 8. Whole mount of unfertilized egg, blastula, gastrula, neurula and tadpole larva of frog 9. Different types of cleavage, various types of placenta. 10. Different types of embryos in Amphibia, Reptilia, Aves and Mammalia. 11. Preserved mammalian embryos or fetal specimens at different developmental stages. 12. Permanent prepared slides of chick embryo at different stages 4 hours, 16 hours, 18 hours, 24 hours, 33 hours, 72 hours and 96 hours.
		Instruments	Magnifying glass, Dissecting microscope, Gloves, Ruler, callipers, Microscope slides, cover slips, scissors, forceps, scalpel,

			Dissection tray or dissecting board, Gloves, Lab Coats, Compound microscope etc.
		Chemical	Histological staining materials etc.
		Chart and other materials	Comparative brain atlases as references for identification. Labelling materials for marking and identification. Comparative brain models or simulations,
	ZOOV102: Medical Laboratory Techniques	**Chemicals**	Sodium Chloride (Nacl), Distilled Water, Ethanol, Hydrochloric Acid, Sodium Hydroxide, Methylene Blue, Crystal Violet, Gram's Iodine, Safranin, Glycerol, pH Paper, Kcl, Na_2HPO_4, KH_2PO_4, Distilled Water, Acryl Amide, Bis Acrylamide, Temed, Ammonium Per Sulphate, Ethidium Bromide, Immersion Oil, Various Additives, Mercuric Chloride, Sodium Sulfate, Hematological Stains (E.G., Leishman, Giemsa, Wright's) etc.
		Glassware	Beakers, Measuring Cylinders, Pipettes, Glass Stirring Rods, Conical Flasks, Funnels, Dropper Bottles, Beakers, Test tubes, Glass or quartz cuvettes, Vacutainer tubes, Cover slip, RBC Pipette, Slides, Staining jars etc.
		Instruments/ Equipments	Weighing Balance, pH Meter, Hot Plate, Bunsen Burner, Colorimeter, Spectrophotometer, Agarose Gel Electrophoresis, Polyacrylamide Gel Electrophoresis, Compound Microscope, Ocular Micrometer, Stage Micrometer, Venipuncture Needles (21G, 22G, 23G), Sphygmomanometer, Stethoscope, Compound Microscope, Neubauer's Chamber (Haemocytometer), Timer Etc.
		Other Materials	Tissue Paper, Lint-Free Wipes, Safety Gloves, Goggles, Test Tube Rack, Micropipettes, Lens Cleaning Tissue, Needle Holder, Tourniquet, Alcohol Swabs, Disposable Gloves, Cotton Balls, Gauze, Adhesive Bandages, Labelling Materials etc.
III	**ZOOC203: Lab Activities on ZOOC201**	**Instrument**	Compound microscope, Spirit lamp, ECG, Kymograph unit, Respirometer, Definite size quadrate (50 X 50 cm), Meter scale etc.
		Glassware & Other Material	Pricking needle, Dropper, Cotton, Glass slides, Cover slips, Sterile lancet, Filter paper, Cotton wool, Test tubes, Test tube stand, Pipette, measuring cylinder, Conical Flasks, Neubauer chamber, W.B.C. pipette, R.B.C. pipette, Stop Watch, Capillary Tube, ECG graph, Sahli's Haemoglobinometer,

			Gooch Crucible (China Clay Crucible with Perforated Bottom), Pestle and Mortar, Petri Dish, Beaker, Glass Rod, Balance and Blotting Paper, Conical flask, Burette, Spatula, BOD Bottle, Erlenmeyer flask, Secchi Disk etc.
		Chemicals	70%, 90% ethanol, Glacial acetic acid, Takayama's reagent, Leishman's stain, Standard Glucose Solution, Dinitro Salicylic Acid, distilled water, NaOH, sodium potassium tartarate, glacial acetic acid, gentian violet, thymol, W.B.C. diluting fluid, R.B.C. diluting fluid, sodium citrate, formalin I, HCl, Ammonium chloride (NH_4Cl), Ammonia (NH_3), Eriochrome Black T (EBT), EDTA, pH buffer solution, H_2SO_4, Phenolphthalein indicator, Methyl Orange indicator, Manganese sulfate ($MnSO_4.4H_2O$), acidified potassium iodide (KI), Sulfuric acid, Alkali-iodide-azide reagent, Starch solution, salicyclic acid Standard sodium thiosulfate ($Na_2S_2O_3 .5H_2O$), NaOH, bi-iodate solution, Standard potassium bi-iodate solution (KH (IO_3)), KI, H_2SO_4, iodine, thiosulfate, Water analysis Kit etc.
	ZOOV201: Apiculture	**Specimen / Chart / Samples**	Queen, Worker Bee, Eggs, Larvae, Langstroth Hive
		Data material	Identification keys of different species of honey bees etc.
		Instruments/ Apparatus	Dissecting Microscope, Forceps, Glass slide, Brush, Petri dish, drones, Magnifying glass, loupe, Langstroth hive (with brood box, frames, honey supers, queen excluder, inner cover, outer cover), Hive tool Smoker, Honey extractor, Uncapping knife, Frame feeder, Beekeeping suit, Gloves, Veil, Boots, Smoker, Bee veil, Hive tool, Bee brush, Empty super bodies, Uncapping knife, Boiling water, Drip trays, Honey extractor, Honey storage container, Muslin cloth, Beehives (Langstroth hives or others), Hive tools (smoker, hive brush, uncapping knife), Bee frames, Bee feed, Pollen traps, Hive scales, Hydrometer etc.
IV	**ZOOC207: Lab Activities on**	**Samples/**	Drosophila 3rd instar larvae/ Chironomus larvae
		Charts/	Photographs of Mendelian laws, Blank World Maps, Spread Sheets of Normal and

	ZOOC205	**Models**	Abnormal Human Karyotypes, Charts Pictogram or Actual Fossil, Models & Specimens/Pictures of Turtle, Draco, Exocoetus, Bat And Parrot, Antiserum (A, B, D) etc.
		Instrument	Dissection Microscope.
		Chemicals	Ethyl alcohol (Absolute), Acetic acid, Orcein stain, Sealing material (Nail polish or paraffin),
		Glassware/ Other Material	Needles, Dissection needles, Forceps, Cover slips, Glass slides, Watch glass, Glass capillary, Sterile needle, Clean slide, Cotton plug etc.
V	**ZOOC303: Lab Activities on ZOOC301**	**Permanent Slides/ Charts**	1. Squamous Epithelial Tissue, Cuboidal Epithelial Tissue, Columnar Epithelial Tissue, Ciliated Epithelial Tissue, Areolar Connective Tissue, 2. Tissue of the preserved Rat: Striated Muscle Fiber, Smooth Muscle Fiber, Medullated Nerve Fibers, Hyaline Cartilage, 3. Permanent slides: T.S. of mammalian skin, V.S. of tooth, V.S. of tongue, salivary gland, T.S. of esophagus, T.S. of stomach, T. S. of duodenum, T.S. of ileum, T.S. of rectum, T. S. of pancreas, C.S. of liver, T. S. of artery, T. S. of vein, T.S. of trachea, C.S. of lung, L. S. of kidney, T. S. of testis, L. S. of ovary, T. S. of Pituitary Gland, T. S. of Adrenal Gland, T.S. Thyroid Gland, 4. Specimen Tissue: Liver, Kidney etc.
		Instruments	Light microscope, Pointer, Dissecting Microscope, Compound microscope, Hot plate, Water bath, Microtome etc.
		Chemicals	Immersion oil Haematology stains (Leishman's stain/Geimsa stain), Alcohol wipes, Distilled water, Methylene blue stain, Glycerin, Formalin, Graded ethanol, Xylene, Paraffin wax, DPX, Hematoxylin, Eosin, Graded alcohols (70%, 90%, 100%) etc.
		Other material	Cotton Swabs, Gloves, Sterile Lancets, Glass Slide, Cover Slip, Toothpick, Dropper, Blotting Paper / Tissue, Needle, Forceps, Embedding Moulds, Metal Forceps, Scalpel, Tissue Cassettes, Coplin Jars or Staining Troughs, Forceps etc.
	ZOOV301:	**Specimen / Chart /**	Live rocks or coral reefs charts, Fish and invertebrate species (based on aquarium

	Aquarium Management	**Samples / Food stock**	type), De-chlorinated water or saltwater mix, Fish food (Pellets, Flakes, Frozen Food, Live Food), Freshwater fish species, Aquatic plants: *Vallisneria*, *Hydrilla*, *Pistia*, *Sagittaria*, *Ceratophyllum*, *Echinodorus*, *Cryptocoryne*, *Potamogeton*, *Aponogeton*, *Najas*, Yeast and Chlorella culture etc.
		Glassware and other materials	Glass or acrylic aquarium tanks (various sizes), Filtration systems (sponge filter, hang-on-back filter, canister filter, protein, skimmer), Substrate (gravel, sand, crushed coral), Water testing kits (pH, ammonia, nitrite, nitrate, salinity), Heating system (aquarium heaters), Lighting system (LED or fluorescent lights), Aeration system (air pumps, air stones), Maintenance tools (net, siphon, algae scraper), Glass sheets (5 mm - 15 mm thickness, depending on size), Glass cutter, Silicone sealant (aquarium-safe), Adhesive tape or clamps or silicone gum, Measuring tape, Marker pen, Ruler or scale, Sandpaper, Acetone or alcohol (for cleaning), Plastic or wooden base, Hanger, Aquarium stand, Filter (mechanical, chemical, and biological), Air pump and air stones, Aquarium heater, Aquarium lighting system, Aquatic plants (natural/artificial), Fish net, Thermometer, Aquarium decorations, Aquarium light (LED or fluorescent), Power source and extension cords, Measuring beaker, Magnifying glass, Planting tools (tweezers, scissors), Microscope, Scoop nets (50-500 micron mesh), Plastic buckets, Glass tubes (10-20 ml capacity), Beakers and jars (50 ml to 2 L), Culture tanks (10-1000 L capacity), Aeration system, Pipettes, droppers, Flat trays, Glass slides and cover slips, Dissection kit, pH Paper, Beakers, Bulb with Pipette, Centigrade, Thermometer, Blot Paper, Conical flask, Measuring cylinder, Glass stoppered bottle, Burette, Reagent bottle, Burette stand.
		Chemicals	Test kits (pH, ammonia, nitrite, nitrate, hardness), Water conditioner/dechlorinator, Dechlorinated water, Fertilizers: ammonium sulphate, single super phosphate, urea, formalin, potassium permanganate, copper sulfate, pH Buffer Solutions, Distilled Water, Ammonia buffer solution, EDTA, Eriochrome Black T indicator, Winkler's A

			& B solution, H_2SO_4, Starch indicator, Sodium thiosulphate, Magnous Sulphate, Alkaline Sodium, Potassium Iodide (Winkler B), NaOH, KOH, NaCI, KI, Starch etc.
		Instruments	Colorimetric Equipment, Spectrophotometer, Filter Photometer, Magnetic Stirrer, pH Meter, Camera, Thermometer etc.
VI	**ZOOC311: Lab Activities on ZOOC309**	**Specimen / Chart / Samples**	Parasite specimens, Gut Samples, blood samples, cockroach etc.
		Charts	Charts, Photographs of parasitic specimens.
		Instruments	Dissection Microscope, Microscope, Hand Compression Sprayer/ Knapsack sprayer/ Rocker sprayer,
		Samples with other materials	Soil Samples from Different Sites (Garden, Road Side, Bank of River, Paddy Field Etc. plant Protection Appliances, Pest Control Appliances, Plant Protection Appliances etc.
		Chemicals	Food Pesticides Testing Kit etc.
VII	**ZOOC404: Lab on Biochemistry, Cell Biology & Applied Zoology Part-I**	**Specimen / Chart / Samples**	Saliva, Onion root tips, Human blood, culture of *Amoeba proteus*, Live Specimens - *Anopheles*, *Culex*, *Aedes*, Housefly, Live Silkworms - Tasar, Eri and Muga etc.
		Glassware	Standard flask, Test Tubes, Beaker, Dropper, Graduated Pipette, 96 well flat-bottom plate, polycarbonate tubes, Wheaton Type B, Cover Slips, Watch Glass, Blade, Brush, Blotting Paper, Spirit Lamp, Sterilized Pin/Lancet, Cotton etc.
		Chemicals	Bovine serum albumin (BSA), cupric sulphate, Sodium potassium tartrate, Potassium iodide, vanilline powder, sulphuric acid, Chloroform, methanol, sodium chloride, phosphoric acid, cholesterol, Trichloro acetic acid, Sodium hydroxide, Ninhydrin, acetate buffer, Standard amino acid, HCL, Anthrone, H_2S0_4, D. glucose, Starch, Standard Iodine, Phosphate buffer, $NaH_2PO_4.H_2O$, Nicotinamide adenine dinucleotide (NADH), Sodium pyruvate, Lactate dehydrogenase, Mitochondria Isolation Kit, sucrose, EDTA, Hepes-NaOH, KCl, $MgCl_2$, Ethanol, Mannitol, Glacial acetic acid, carmine, Acetocarmine, Leishman‟s stain, Glycerin, Alcian blue, Sodium azide, Petroleum jelly, Glutaraldehyde, Osmium tetroxide, Ethanol, Epoxy resin, Uranyl acetate etc.

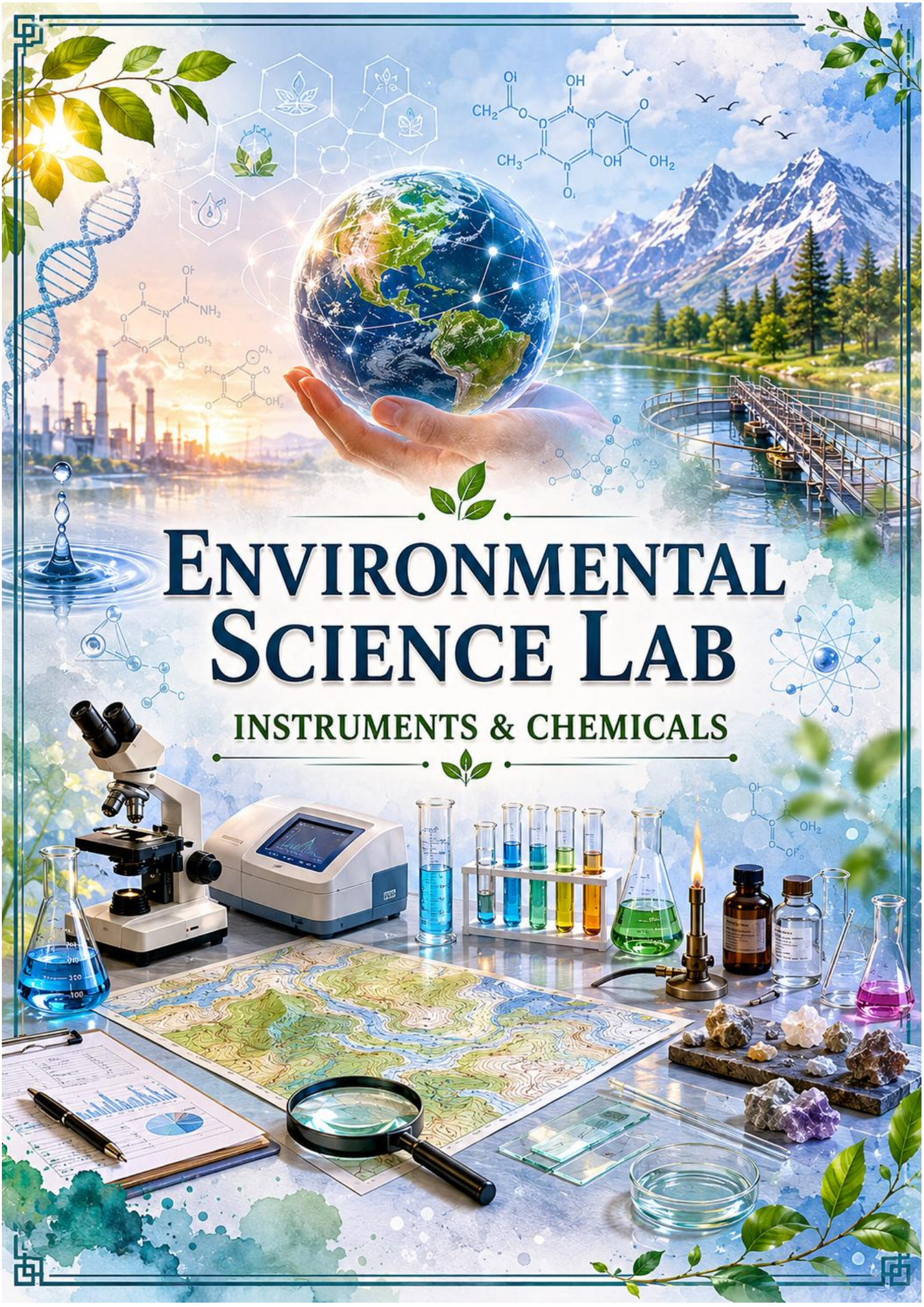
		Instruments	Spectrophotometer, hot water bath, Centrifuge, Tissue homogenizer, colorimeter, Spectrophotometric multiwell plate reader, Refrigerator, Low-speed refrigerated centrifuge, swinging-bucket rotor, Dounce homogenizer, Ultracentrifuge, Transmission Electron Microscope, ultramicrotome, Specimen grids, Tweezers etc.
VIII	**ZOOC412: Lab on Molecular Biology, Genetics & Applied Zoology Part-II**	**Samples/ Kit**	DNA extract from *E.coli*, goat liver, Bacterial culture, plasmid DNA isolation kit, Bacterial cell culture containing plasmid etc.
		Instruments	Cuvette, Tabletop centrifuge, 1.5 ml Eppendorf tube, Centrifuge tubes, UV spectrophotometer, Electrophoretic unit, UV trans illuminator, Microwave Oven, Water Bath, Incubator, Cooling Centrifuge, vertical gel electrophoresis apparatus, power pack etc.
		Chemicals	Agarose, 6x staining dye, 50x TAE, Ethanol, Saline, EDTA, NaCl, SDS, phenol, ethanol, DNA Isolation Kit, TE Buffer, Proteinase K, chloroform, RNAase, Luria Broth, Isopropanol, Luria Bertani medium, Bactotryptone, Bacto Yeast extract, Sodium Chloride, Tris Cl, Glucose, K acetate, Glacial acetatic acid, RNA isolation kit, Trizol, β Mercaptoethanol, bromophenol blue, Acrylamide, bis acrylamide, APS, coomassie brilliant blue R^{250}, methanol, Tris, Blood groups testing kit etc.

III. Laboratory Requirement for Minor Discipline of Zoology:

Semester	Course Name	Category	Details
III	ZOOM202: Lab Activities on ZOOM201	Samples	Soil Samples from Different Sites (Garden, Road Side, Bank of River, Paddy, Water Samples etc.
		Chemicals	Diethyl Ether, Ammonium chloride (NH_4Cl), Concentrated ammonia solution (NH_3), Eriochrome Black T (EBT), EDTA, H_2SO_4, Phenolphthalein and Methyl Orange indicator, $MnSO_4$, $4H_2O$, $MnSO_4$, potassium iodide (KI), Alkali-iodide-azide reagent, Salicyclic acid, sodium thiosulfate, KH (IO_3), NaOH etc.
		Glasswares	Five Test tubes, Test tube rack, Microscopic slide, Cover slips, Petri Dish, Beaker, Glass Rod, Conical flask, Burette, Pipette, Spatula, Measuring cylinder, BOD Bottle, Erlenmeyer flask, Water sampling bottles etc.
		Instruments / Other materials	Quadrat frame, Large nail or stick, Rope, Meter scale, Marker tags, Plankton-net with handle, Rubber guarder, Dropper, Binocular Microscope, Gooch Crucible (China Clay Crucible with Perforated Bottom), Filter Paper, Pestle and Mortar, Balance, Blotting Paper, Digital thermometer, pH meter, Dissolved oxygen meter, Secchi disk, Spectrophotometer (for nutrient analysis), digital devices for recording observations, Icebox, Gloves, goggles and other safety equipment.
IV	ZOOM204: Lab Activities on ZOOM203	Specimen / Chart / Samples	Prokaryotic Cell Slide (Stained bacteria *E. coli*), Permanent slide of protozoa like amoeba, paramecium, picture of eukaryotic cell/model of eukaryotic cell, Electron micrographs of Plasma Membrane Nucleus, Nuclear Pore Complex, Mitochondrion, Golgi Bodies, Endoplasmic Reticulum, and Lysosomes, Onion bulb, Onion plant with root, Onion root tips.
		Instruments	Compound Microscopes, Knife or scalpel, Forceps, Scissors, Razor blade, needle, Brush, blotting paper, spatula, toothpick, Pricking needle, Cotton, Filter paper, Dropper etc.
		Glassware	Microscopic Slides, Glass slides, Cover Slips, Droppers, Watch glass, Glass rod, Coplin Staining Jar, Test tubes, beakers, Pipettes etc.

		Chemicals	Janus Green B, Acetocarmine stain, HCl., Aceto-orcein or Aceto-carmine Stain, Ethanol, Glycerin, Methylene blue stain, Oil immersion, Cedarwood oil, Leishman Stain Sodium chloride (NaCl) etc.
V	**ZOOM302: Lab Activities on ZOOM301**	**Instruments / Other materials**	Topographic Map or Digital Map Application, GPS Device, Weighted Rope Device (Sounding Line), Clinometer or Abney Level, Measuring Tape/Rope, Digital Camera/Smartphone, Secchi Disk, GIS Software (ArcGIS or QGIS), Compound microscope, Plankton nets, pH Meter, Thermometer, Conductivity Meter, Turbidity meter (Nephlometer), PONAR Grab Sampler, Dissecting Tray, Magnifying Glass, Stereo Microscope, pH meter, TDS meter, Turbidity tube, BOD/COD field Kit etc.
		Chemicals	Lugols iodine, formalin, Turbidity free distilled water, Formazine turbidity concentrate, hydrazine sulphate, hexamine, Formazine standard, HCL, Phenolphthalein and Methyl orange indicator, Ethyl alcohol, Na_2CO_3, Sodium Hydroxide (NaOH), oxalic acid, Indicator Paper (pH strips) (optional), pH Indicator, Standard Buffer Solutions etc.
		Glassware	Sample bottles, Glass slides, Cover Slips, Dropper, pipette, label samples, Burette, Conical flask, Glazed tile, Beaker, Measuring cylinder, Forceps, Cuvettes, Glass Rod, Tissue Paper, Blotting Paper, Dissection tools (Forceps, probes, scissors, and scalpels) etc.
		Data Materials	Plankton identification keys or taxonomic keys, Sketching materials etc.
VI	**ZOOM304: Lab Activities on ZOOM303**	**Specimen / Chart / Samples**	Termite specimens, Sea Anemone, Clownfish image, Hermit crab and shell image, Plasmodium infected blood smears Slides, Preserved Ectoparasites specimens or images (e.g., Ticks, Fleas and Lice on mammals). Specimens, Permanent Slides or Micro Photographs, *Plasmodium vivax, Entamoeba histolytica, Taenia solium, Ascaris lumbricoides*, Soft tick Sarcoptes scabiei and *Cimex lectularius*, Live cockroach, Fresh fecal samples of Hen, Goat, and Fish etc.
		Instruments	Compound/Stereoscope Microscope, Centrifuge etc.
		Chemicals	NaCl, Lugol's iodine, Absolute alcohol.
		Glassware	Watch glass, Clean glass slides, Cover slips, Droppers / Pasteur pipettes, Glass rods /

			applicator sticks, Dissecting tray and pins, Fine pointed scissor, Test tubes, Beakers, Gloves, laboratory coat, Disinfectant (phenol / lysol), Biohazard disposal bags, Insect collecting net, killing bottles of various sizes, Aspirators, Forceps, Small boxes or containers etc.


ENVIRONMENTAL
SCIENCE LAB
INSTRUMENTS & CHEMICALS

I. Recommended Quantities of Miscellaneous Instruments for All Semesters of Major Courses for Batch of 15 Students.

S.N.	Instrument Name	Required Quantity
1.	UV Spectrophotometer	01
2.	Centrifuge machine	01
3.	Hot air oven	01
4.	Hot Plate	02
5.	Weighing balance	01
6.	Autoclave	01
7.	Laminar Air Flow Cabinet	01
8.	Incubator	01
9.	Microscope	05
10.	Cylinder	01
11.	Burner	01
12.	Nephelometer	01
13.	Sound Level Meter	02
14.	Lux Meter	02
15.	Quadrate	03
16.	Plankton collecting net	03
17.	pH meter	02
18.	EC meter	02
19.	Flame Photometer	01
20.	COD Digester	01
21.	Kjeldahl Assembly	01
22.	Set of Condenser and reflux tubes of COD digester	01 Set
23.	Nessler's Tube	02
24.	Muffle furnace	01
25.	Atomic Absorption Spectrophotometer (Available nearby)	01
26.	Arc GIS or QGIS	Open Source Software (05 Computers)
27.	Google Earth App	05 Computers
28.	GPS	02
29.	Digital Toposheet	05 Computers
30.	Rocks and Minerals specimens	05 examples of each

31.	Toposheet (Hardcopy)	05 toposhets

- **Miscellaneous Material Required For All Semester:**

S.N.	Material	Required Quantity
1.	Mortar & Pestle	03
2.	Pipettes (1ml, 5ml, 10ml)	05 each
3.	Beakers (25ml, 50ml, 100ml, 250ml)	05 each
4.	Funnel	05
5.	Conical Flasks (25ml, 50ml, 100ml, 250ml)	05 each
6.	Volumetric Flasks (25ml, 50ml, 100ml, 250ml)	05 each
7.	Filter paper	-
8.	Whatmann Filter paper	-
9.	Porcelain Dish	10
10.	Measuring cylinder (10ml, 50ml, 100ml)	05 each
11.	Petri dish	30
12.	Test tube	50
13.	Durham's Tube	50
14.	Bumper Testtubes	50
15.	Cotton	-
16.	Nicron wire loop / Inoculating loop	15
17.	Glass slide	15
18.	Cover slips	15
19.	Burette (50ml)	15
20.	Glass rod	-
21.	Glass spreader	05

II. Laboratory Requirement for Major Discipline of Environmental Science:

SEM	Course Code and Course Name	Requirement	Details	Practical
I	EVSC102: Lab Activities on EVSC101	List of Chemicals	Acetone	Chlorophyll content,
			Magnesium Sulphate	Chlorophyll content,
		List of Instruments	Spectrophotometer	Chlorophyll content
			Centrifuge machine	Chlorophyll content,
			Hot air oven	Primary Productivity of grassland,
			Hot Plate	Common

			Weighing balance	Common
	EVSV101: Environmental Microbiology	**List of Chemicals**	Nutrient Agar	Isolation of bacteria
			Agar Agar	Isolation of bacteria
			Crystal Violet dye	Gram's staining
			Gram's Iodine	Gram's staining
			Safranin dye	Gram's staining
		List of Instruments	Hot Plate	Common
			Weighing balance	Common
			Autoclave	Isolation of bacteria
			Laminar Air Flow Cabinet	Isolation of bacteria
			Incubator	Isolation of bacteria
			Microscope	Isolation of bacteria
		List of Other Required Materials	Cylinder	Sterilization
			Burner	Sterilization
II	**EVSC104: Lab Activities on EVSC103**	**List of Chemicals**	Hydrazine sulphate	Turbidity
			Hexamethylene tetramine	Turbidity
			Ethanol	Pigment study of plant
			Methanol	Pigment study of plant
			Acetone	Pigment study of plant
		List of Instruments	Nephelometer	Turbidity
			Spectrophotometer	Pigment content from leaf
			Hot Plate	Common
			Weighing balance	Common
	EVSV102: Basics of Environmental Audit	**List of Other Materials**	Water Analysis kit or laboratories to analyse water parameter	For Water Audit
			Ambient Air quality data from recognized website	For Air Audit
			Sound Level Meter	For Noise Intensity Audit
			Lux Meter	For Energy Audit
			Measuring Tape, Clinometer or Mobile App to measure tree height	Carbon sequestration
	EVSC203: Lab	**List of Chemicals**	Nutrient Agar	Isolation of bacteria, MPN

III	**Activities on EVSC201**		Agar Agar	Isolation of bacteria, MPN
			Crystal Violet dye	Gram's staining
			Gram's Iodine	Gram's staining
			Safranine dye	Gram's staining
		List of Instruments	Autoclave	Isolation of bacteria
			Laminar Air flow cabinet	Isolation of bacteria
			Incubator	Isolation of bacteria
			Microscope	Isolation of bacteria, Plankton collection
		List of Other Required Materials	Quadrate for species counting	Quadrate method
			Aerial photograph (by google map)	Vegetation mapping
			Plankton collecting net	Plankton collection
			Cylinder	Sterilization
			Burner	Sterilization
	EVSV201: Soil Health Management	**List of Chemicals**	Diethylenetriaminepentaacetic acid	Zn from soil
			Potassium thiocyanate	Iron from soil
			Azomethine-H	Boron from soil
			Calcium Chloride	Boron from soil
			Sodium hydroxide	Nitrogen, Sodium Absorption Ratio
			Diphenylamine indicator	Organic Carbon
			Potassium permagnet	Nitrogen
			Boric Powder	Nitrogen
			Bromocresol Green	Nitrogen
			Methyl Red	Nitrogen
			Sodium Bicarbonate	Phosphorous
			Ascorbic Acid	Phosphorous
			Antimony Potassium Tartrate	Phosphorous
			P-nitrophenol	Phosphorous
			Potassium dihydrogen orthophosphate	Phosphorous
			Ammonium Acetate	Potassium
			Murexide powder	Sodium Absorption Ratio

			Potassium dichromate	Organic Carbon
			Ferrous ammonium sulphate	Organic Carbon
			Conc. Hydrochloric Acid	Sodium Absorption Ratio,
			Sodium Chloride	Sodium Absorption Ratio,
			Ammonium Molybdate	Phosphorous
			Ethyledene Diamine Tetra Acetic acid solution	Sodium Absorption Ratio,
			Eriochrome Black - T	Sodium Absorption Ratio,
			Ammonium chloride	Sodium Absorption Ratio,
			Potassium Chloride	Potassium
			Conc. Sulphuric Acid	Organic Carbon, Nitrogen
		List of Instruments	pH meter	pH
			EC meter	Conductivity
			Spectrophotometer	Phosphate, Phosphorous,
			Flame Photometer	Potassium, Sodium Absorption Ratio
		List of Other Required Materials	Cylinder	Sterilization
			Burner	Sterilization
IV	**EVSC207: Lab Activities on EVSC205**	**List of Chemicals**	Manganese Sulphate	DO, BOD
			Sodium hydroxide	DO, BOD, Nitrogen, Sodium Absorption Ratio, NO_x , CO_2 ,
			Sodium Iodide	DO, BOD
			Conc. Sulphuric Acid	DO, BOD, COD, Organic Carbon, Nitrogen
			Sodium thiosulphate	DO, BOD
			Starch powder	DO, BOD
			Potassium dichromate	COD, Organic Carbon
			Mercuric sulphate	COD
			Ferroin Indicator	COD
			Ferrous ammonium sulphate	COD, Organic Carbon

			Conc. Hydrochloric Acid	Sulphate, Phosphate, CO_2
			Sodium Chloride	Sulphate, Sodium, Sodium Absorption Ratio,
			Glycerol	Sulphate
			Barium Chloride	Sulphate
			Anhydrous Sulphate (Na_2SO_4)	Sulphate
			Ammonium Molybdate	Phosphorous, Phosphate
			Stannous Chloride	Phosphorous
			Potassium chromate	Chloride
			Silver Nitrate	Chloride
			Ethyledene Diamine Tetra Acetic acid solution	Hardness, Sodium Absorption Ratio,
			Eriochrome Black - T	Hardness, Sodium Absorption Ratio,
			Ammonium solution	Hardness
			Ammonium chloride	Hardness, Sodium Absorption Ratio,
			Potassium Chloride	Potassium from soil & water
			Diphenylamine indicator	Organic Carbon
			Potassium permagnet	Nitrogen
			Boric Powder	Nitrogen
			Bromocresol Green	Nitrogen
			Methyl Red	Nitrogen
			Sodium Bicarbonate	Phosphorous
			Ascorbic Acid	Phosphorous
			Antimony Potassium Tartrate	Phosphorous
			P-nitrophenol	Phosphorous
			Potassium dihydrogen orthophosphate	Phosphorous
			Ammonium Acetate	Potassium
			Murexide powder	Sodium Absorption Ratio
			Sodium Tetrachloromercurate	SO_2
			Mercuric Chloride	SO_2

			P-rosaniline	SO_2
			Formaldehyde	SO_2
			Sulphamic Acid	SO_2
			Sulphanilamide	NO_x
			N-(1-Naphthyl)-ethylenediamine Di-hydrochloride (NEDA)	NO_x
			Hydrogen peroxide	NO_x
			Phosphoric Acid	NO_x
			Sodium Nitrate	NO_x
			Phenolphthalein indicator	CO_2
		List of Instruments	Spectrophotometer	Chlorophyll content, Sulphate, Phosphate, Phosphorous, SO_2, NO_x
			COD Digester	COD
			Flame Photometer	Potassium, Sodium Absorption Ratio
			Kjeldahl Assembly	Nitrogen
			Sound Level Meter	Sound Intensity
			BOD Bottle	DO, BOD
			Set of Condenser and reflux tubes of COD digester	COD
			Nessler's Tube	NO_x
		List of Other Required Materials	Cylinder	For Flame Photometer, Sterilization
			Burner	Sterilization
V	**EVSC303: Lab Activities on EVSC301, EVSC302 and Electives**	**Lab Activities on EVSC301**	Water Act, Solid Waste Management Rule, Biodiversity Act, Noise Act	For the Practical in Credit 01
			Audit Reports and LCA cycle report	For the Practical in Credit 02
		Lab Activities on EVSC302	EIA Baseline data for and constructional or operational phase developmental project	For the Practical in Credit 03
		Lab Activities on EVSC304	Weather Data	Climograph/Octagonal/ Ergograph
			Measuring Tape, Clinometer or Mobile	Carbon sequestration

			App to measure tree height	
		Lab Activities on EVSC305	Muffle furnace	Charcoal making,
			Hot Plate	Common
			Weighing balance	Common
		Lab Activities on EVSC306	Arc GIS or QGIS Open Source Software	Vegetation Mapping
VI	**EVSC309: Lab Activities on EVSC307, EVSC308 and Electives**	**Lab Activities on EVSC307**	Arc GIS or QGIS Open Source Software	Installation of Software
			True Colour/False Colour Composite Images	Photo Interpretation
			Google Earth App	Google Earth
			GPS	Collecting Coordinates
			Digital Toposheet	Digitization, Georeferencing
		Lab Activities on EVSC308	EIA Baseline data for and constructional or operational phase developmental project	For the Practical in Credit 03
			Nutrient Agar	Isolation of bacteria
			Agar Agar	Isolation of bacteria
			Crystal Violet dye	Gram's staining
			Gram's Iodine	Gram's staining
			Safranin dye	Gram's staining
			Hot Plate	Common
			Weighing balance	Common
			Autoclave	Isolation of bacteria
			Laminar Air Flow Cabinet	Isolation of bacteria
			Incubator	Isolation of bacteria
			Microscope	Isolation of bacteria
		Lab Activities on EVSC310	Rocks and Minerals specimens	Identification of specimen
			Toposheet (Hardcopy)	Interpreation of geomorphology, Delineation of watershed
		Lab Activities on EVSC311	Statistical Examples related to Environmental Science	For all Lab Activities

		Lab Activities on EVSC312	Any heavy metal chemical (Mercury/Zinc/Lead etc.)	Germination of Seeds, LC_{50}
VII	**EVSC404: Lab Activities on EVSC401, EVSC402 & EVSC403**	**List of Chemicals**	Formalin	Phyto & Zoo plankton identification
			Sodium Chloride	Sodium Absorption Ratio
			Calcium Chloride	Sodium Absorption Ratio
			Conc. Sulphuric Acid	Organic Carbon, Nitrogen
			Phosphoric Acid	Organic Carbon
			Potassium Dichromate	Organic Carbon
			Ferrous sulphate	Organic Carbon
			Diphenylamine indicator	Organic Carbon
			Copper Sulphate	Nitrogen
			Potassium Sulphate	Nitrogen, Ca & Mg
			Sodium hydroxide	Nitrogen, Ca & Mg, CO_2
			Salicylic Acid	Nitrogen
			Methyl Red	Nitrogen
			Potassium Chloride	Potassium
			Ammonium Acetate	Potassium
			Monocalcium Phosphate	Sulphur
			Gum Acacia	Sulphur
			Barium Chloride	Sulphur
			Potassium sulphate	Sulphur
			Nitric Acid	Sulphur
			Ammonium Chloride	Calcium and Magnesium
			Calcium Carbonate	Calcium and Magnesium
			EDTA	Calcium and Magnesium
			Murexide indicator	Calcium and Magnesium
			Sodium diethyl dithiocarbamate crystals	Calcium and Magnesium

			Diethylene triamine pentaacetic acid (DTPA)	Micronutrient
			Manganese Sulphate	Manganese
			Zinc meta	Zinc
			Copper metal	Copper
			Sodium tetra borate	Boron
			Molybdenum trioxide	Molybdenum
		List of Instruments	Hot air oven	Biomass
			Spectrophotometer	
			Atomic Absorption Spectrophotometer (Available nearby)	Micronutrient
			Hot Plate	
			Weighing balance	
			Kjeldahl Assembly	Nitrogen
			LUX meter	Solar Radiation
			pH meter	pH
		List of Other Required Materials	GPS	Biomass
			Quadrate for species counting	Quadrate method
			Plankton Collecting Net	Phyto & Zoo plankton identification
VIII	**EVSC412: Lab Activities on EVSC409 & EVSC410**	**List of Chemicals**	4,7,9.2 pH buffer tablet	pH
			Potassium chromate	Chloride
			Silver Nitrate	Chloride
			Potassium Chloride	Conductivity
			Zinc Sulphate	Hardness
			Eriochrome black - T	Hardness
			EDTA	Hardness
			K-H phthalate	CO_2
		List of Instruments	pH meter	pH
			Hot Plate	Common
			Weighing balance	Common
		List of Other Required Materials	Magnifying Lens/Microscope	Phyto & Zoo plankton identification
			Gooch Crucible	Salinity
			Rocks and Minerals specimens	Identification of specimen
			Toposheet	Geological maps

III. Recommended Quantities of Miscellaneous Instruments for All Semesters of Minor Courses for Batch of 15 Students.

S.N.	Instrument Name	Required Quantity
1.	UV Spectrophotometer	01
2.	Centrifuge machine	01
3.	Hot air oven	01
4.	Hot Plate	02
5.	Weighing balance	01
6.	Autoclave	01
7.	Laminar Air Flow Cabinet	01
8.	Incubator	01
9.	Microscope	05
10.	Cylinder	01
11.	Burner	01
12.	Nephelometer	01
13.	Sound Level Meter	02
14.	Lux Meter	02
15.	Quadrate	03
16.	Plankton collecting net	03
17.	pH meter	02
18.	EC meter	02
19.	Flame Photometer	01
20.	COD Digester	01
21.	Kjeldahl Assembly	01
22.	Set of Condenser and reflux tubes of COD digester	01 Set
23.	Nessler's Tube	02
24.	Muffle furnace	01
25.	Atomic Absorption Spectrophotometer (Available nearby)	01
26.	GPS	02

- **Miscellaneous Material Required For All Semester:**

S.N.	Material	Required Quantity
1.	Mortar & Pestle	03
2.	Pipettes (1ml, 5ml, 10ml)	05 each
3.	Beakers (25ml, 50ml, 100ml, 250ml)	05 each

4.	Funnel	05
5.	Conical Flasks (25ml, 50ml, 100ml, 250ml)	05 each
6.	Volumetric Flasks (25ml, 50ml, 100ml, 250ml)	05 each
7.	Filter paper	-
8.	Whatmann Filter paper	-
9.	Porcelain Dish	10
10.	Measuring cylinder (10ml, 50ml, 100ml)	05 each
11.	Petri dish	30
12.	Test tube	50
13.	Durham's Tube	50
14.	Bumper Testtubes	50
15.	Cotton	-
16.	Nicron wire loop / Inoculating loop	15
17.	Glass slide	15
18.	Cover slips	15
19.	Burette (50ml)	15
20.	Glass rod	-
21.	Glass spreader	05

IV. Laboratory Requirement for Minor Discipline of Environmental Science:

SEM	Course Code and Course Name	Requirement	Details	Practical
III	EVSM202: Lab Activities on EVSM201	List of Chemicals	Nutrient Agar	Isolation of bacteria, MPN
			Agar Agar	Isolation of bacteria, MPN
			Crystal Violet dye	Gram's staining
			Gram's Iodine	Gram's staining
			Safranine dye	Gram's staining
			Diethylenetriaminepentaacetic acid	Zn from soil
		List of Instruments	Autoclave	Isolation of bacteria
			Laminar Air flow cabinet	Isolation of bacteria
			Incubator	Isolation of bacteria
			Microscope	Isolation of bacteria, Plankton collection
			Quadrate for species counting	Quadrate method

		List of Other Required Materials	Aerial photograph (by google map)	Vegetation mapping
			Plankton collecting net	Plankton collection
			Cylinder	Sterilization
			Burner	Sterilization
IV	**EVSM204: Lab Activities on EVSM203**	**List of Chemicals**	Manganese Sulphate	DO, BOD
			Sodium hydroxide	DO, BOD
			Sodium Iodide	DO, BOD
			Conc. Sulphuric Acid	DO, BOD, COD
			Sodium thiosulphate	DO, BOD
			Starch powder	DO, BOD
			Potassium dichromate	COD,
			Mercuric sulphate	COD
			Ferroin Indicator	COD
			Ferrous ammonium sulphate	COD,
			Conc. Hydrochloric Acid	Sulphate, CO_2
			Sodium Chloride	Sulphate, Sodium,
			Glycerol	Sulphate
			Barium Chloride	Sulphate
			Anhydrous Sulphate (Na_2SO_4)	Sulphate
			Ammonium Molybdate	Phosphorous,
			Stannous Chloride	Phosphorous
			Potassium chromate	Chloride
			Silver Nitrate	Chloride
			Ethyledene Diamine Tetra Acetic acid solution	Hardness,
			Eriochrome Black - T	Hardness,
			Ammonium solution	Hardness
			Ammonium chloride	Hardness,
			Potassium Chloride	Potassium from water
		List of Instruments	Spectrophotometer	Chlorophyll content, Sulphate, Phosphate
			COD Digester	COD
			BOD Bottle	DO, BOD
			Set of Condenser and reflux tubes of COD digester	COD
			Sound Level meter	Sound Intensity
		List of Other Required Materials	Cylinder	For Flame Photometer

V	**EVSM302: Lab Activities on EVSM301**	**List of Chemicals**	Diethylenetriaminepentaaceti c acid	Zn from soil
			Potassium thiocyanate	Iron from soil
			Azomethine-H	Boron from soil
			Calcium Chloride	Boron from soil
			Sodium hydroxide	Nitrogen, Sodium Absorption Ratio
			Diphenylamine indicator	Organic Carbon
			Potassium permagnet	Nitrogen
			Boric Powder	Nitrogen
			Bromocresol Green	Nitrogen
			Methyl Red	Nitrogen
			Sodium Bicarbonate	Phosphorous
			Ascorbic Acid	Phosphorous
			Antimony Potassium Tartrate	Phosphorous
			P-nitrophenol	Phosphorous
			Potassium dihydrogen orthophosphate	Phosphorous
			Ammonium Acetate	Potassium
			Murexide powder	Sodium Absorption Ratio
			Potassium dichromate	Organic Carbon
			Ferrous ammonium sulphate	Organic Carbon
			Conc. Hydrochloric Acid	Sodium Absorption Ratio,
			Sodium Chloride	Sodium Absorption Ratio,
			Ammonium Molybdate	Phosphorous
			Ethyledene Diamine Tetra Acetic acid solution	Sodium Absorption Ratio,
			Eriochrome Black - T	Sodium Absorption Ratio,
			Ammonium chloride	Sodium Absorption Ratio,
			Potassium Chloride	Potassium
			Conc. Sulphuric Acid	Organic Carbon, Nitrogen
			Sodium Tetrachloromercurate	SO_2
			Mercuric Chloride	SO_2
			P-rosaniline	SO_2
			Formaldehyde	SO_2

			Sulphamic Acid	SO_2
			Sulphanilamide	NO_x
			N-(1-Naphthyl)- ethylene diamine Di-hydrochloride (NEDA)	NO_x
			Hydrogen peroxide	NO_x
			Phosphoric Acid	NO_x
			Sodium Nitrate	NO_x
			Phenolphthalein indicator	CO_2
		List of Instruments	Spectrophotometer	Sulphate, Phosphate, Phosphorous, SO_2, NO_x
			Flame Photometer	Potassium, Sodium Absorption Ratio
			Kjeldahl Assembly	Nitrogen
			Nessler's Tube	NO_x
		List of Other Required Materials	Cylinder	For Flame Photometer, Sterilization
			Burner	Sterilization
VI	**EVSM304: Lab Activities on EVSM303**	**List of Other Required Materials**	• Water Act, Solid Waste Management Rule, Biodiversity Act, Noise Act.	
			• Audit Reports and LCA cycle report.	
			• EIA Baseline data for and constructional or operational phase developmental project.	
			• Rule 14 of the Environment (Protection) Rules, 1986.	

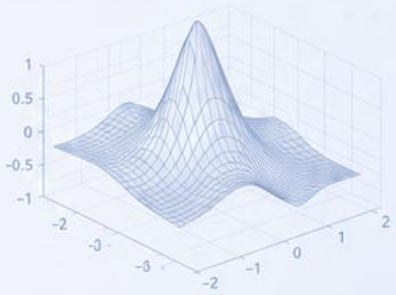
SECTION B:

List of Laboratory Requirements for PG Programmes Offered Under School of Sciences

$$\int_a^b f(x)\,dx$$

$$A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$$

$$\sum_{i=1}^{n} i$$



MATHEMATICS LAB



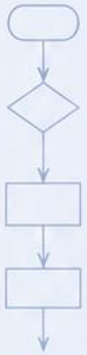
```
import numpy as np
import matplotlib.pyplot as plt

x = np.linspace(0, 2*np.pi, 400)
y = np.sin(x)

plt.plot(x, y)
plt.grid(True)
plt.show()
```

SOFTWARES AND PROGRAMMING LANGUAGES





Python | MATLAB | Scilab | SageMath | MS-Excel with Copilot

```
\documentclass{article}
\usepackage{amsmath}

\begin{document}

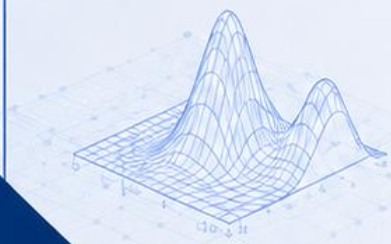
  Euler's Identity:
  $e^{i\pi} + 1 = 0

\end{document}
```

LaTeX | GeoGebra | C | R

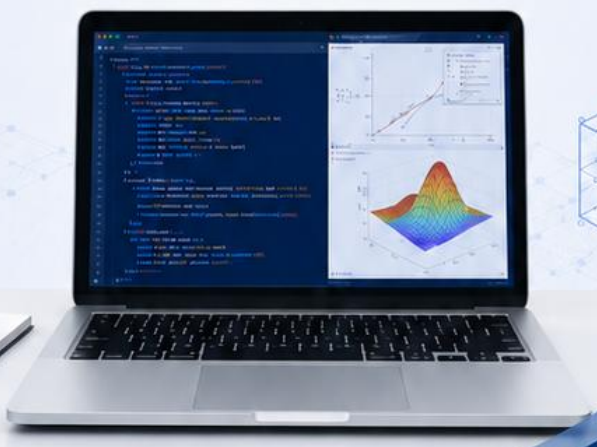
```
x <- c(1,2,3,4,5)
y <- c(2,4,5,4,3)
plot(x, y, type='b')
```







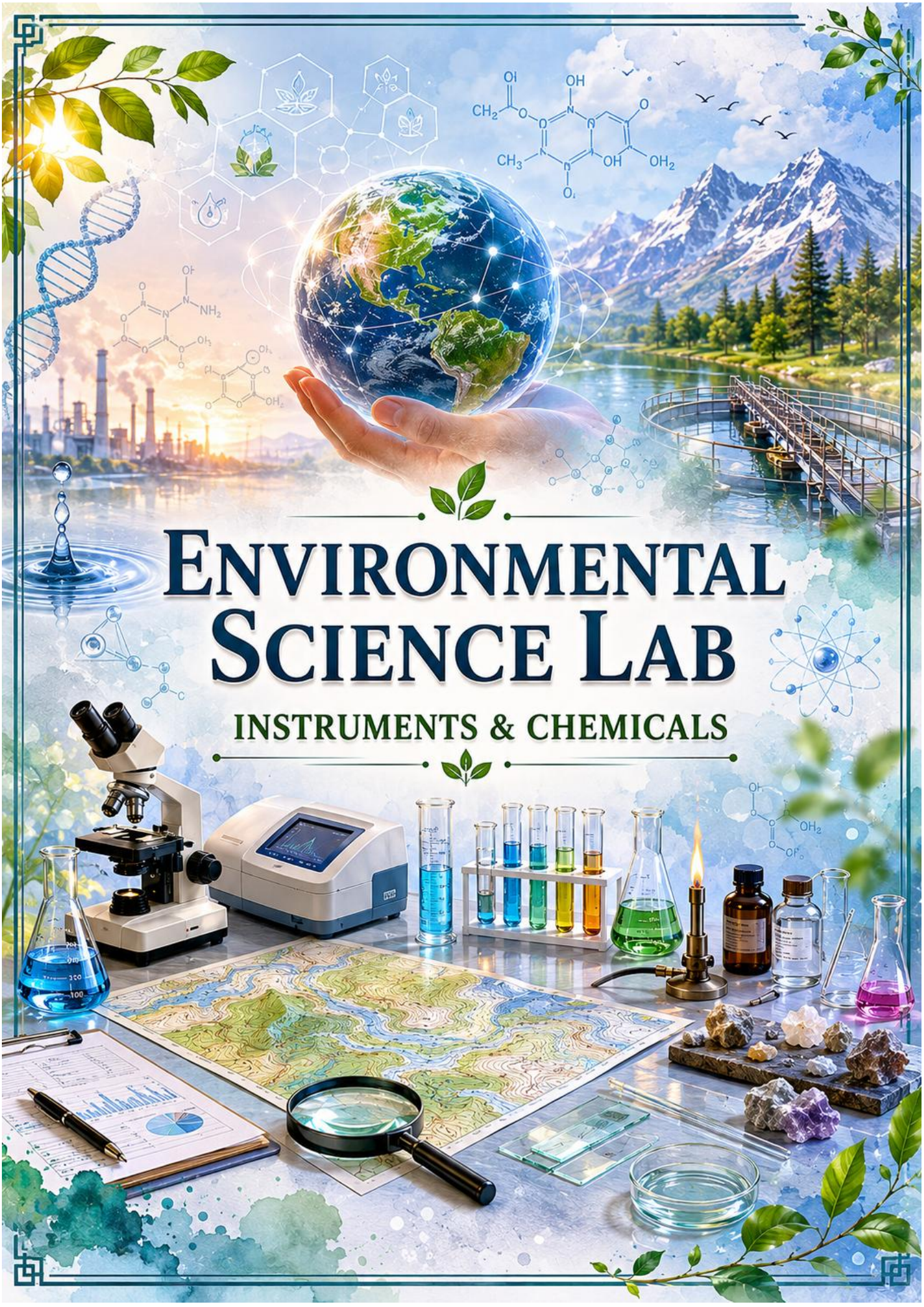




V151: M.Sc. (Mathematics) {2023 Pattern}

I. Recommended Quantities of Miscellaneous Instruments for All Semesters for Batch of 15 Students.

Semester	Course Code & Name	Equipment/ Instrument/ Software/ Programming Language
	Computer Lab of 15 Computers with:	
I	MAT504: Programming in C and Scilab	1) C - Programming Language (Open source) 2) Scilab - Programming Language (Open source)
II	MAT512: LaTeX & Programming in SageMath	1) LaTeX - TeXstudio, Overleaf, or MiKTeX. (Open source) 2) SageMath - Software (Open source)
III	MAT604: Mathematical Statistics and Combinatorics	1) Microsoft Excel - Software Program
IV	MAT611: Programming in Python	1) Python - Programming Language (Open source)


ENVIRONMENTAL
SCIENCE LAB
INSTRUMENTS & CHEMICALS

V152: M.Sc. (Environmental Science) {2023 Pattern}

I. Recommended Quantities of Miscellaneous Instruments for All Semesters for Batch of 15 Students.

S.N.	Instrument Name	Required Quantity
1.	UV Spectrophotometer	01
2.	Centrifuge machine	01
3.	Hot air oven	01
4.	Hot Plate	02
5.	Weighing balance	01
6.	Autoclave	01
7.	Laminar Air Flow Cabinet	01
8.	Incubator	01
9.	Microscope	05
10.	Cylinder	01
11.	Burner	01
12.	Orsat Gas Analysis Apparatus	01
13.	Lux Meter	02
14.	Quadrate	03
15.	Plankton collecting net	03
16.	pH meter	02
17.	EC meter	02
18.	Kjeldahl Assembly	01
19.	Nessler's Tube	02
20.	Muffle furnace	01
21.	Atomic Absorption Spectrophotometer (Available nearby)	01
22.	GPS	02
23.	Rocks and Minerals specimens	05 examples of each
24.	Toposheet (Hardcopy)	05 Toposhets

- **Miscellaneous Material Required For All Semester:**

S.N.	Instrument Name	Required Quantity
1.	Mortar & Pestle	03
2.	Pipettes (1ml, 5ml, 10ml)	05 each
3.	Beakers (25ml, 50ml, 100ml, 250ml)	05 each
4.	Funnel	05

5.	Conical Flasks (25ml, 50ml, 100ml, 250ml)	05 each
6.	Volumetric Flasks (25ml, 50ml, 100ml, 250ml)	05 each
7.	Filter paper	-
8.	Whatmann Filter paper	-
9.	Porcelain Dish	10
10.	Measuring cylinder (10ml, 50ml, 100ml)	05 each
11.	Petri dish	30
12.	Test tube	50
13.	Durham's Tube	50
14.	Bumper Testtubes	50
15.	Cotton	-
16.	Nicron wire loop / Inoculating loop	15
17.	Glass slide	15
18.	Cover slips	15
19.	Burette (50ml)	15
20.	Glass rod	-
21.	Glass spreader	05

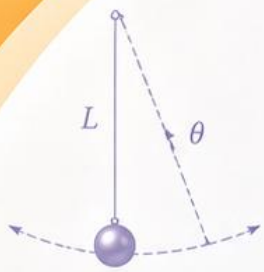
II. Laboratory Requirement Semester-wise:

SEM	Course Code & Course Name	Requirement	Details	Practical
I	**EVS504: Lab Activities on EVS501, EVS502 & EVS503**	**List of Chemicals**	Formalin	Phyto & Zoo plankton identification
			Sodium Chloride	Sodium Absorption Ratio
			Calcium Chloride	Sodium Absorption Ratio
			Conc. Sulphuric Acid	Organic Carbon, Nitrogen
			Phosphoric Acid	Organic Carbon
			Potassium Dichromate	Organic Carbon
			Ferrous sulphate	Organic Carbon
			Diphenylamine indicator	Organic Carbon
			Copper Sulphate	Nitrogen
			Potassium Sulphate	Nitrogen, Ca & Mg
			Sodium hydroxide	Nitrogen, Ca & Mg, CO_2
			Salicylic Acid	Nitrogen

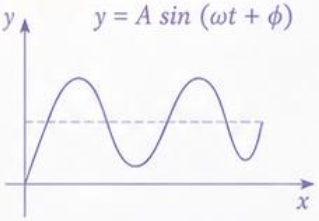
			Methyl Red	Nitrogen
			Potassium Chloride	Potassium
			Ammonium Acetate	Potassium
			Monocalcium Phosphate	Sulphur
			Gum Acacia	Sulphur
			Barium Chloride	Sulphur
			Potassium sulphate	Sulphur
			Nitric Acid	Sulphur
			Ammonium Chloride	Calcium and Magnesium
			Calcium Carbonate	Calcium and Magnesium
			EDTA	Calcium and Magnesium
			Murexide indicator	Calcium and Magnesium
			Sodium diethyl dithiocarbamate crystals	Calcium and Magnesium
			Diethylene triamine pentaacetic acid (DTPA)	Micronutrient
			Manganese Sulphate	Manganese
			Zinc meta	Zinc
			Copper metal	Copper
			Sodium tetra borate	Boron
			Molybdenum trioxide	Molybdenum
		List of Instruments	Hot air oven	Biomass
			Spectrophotometer	-
			Atomic Absorption Spectrophotometer (Available nearby)	Micronutrient
			Hot Plate	-
			Weighing balance	
			Kjeldahl Assembly	Nitrogen
			LUX meter	Solar Radiation
			pH meter	pH
		List of Other Required Materials	GPS	Biomass
			Quadrate for species counting	Quadrate method

			Plankton Collecting Net	Phyto & Zoo plankton identification
II	**EVS512: Lab Activities on EVS509 & EVS510**	**List of Chemicals**	4,7,9.2 pH buffer tablet	pH
			Potassium chromate	Chloride
			Silver Nitrate	Chloride
			Potassium Chloride	Conductivity
			Zinc Sulphate	Hardness
			Eriochrome black - T	Hardness
			EDTA	Hardness
			K-H phthalate	CO_2
		List of Instruments	pH meter	pH
			Hot Plate	Common
			Weighing balance	Common
		List of Other Required Materials	Magnifying Lens/Microscope	Phyto & Zoo plankton identification
			Gooch Crucible	Salinity
			Rocks and Minerals specimens	Identification of specimen
			Toposheet	Geological maps
III	**EVS604: Lab Activities on EVS601 & EVS602**	**List of Chemicals**	Potassium chromate	Chloride
			Silver Nitrate	Chloride
			Crystal Violet dye	Gram's staining
			Potassium Dichromate	Chromatography
			Potassium Permagnet	Chromatography
		List of Instruments	Dry and Wet bulb hygrometer	If available at nearby weather station
			Colorimeter	Chlorine
			Whatmann Chromatography paper	Paper Chromatography
			Thin layer chromatography	Thin layer chromatography
IV	**EVS611: Lab Activities on EVS609 & EVS610**	**List of Chemicals**	Hydrogen Peroxide	Metals from soil
			Biuret reagent	Protein
			Bovine Serum Albumin	Protein
			Potassium Thiocyanate	Salinity

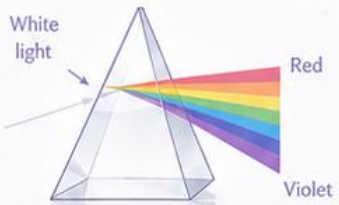
			Isopropanol	Paper Chromatography
			Hexane	Thin layer chromatography
			Ethyl acetate	Thin layer chromatography
			Acetone	-
			Acetaldehyde	
			Nutrient Agar	Isolation of bacteria, MPN
			Agar Agar	Isolation of bacteria, MPN
			Crystal Violet dye	Gram's staining
			Gram's Iodine	Gram's staining
			Safranine dye	Gram's staining
		List of Instruments	Autoclave	Isolation of bacteria
			Laminar Air flow cabinet	Isolation of bacteria
			Incubator	Isolation of bacteria
			Orsat Gas Analysis Apparatus	Hydrocarbon from fuel
			Hot Plate	Common
			Weighing balance	Common
		List of Other Required Materials	Cylinder	For Flame Photometer, Sterilization
			Burner	Sterilization



$$T = 2\pi\sqrt{\frac{L}{g}}$$



$$y = A\sin(\omega t + \phi)$$



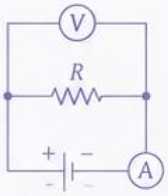
$$s = ut + \frac{1}{2}at^2$$

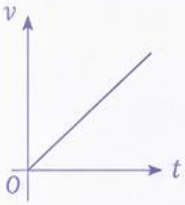
$$v^2 = u^2 + 2as$$

$$F = ma$$

PHYSICS LAB

EQUIPMENTS/INSTRUMENTS







TIME MEASUREMENT | LENGTH MEASUREMENT | FORCE & MOTION | WAVES & OSCILLATIONS | OPTICS & LIGHT | ELECTRICITY & ELECTRONICS

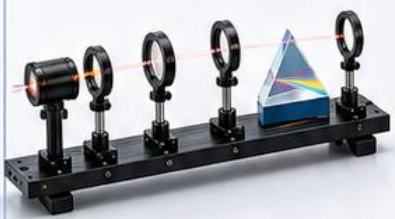










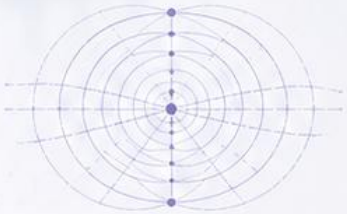


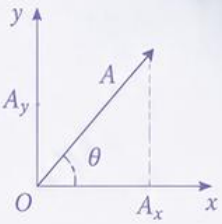




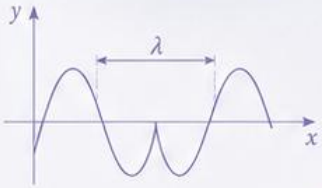








$$E = mc^2$$



V153: M.Sc. (Physics) {2023 Pattern}

I. Recommended Quantities of Miscellaneous Instruments for All Semesters for Batch of 15 Students.

Sr. No.	Required Equipments / Instruments	Recommended Quantities
1.	IC 741 (operational amplifier)	05
2.	IC 555 (timer IC)	05
3.	IC 566 (Voltage-Controlled Oscillator)	05
4.	IC 565 Phase-Locked Loop (PLL)	05
5.	IC 7400, 7402, 7404, 7408, 7432, 7486	05
6.	IC 8038 Function Generator IC	05
7.	IC 78XX (e.g., LM7805 for +5V output)	05
8.	IC 79XX (e.g., LM7905 for -5V output)	05
9.	IC L7106 IC (or equivalent ADC IC)	05
10.	IC 7490 Decade Counter IC	05
11.	Resistors (various values)	10 each
12.	Capacitors (various values, electrolytic and ceramic)	10 each
13.	Breadboard or PCB for circuit assembly	10
14.	Connecting wires	02 bundles
15.	Power supply	05
16.	Oscilloscope	02
17.	Digital multimeter	05
18.	Push-button switch	05
19.	LEDs (with different colours)	10 each
20.	Function generator	02
21.	Potentiometer (variable resistor)	02
22.	Dual Power Supply	02
23.	Jumper Wires	01 set
24.	BNC Cables and Connectors	02 set
25.	Transformer	02
26.	Rectifier Bridge	01
27.	Filter Capacitors (With different values)	05 each
28.	Switching Transistor (e.g., MOSFET)	04
29.	Control IC (e.g., PWM Controller)	05
30.	Inductors (with different values)	05 each
31.	Heat Sink (for MOSFET or other heat-generating components)	01
32.	Heat Shrink Tubing and Insulation Materials	01
33.	Soldering Iron and Solder	01

34.	Operational Amplifiers (Op-Amps)	02
35.	PN junction diodes with different values	10 each
36.	Inductor (coil)	01
37.	Transistor (e.g., MOSFET)	02 each
38.	Load resistor	01
39.	Seven-segment display (common cathode)	02
40.	Temperature sensor (e.g., LM35 or LM75)	02
41.	Seven segment display driver IC (e.g., 7447 or CD4511)	02
42.	Clock pulse source (e.g., 555 timer or crystal oscillator)	02
43.	Computer Systems with installed 'C' Programming kit	15
44.	experimental set up consists of four probe arrangement	01 set
45.	Digital ESR kit	01
46.	Helmholtz coil	01
47.	RF oscillator	01
48.	Electromagnet	01
49.	Gaussmeter	01
50.	Coaxial cables	01 set
51.	Electromagnetic radiation source (microwave or RF source)	01
52.	Waveguide or antenna	01
53.	Vernier caliper	05
54.	GM Counting System GC601A / GC602A with A.C. main chord	01
55.	gamma source	02
56.	Laser light source	02
57.	Michelson interferometer kit	01
58.	optical bench	01
59.	meter scale	03
60.	Spectrometer	02
61.	diffraction grating element	02
62.	mercury vapour lamp	01
63.	Emissivity measurement apparatus	01
64.	Fabry-Perot Etalon	01
65.	condensing lens	01
66.	sodium lamp	01
67.	X-ray source (0.2 – 2Ao i.e. white X-ray)	01
68.	Single crystal (1x1x1) mm	01
69.	Collimator	01

70.	X-ray Photographic Films	01
71.	Goniometer	01
72.	Greninger charts	01
73.	protractor	02
74.	Liquid nitrogen (LN2)	01
75.	Magnet	02
76.	Forceps (Tweezers)	02
77.	Superconducting thermocouple	02
78.	Four point probe	01
79.	Digital Multimeter	03
80.	Superconductor pallet (Y1Ba2Cu3O6+y i. e. YBCO or Mix metal with La, Ba, and Cu)	01
81.	Plane transmission grating with its holder	01
82.	He-Ne Laser (≈670 nm)	01
83.	AC Adapter	01
84.	spirit level	02
85.	fine thin wire of length about 10-15 cm in length	01 bundle
86.	white screen with mm scale	01
87.	Dielectric constant meter	01
88.	Volumetric flask (25ml)	02
89.	Pipet	03
90.	weighing balance	01
91.	Benzen, Chlorobenze, Nitrobenzene, etc.	As per Requirement
92.	Specific gravity bottle	01
93.	Quincke's tube or (U- shape tube)	01
94.	Travelling Microscope	02
95.	Fluxmeter with sensor	01
96.	Ferric Chloride Solution (FeCl3), water etc	As per Requirement
97.	Operational amplifier (e.g., LM741 or TL081, LM358, OP07, LM324, AD623, IC 741 or TL082)	02 each
98.	Silicon diodes (e.g., 1N4148 or 1N914)	02 each
99.	Thermocouple (e.g., Type K or Type J)	02
100.	Reference Temperature Sensor (e.g., LM35 or PT100)	02
101.	Potentiometer	01
102.	Variable capacitor	01
103.	Slider or rotatable arm for displacement	01
104.	Microcontroller (optional, e.g., Arduino, Raspberry Pi, or equivalent)	01
105.	Load or displacement calibration setup	01

106.	Accelerometer module (e.g., ADXL335, ADXL345, or similar)	01
107.	Power supply or USB connection	01
108.	Analog Multiplexer IC (e.g., CD4051)	01
109.	Digital Storage Oscilloscope (DSO)	01
110.	Digital Input Switches (or Microcontroller for digital input)	01
111.	Bipolar Power Supply (+15V, -15V)	01
112.	Diodes (e.g., 1N4148 or similar small-signal diodes)	01
113.	Analog multiplier IC (e.g., AD633)	01
114.	Thermistor (NTC or PTC type)	01
115.	Constant temperature bath or heater	01
116.	ohmmeter	01
117.	Thermometer or temperature sensor	05
118.	Strain gauge	01
119.	Cantilever beam or strain application setup	01
120.	Wheatstone bridge circuit	01
121.	Load or weight set (with different values)	02
122.	Photoelectric devices (photodiodes, phototransistors, photocells)	02
123.	Lux meter (to measure light intensity)	02
124.	Analog-to-Digital Converter (ADC)	01
125.	Digital-to-Analog Converter (DAC)	01
126.	Microcontroller or DAQ Card (e.g., Arduino, NI DAQ, LabVIEW)	01
127.	Computer with interfacing software (LabVIEW, MATLAB, Python)	15
128.	LVDT Sensor (Linear Variable Differential Transformer)	01
129.	Excitation Source (AC Power Supply, typically 1–10 kHz)	01
130.	Core Movement Mechanism (Micrometer or Translation Stage)	01
131.	Signal Conditioning Circuit (for amplification and rectification)	01
132.	Graphite sample (in powder or solid form)	01
133.	Calorimeter (preferably made of copper or aluminum)	01
134.	Testing machine (Universal Testing Machine - UTM or Tensile Testing Machine)	01
135.	Elastic material sample (e.g., steel, copper, aluminum wire, or polymer strip)	01

136.	Semiconductor substrate (Silicon wafer, Glass, or GaAs)	01
137.	Photoresist (Positive or Negative)	01
138.	Spin Coater (for uniform coating of photoresist)	01
139.	UV Exposure System (Mask Aligner)	01
140.	Photomask (with microstructure patterns)	01
141.	Optical Microscope (for inspecting developed microstructures)	01
142.	Nanoparticle sample (e.g., CdSe quantum dots, ZnO nanoparticles, or oth er semiconductor nanomaterials)	As per Requirement
143.	Photoluminescence spectrometer (PL spectrofluorometer)	01
144.	UV-Visible light source (e.g., xenon or mercury lamp)	01
145.	Optical filters (to select specific excitation wavelengths)	01
146.	Quartz cuvette (for liquid nanoparticle samples)	01
147.	Spectrometer software for data acquisition and analysis	01
148.	Computer for data visualization and processing	01
149.	Laser excitation source (optional)	01

II. Laboratory Requirement Semester-wise:

Semester I

Course Code & Course Name	Sr. No.	Required Equipments / Instruments
PHY504: Physics - I Practical	1.	IC 741 (operational amplifier) IC 555 (timer IC) IC 566 (Voltage-Controlled Oscillator) IC 565 Phase-Locked Loop (PLL) IC 7400, 7402, 7404, 7408, 7432, 7486 IC 8038 Function Generator IC IC 78XX (e.g., LM7805 for +5V output) IC 79XX (e.g., LM7905 for -5V output) IC L7106 IC (or equivalent ADC IC) IC 7490 Decade Counter IC
	2.	Resistors (various values)
	3.	Capacitors (various values, electrolytic and ceramic)
	4.	Breadboard or PCB for circuit assembly
	5.	Connecting wires
	6.	Power supply
	7.	Oscilloscope

	8.	Digital multimeter
	9.	Push-button switch
	10.	LEDs
	11.	Other passive components
	12.	Function generator for the modulating signal
	13.	Frequency counter
	14.	Probes
	15.	Potentiometer (variable resistor)
	16.	Dual Power Supply
	17.	Jumper Wires
	18.	BNC Cables and Connectors
	19.	AC Mains Input (220V AC)
	20.	Transformer
	21.	Rectifier Bridge
	22.	Filter Capacitors
	23.	Switching Transistor (e.g., MOSFET)
	24.	Control IC (e.g., PWM Controller)
	25.	Inductors
	26.	Output Voltage Regulation Circuitry
	27.	Output Capacitors
	28.	Voltage and Current Measurement Tools
	29.	Heat Sink (for MOSFET or other heat-generating components)
	30.	Heat Shrink Tubing and Insulation Materials
	31.	Soldering Iron and Solder
	32.	Safety Gear (gloves, safety glasses, etc.)
	33.	Electrical Loads (resistors, LEDs, etc.)
	34.	DC Power Supply
	35.	Cathode Ray Oscilloscope (Analog type) (20/30/100 MHz Frequency)
	36.	Analog IC tester
	37.	Operational Amplifiers (Op-Amps)
	38.	Diodes (e.g., 1N4001, etc)
	39.	Inductor (coil)
	40.	Transistor (e.g., MOSFET)
	41.	Load resistor
	42.	Seven-segment display (common cathode)
	43.	Temperature sensor (e.g., LM35 or LM75)
	44.	Sevensegment display driver IC (e.g., 7447 or CD4511)
	45.	Clock pulse source (e.g., 555 timer or crystal oscillator)

Semester II

PHY512: Physics - II Practical (Computational Methods Using 'C' Program)	1.	Computer Systems with installed 'C' Programming kit

Semester III

PHY604: Physics - III Practical	1.	experimental set up consists of four probe arrangement
	2.	sample
	3.	oven 0- 200°C
	4.	constant current generator
	5.	oven power supply
	6.	digital panel meter(measuring voltage and current)
	7.	Digital ESR kit
	8.	CRO
	9.	Helmholtz coil
	10.	RF oscillator
	11.	Electromagnet
	12.	Gaussmeter
	13.	simple balance
	14.	sample tube
	15.	Signal generator (RF signal generator)
	16.	Coaxial cables
	17.	Oscilloscope
	18.	Power meter or voltage meter
	19.	Electromagnetic radiation source (microwave or RF source)
	20.	Waveguide or antenna
	21.	Vernier caliper
	22.	Multimeter
	23.	Computer with data acquisition system (optional for automated readings)
	24.	GM Counting System GC601A / GC602A with A.C. main chord
	25.	GM Detector (End window) stand (or) G.M Detector/source holder bench (optical bench)
	26.	GM Detector (in PVC cylindrical enclosure) with connecting cable
	27.	gamma source
	28.	Laser light source

	29.	Michelson interferometer kit
	30.	optical bench
	31.	meter scale
	32.	Spectrometer
	33.	diffraction grating element
	34.	mercury vapor lamp
	35.	Emissivity measurement apparatus (The experimental set up consists of two circularaluminum plates identical in size provide with heater coils at the bottom)
	36.	Fabry-Perot Etalon
	37.	condensing lens
	38.	reading lamp
	39.	sodium lamp
	40.	X-ray source (0.2 – 2Ao i.e. white X-ray)
	41.	Single crystal (1x1x1) mm
	42.	Collimator
	43.	X-ray Photographic Films
	44.	Goniometer
	45.	Greninger charts
	46.	protractor
	47.	Liquid nitrogen (LN2)
	48.	Pyrex dish
	49.	Piece of magnet
	50.	Forceps (Tweezers)
	51.	Superconducting thermocouple
	52.	Four point probe
	53.	Digital Voltmeter and Ammeter
	54.	Superconductor pallet (Y1Ba2Cu3O6+y i. e. YBCO or Mix metal with La, Ba, and Cu)
	55.	Connecting probes
	56.	Plane transmission grating with its holder
	57.	He-Ne Laser beam (≈670 nm)
	58.	AC Adapter
	59.	spirit level
	60.	He-Ne gas laser diode
	61.	stand
	62.	screen
	63.	graph paper
	64.	Laser source of known wavelength
	65.	fine thin wire of length about 10-15 cm in length

	66.	white screen with mm scale
	67.	traveling eye-piece
	68.	lens
	69.	Dielectric constant meter
	70.	Volumetric flask (25ml)
	71.	Pipet
	72.	weighing balance
	73.	Specific gravity bottle
	74.	Quincke's tube or (U- shape tube)
	75.	Travelling Microscope
	76.	Fluxmeter with sensor
	77.	Ferric Chloride Solution (FeCl3), water etc.
	78.	Benzen, Chlorobenze, Nitrobenzene, etc.

Semester IV

PHY611: Physics - IV Practical	1.	Breadboard or PCB
	2.	Operational amplifier (e.g., LM741 or TL081, LM358, OP07, LM324, AD623, IC 741 or TL082)
	3.	Silicon diodes (e.g., 1N4148 or 1N914)
	4.	Resistors (varied values as per design)
	5.	Function generator
	6.	Digital multimeter
	7.	Dual power supply (+15 V, -15 V)
	8.	Oscilloscope
	9.	Thermocouple (e.g., Type K or Type J)
	10.	Reference Temperature Sensor (e.g., LM35 or PT100)
	11.	Resistors and capacitors (as per circuit requirements)
	12.	Dual power supply
	13.	Breadboard or PCB for circuit assembly
	14.	Soldering kit (if using PCB)
	15.	Temperature source (e.g., a heat plate or thermocouple calibrator)
	16.	Load cell (e.g., strain gauge-based)
	17.	capacitors (various values as per design)
	18.	connecting wires
	19.	DC power supply (+15V, -15V)
	20.	Weights for calibration (known mass values)
	21.	IC 7107 (Analog-to-Digital Converter)
	22.	Instrumentation amplifier (such as INA 125 or equivalent)
	23.	Operational amplifiers (for conditioning signals)

	24.	3½ Digit Seven Segment Display
	25.	Potentiometer (for calibration)
	26.	Potentiometer (linear or rotary)
	27.	Variable capacitor
	28.	Slider or rotatable arm for displacement
	29.	Microcontroller (optional, e.g., Arduino, Raspberry Pi, or equivalent)
	30.	Measurement scale or ruler
	31.	Load or displacement calibration setup
	32.	Accelerometer module (e.g., ADXL335, ADXL345, or similar)
	33.	Power supply or USB connection
	34.	Computer with necessary software for data acquisition and analysis
	35.	Analog Multiplexer IC (e.g., CD4051)
	36.	Signal Generator
	37.	Digital Storage Oscilloscope (DSO)
	38.	Resistors (Precision resistors of values like R, 2R, 4R,)
	39.	Digital Input Switches (or Microcontroller for digital input)
	40.	Bipolar Power Supply (+15V, -15V)
	41.	Diodes (e.g., 1N4148 or similar small-signal diodes)
	42.	Analog multiplier IC (e.g., AD633)
	43.	Thermistor (NTC or PTC type)
	44.	Constant temperature bath or heater
	45.	ohmmeter
	46.	Thermometer or temperature sensor
	47.	Strain gauge
	48.	Cantilever beam or strain application setup
	49.	Wheatstone bridge circuit
	50.	Load or weight set
	51.	Photoelectric devices (photodiodes, phototransistors, photocells)
	52.	Light source (e.g., a lamp or LED with variable intensity)
	53.	Optical bench or experimental setup for controlled light exposure
	54.	Lux meter (to measure light intensity)
	55.	Data Acquisition System (DAS) module
	56.	Sensors (Temperature, Pressure, Light, etc.)
	57.	Analog-to-Digital Converter (ADC)
	58.	Digital-to-Analog Converter (DAC)
	59.	Microcontroller or DAQ Card (e.g., Arduino, NI DAQ, LabVIEW)
	60.	Computer with interfacing software (LabVIEW, MATLAB, Python)

	61.	LVDT Sensor (Linear Variable Differential Transformer)
	62.	Excitation Source (AC Power Supply, typically 1–10 kHz)
	63.	Core Movement Mechanism (Micrometer or Translation Stage)
	64.	Digital Voltmeter (DVM) or Cathode Ray Oscilloscope (CRO)
	65.	Signal Conditioning Circuit (for amplification and rectification)
	66.	Ruler/Scale
	67.	Graphite sample (in powder or solid form)
	68.	Calorimeter (preferably made of copper or aluminum)
	69.	Thermometer (least count: 0.1°C)
	70.	Heater (electric heating coil) or a hot water bath
	71.	Stirrer
	72.	Weighing balance (accuracy: 0.01 g)
	73.	Beaker
	74.	Measuring cylinder
	75.	Insulating material (cotton or foam to minimize heat loss)
	76.	Testing machine (Universal Testing Machine - UTM or Tensile Testing Machine)
	77.	Elastic material sample (e.g., steel, copper, aluminum wire, or polymer strip)
	78.	Vernier caliper or micrometer screw gauge
	79.	Dial gauge or extensometer (to measure elongation)
	80.	Weight set (for applying force, if a manual test is conducted)
	81.	Load cell and digital indicator (for precise force measurements)
	82.	Graph sheet or software (to plot the stress-strain curve)
	83.	Sample material (e.g., semiconductor, metal, or alloy)
	84.	Two-probe measurement setup
	85.	Temperature-controlled furnace or heating arrangement
	86.	Thermocouple or temperature sensor
	87.	Semiconductor substrate (Silicon wafer, Glass, or GaAs)
	88.	Photoresist (Positive or Negative)
	89.	Spin Coater (for uniform coating of photoresist)
	90.	UV Exposure System (Mask Aligner)
	91.	Photomask (with microstructure patterns)
	92.	Developer Solution (for developing the exposed photoresist)
	93.	Etching Solution (for transferring patterns to the substrate)
	94.	Hot Plate (for soft and hard baking of photoresist)
	95.	Deionized Water (for cleaning the wafer)
	96.	Nitrogen Gun (for drying the wafer)
	97.	Optical Microscope (for inspecting developed microstructures)

	98.	Nanoparticle sample (e.g., CdSe quantum dots, ZnO nanoparticles, or oth er semiconductor nanomaterials)
	99.	Photoluminescence spectrometer (PL spectrofluorometer)
	100.	UV-Visible light source (e.g., xenon or mercury lamp)
	101.	Optical filters (to select specific excitation wavelengths)
	102.	Quartz cuvette (for liquid nanoparticle samples)
	103.	Spectrometer software for data acquisition and analysis
	104.	Computer for data visualization and processing
	105.	Laser excitation source (optional)
	106.	Liquid nitrogen (for low-temperature measurements, if required)

CHEMISTRY LAB

INSTRUMENTS, GLASSWARE & CHEMICALS



I. Recommended Quantities of Miscellaneous Instruments for All Semesters for Batch of 15 Students.

Sr. No	Instrument Name	Required Quantity
1.	pH meter	02
2.	Weighing balance	01
3.	Buchner Funnel	05
4.	Conductometer	02
5.	Copper electrode	02
6.	Ag/AgCl reference electrode	02
7.	Silver and calomel electrodes	02
8.	KNO_3 salt bridge	02
9.	Potentiometer	02
10.	Platinum electrode	02
11.	Colorimeter	02
12.	Cuvettes	02
13.	Polarimeter	02
14.	Hot air oven	01
15.	Dryer	01
16.	Magnetic Stirrer	05
17.	Magnetic Stirrer with hot plate	05
18.	Flame Photometer	02
19.	UV Chamber	01
20.	Distillation Unit	01
21.	IR lamp	01
22.	Dilatometer	01
23.	Thermostat	01
24.	Stopwatch	10
25.	Stalagmometer	01
26.	D.C. source (battery)	01
27.	Cadmium stick electrode	01
28.	Thermometer	10
29.	Buchner funnel	05
30.	Bunsen Burner	10
31.	Desiccator	02

II. Laboratory Requirement Semester-wise:

Semester	Course Code and Course Name	Laboratory Materials	
I	**CHE504: Lab Activities on CHE501, CHE502 & CHE503**	**Chemicals**	Sulphuric Acid, Nitric Acid, Zinc Oxide, Potassium Permanganate, Sodium Oxalate, Ammonium Hydroxide, Acetic Acid, Disodium hydrogen phosphate, Potassium Iodide, Sodium thiosulphate, Starch, Diphenyl amine indicator, Potassium Dichromate, Tin(II) Chloride, Mercury(II) Chloride, Phosphoric acid, Perchloric acid, Dolomite ore, EDTA, Ammonium chloride, Ammonium dihydrogen phosphate, Magnesium ammonium chloride, lead nitrate, Hydrogen peroxide, Sodium Hydroxide, Dimethyl glyoxime, Ammonium acetate, Ethanol Sodium acetate, Potassium Chromate, Aluminium sulphate, Oxalic acid, Potassium oxalate, Thiourea, Copper powder or turnings, Hydrochloric Acid, Chloro penta-ammino cobalt (III) chloride, Sodium nitrite, Cobaltous chloride hexahydrate,Zinc Sulphate Heptahydrate, Eriochrome Black T indicator, Methanol, Sodium Bicarbonate, Sodium Carbonate, Bromine, Ferrous Sulphate, Sodium Nitroprusside, Silver Nitrate, Chloroform, Silica powder, Charcoal, Calcium Carbonate, Methanol, Petroleum ether, Hexane, Diethyl ether Ethyl acetate, Acetone, Hydroxylamine hydrochloride, 2, 4-Dinitro phenyl hydrazine, Acetic anhydride Phenol, KCl Trichloroacetic acid, monochloroacetic acid, acetic acid, Potassium nitrate, Copper (II) nitrate, Potassium Bromate, Ferrous ammonium sulphate, Benzoic acid, p-Nitrobenzoic acid, Aspirin tablet, Phenolphthalein indicator, Glycine, Methyl red, Bromo-phenol blue, Salicylic acid, Ferric nitrate, 1,10-

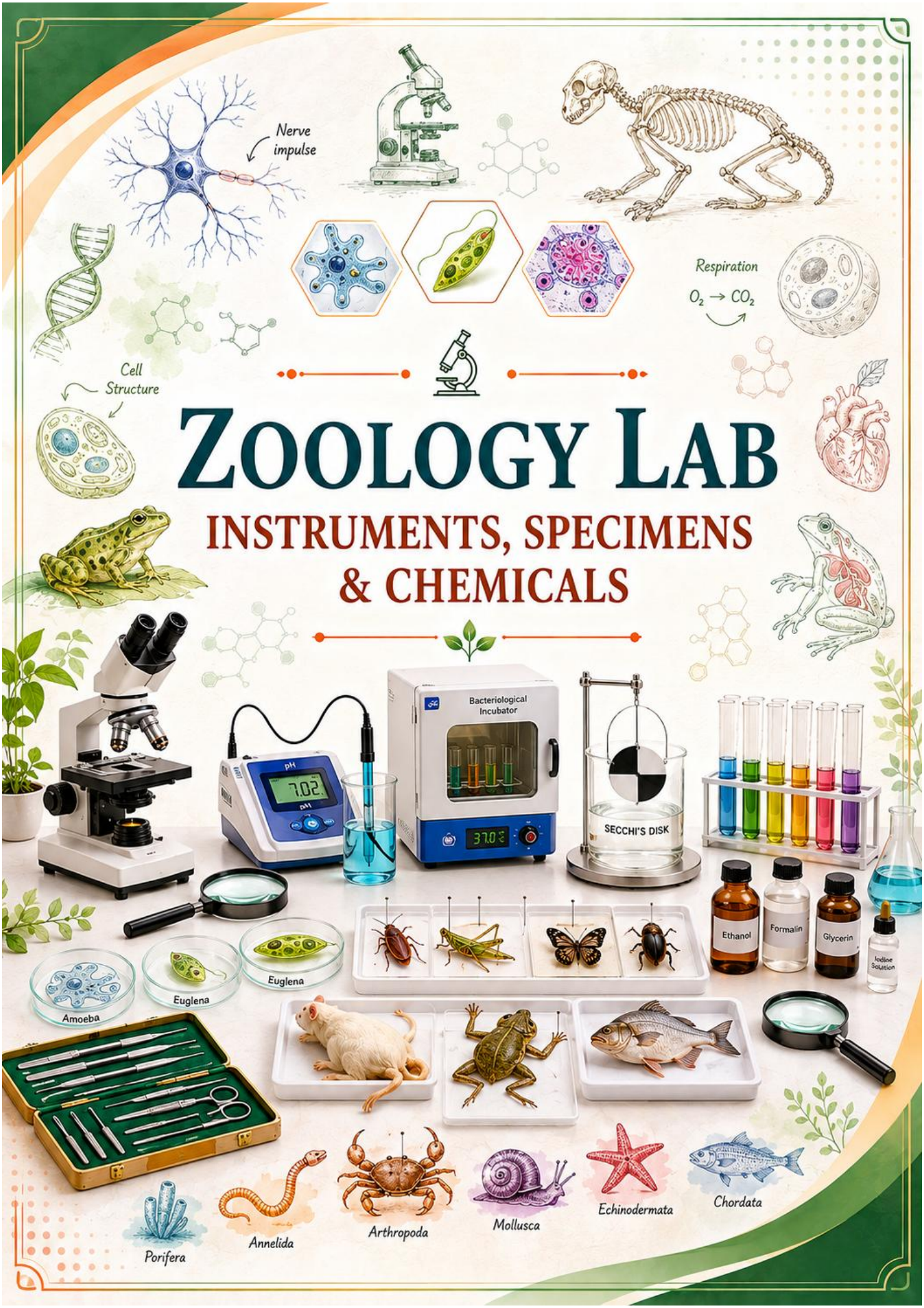
			Phenanthroline, Camphor, Benzene, Carbon tetrachloride, D-Glucose, D-Tartaric acid.
		Glassware	Stem-cut Funnel, Silica crucible, Volumetric Flask, Conical Flask, Burettes, Beakers, Wire Gauze, Test Tube, Water bath, Watch Glass, Porcelain Tile, Pipettes, Glass rods, Beakers, Gooch Crucible, Measuring Cylinder, Porcelain dish, Mortar pestle, Tripod Stand, Test tube Holder, Round Bottom Flask, Hickman Head, Water Condenser, Thermometer, Thiele's Tube, Sodium Fusion Tube, Glass Column, TLC plate, Micro burette, pH paper, Erlenmeyer/Conical flask, Whatman Filter paper No.42, Whatman Filter paper No.41, Blue litmus paper.
		Instruments	pH meter, Analytical Balance, Buchner Funnel, Weighing Balance, UV cabinet, Conductometer with Cell, Magnetic Stirrer, copper electrode, Ag/AgCl reference electrode, silver and calomel electrodes, KNO_3 salt bridge, Potentiometer, platinum electrode, Colorimeter, Cuvettes, Spectrophotometer, Polarimeter.
II	**CHE512- Lab Activities on CHE509, CHE510 & CHE511**	**Chemicals**	Sodium chloride, Potassium chloride, Calcium chloride, Hydrochloric acid, Phenolphthalein Indicator, Ammonium molybdate, Ascorbic acid, Ammonium persulfate, Sulfuric acid, Potassium iodide, Copper sulphate, Sodium thiosulfate, Starch, Boric acid, Ammonium hydroxide, Benzaldehyde Acetophenone, Sodium Hydroxide, Ethanol, Resorcinol, Ethyl acetoacetate, Methanol, Camphor, Sodium Borohydride, Benzophenone, 2-propanol, Ethyl acetoacetate, Phenyl hydrazine, Diethyl ether, ethanol, Copper sulphate, Cu-Turning, Sodium Chloride, Hydrochloric Acid, p-amino benzoic acid, Sodium nitrite, 2-Methoxy Naphthalene, Phosphorous oxychloride, Sodium

			acetate, Glycine, Benzoyl chloride, Cyclohexanol, Nitric acid, Cyclohexanone, Hydroxylamine, sodium carbonate, Petroleum ether, p-nitrotoluene, Sodium dichromate, Sodium Thiosulphate, Starch, Potassium Iodide, Phenol, Potassium Dichromate, Acetone, Glucose, Sodium Carbonate, Iodine, Stannous Chloride, Aniline, Potassium iodide, Antimony Sodium, Cinnamic acid, Benzalacetophenone, Phthalic Acid, Urea, Chlorobenzene, Nitric Acid, Diacetone alcohol, Potassium per sulphate, sodium acetate, Sodium laurylsulphate, Cadmiun Chloride, Activated charcoal, Benzoic acid, Mohr's salt, Phosphoric acid, Calcium Oxalate dehydrate, Ibuprofen Oxalic acid, Methylene blue.
		Glassware	Crucible, Beakers, Pipette, Erlenmeyer Flask, Glass rod, 100, 250,500ml Volumetric Flask, Hard glass test tube, Tripod Stand, Funnel, Rubber cork, Conical Flask, TLC plate, Watch glass Round Bottom flask, Air Condenser, Capillary tube, Water Condenser, Burette, Two necked Round Bottom Flask, Porcelain dish, Thiel's tube, Stopper bottles, density bottle, Rubber tube.
		Instruments	Calorimeter, Weighing Balance, Magnetic Stirrer, pH meter, Flame Photometer, Spectrophotometer, Cuvettes, Colorimeter, Potentiometer Conductometer, IR lamp, Dilatometer Thermostat, stop-watch, Stalagmometer Cadmium stick electrode D.C. source (battery), Platinum electrode, Thermometer.
		Chemicals	Benzaldehyde, Acetophenone, Sodium Hydroxide, Ethanol, Sulphuric Acid, Resorcinol, Ethyl

III	**CHE604: Lab Activities on CHE601, CHE602 & CHE603**		acetoacetate, Methanol, Camphor, Sodium Borohydride, Benzophenonem,2-propanol, Methanol, Ethyl acetoacetate, Phenyl hydrazine, Diethyl ether, Copper sulphate, Cu-Turning, Sodium chloride, Hydrochloric Acid, p-amino benzoic, cid, Sodium nitrite, 2-Methoxy Naphthalene, Phosphorous oxychloride, Sodium acetate, Glycine, Benzoyl chloride, Cyclohexanol, Nitric acid, Cyclohexanone, Hydroxylamine, Petroleum ether, Phthalic anhydride Urea, Bromine, Potassium Hydroxide , Glacial acetic acid, Nitrobenzene, Iron filings, Sodium hydroxide, Aniline, Sodium iodide, Nitric acid, Diethyl ether, Sodium borohydride, Isopropyl alcohol, Sodium sulphate, Magnesium sulphate, O-phenylenediamine, Formic acid (90%), Calcium hydroxide, Ethanol, Phenolphthalein, Sodium, carbonate, Anhydrous sodium sulphate, Ethyl acetate, Activated charcoal, Dichloromethane, Hexane, petroleum ether, Silica gel, Ethyl acetate,Methanol, Dichloromethane, Acetone, Acetanilide, Potassium bromide, Ceric ammonium nitrate, Benzil, Benzophenone, Iso-Propanol, Glacial Acetic Acid, Benzaldehyde, Lithium Hydroxide, Ethyl acetoacetate, Salicylic Acid, Acetic anhydride, Phosphoric Acid, Sodium Bicarbonate, P-Nitroaniline, Copper(I) Chloride, Sodium Metal, Sodium ethoxide, Potassium Iodide, Starch, Iodine, Potassium Permangante, EDTA, Erichrome Black-T, Tartaric Acid.
		Glassware	Hard glass test tube, rubber cork, Glass rod, tripod stand, Separating Funnel, TLC plate, Thiel's Tube, Capillary tube, Sodium fusion tube, Conical Flask, Beaker, Water bath, R. B. flask, Reflux condenser water condenser, Evaporating dish, Petri dish, pH paper.

		Instruments	IR lamp, Magnetic Stirrer with hot plate, Buchner funnel, thermometer, UV lamp Rotary evaporator, Soxhlet extractor, Weighing balance, Mortar and pestle, Distillation apparatus.
IV	**CHE611 - Lab Activities on CHE609 & CHE610**	**Chemicals**	Sodium Bicarbonate, Sodium Hydroxide, Hydrochloric Acid, Potassium Permanganate, Ferric Chloride, Ferrous sulphate, Sodium nitroprusside, Nitric Acid, Silver Nitrate, Phthalic anhydride, Sodium Nitrate, Sulphuric Acid, Ethanol, Phenolphthalein, Hydroxylamine hydrochloride, Zn dust, Ferrous ammonium Sulphate, β- Naphthol, Calcium Chloride, Ferrous Sulphate, Carbon Tetrachloride, Cobalt(II) Nitrate, 2,4 Di-nitrophenyl hydrazine, Iodine, Benzene, Chloroform, Aluminium Chloride, Potassium Dichromate, Acetic acid, Acetone, Silica Powder, Hexane, Ethyl acetate, Nitrobenzene, Benzophenone, Anhydrous ether, Thionyl chloride, Phosphorus penta chloride, Phthalic anhydride, Urea Succinic anhydride, Resorcinol, Ethyl acetoacetate, Glacial acetic acid, Cyclohexanone, Phenyl hydrazine, 4-chloronitrobenzene, N,N-Dimethyl Formamide, Tetrahydrofuran, Ammonium Chloride, Dichloromethane, Sodium Sulphate, Potassium Tert-Butoxide,2-propanol, Ferric Chloride, Hexahydrate, Hydrazine hydrate, Acetic anhydride, p-ethoxyaniline, triethylamine, Phenolphthalein, Antimony Sodium, Sodium thiosulphate, Bromine, Starch, Copper sulphate, Benzophenone, Isopropyl alcohol, Glasical acetic acid, p-nitrotoluene, Sodium dichromate, Anisole, Nitric acid, Phthalic anhydride, Phthalimide, Hypobromite, Acetanilide, p-Bromoacetanilide, Sodium sulphide, Sodium bicarbonate, m- dinitrobenzene, Methanol, Cyclohexanone, Sodium

			bisulfate, Benzophenone, Zinc dust, Anthracene, Chromium trioxide, Chloro benzene, 2, 4-dinitrochlorobenzene, Caustic soda, Phenyl hydrazine, Ethyl acetoacetate, Anhydrous sodium acetate, Acetic anhydride, 4-chlorobenzaldehyde, Potassium hydroxide, Sodium bicarbonate, Sodium chloride, Sodium dried thiophene, Succinic anhydride, Anhydrous aluminium chloride, Benzaldehyde, Methylated spirit, Copper sulphate, p-amino benzoic acid, Sodium nitrite, Dimethylformamide, Phosphorus oxychloride, Dimethylaniline, Sodium acetate, Methyl acetate, Potassium Sulphate, Lead Nitrate, Copper sulphate, Cadmium chloride, n-Butanol, Dithizone, Barium Chloride, Dimethyglyoxime, Potassium Thiocyanate.
		Glassware	Litmus paper, Beaker, Glass rod, Test tube, Test tube stand, Porcelain dish, Thiel's Tube, Capillary tube, Sodium fusion tube, evaporating dish, thermometer, Glass column, TLC plates Glass chamber, Round bottomed flask, conical flask, Sand bath, Water bath, Erlenmeyer flask, Condenser, Measuring cylinder, Separatory funnel.
		Instruments	Distillation apparatus, Buchner funnel, Magnetic stirrer, UV lamp.


Nerve impulse
Respiration
$O_2 \rightarrow CO_2$
Cell Structure
ZOOLOGY LAB
INSTRUMENTS, SPECIMENS & CHEMICALS
Bacteriological Incubator
pH
7.02
37.0
SECCHI'S DISK
Ethanol
Formalin
Glycerin
Iodine Solution
Amoeba
Euglena
Euglena
Porifera
Annelida
Arthropoda
Mollusca
Echinodermata
Chordata

V155: M.Sc. (Zoology) {2023 Pattern}

I. Recommended Quantities of Miscellaneous Instruments for All Semesters for Batch of 15 Students.

Sr. No	Instrument Name	Required Quantity
1.	UV Spectrophotometer	01
2.	Colorimeter	01
3.	Dissecting Microscope	10
4.	Compound Microscope	10
5.	Hemoglobinometer	05
6.	Hemocytometer	05
7.	Deep Freezer	01
8.	Cooling Micro Centrifuge	01
9.	Distillation Unit	01
10.	Variable Type Power Pack	01
11.	Mini Vertical Gel Electrophoresis	01
12.	Mini Horizontal Gel Electrophoresis	01
13.	Magnetic Stirrer	01
14.	Vortex Mixer	01
15.	pH Meter	02
16.	Micro Pipette Variable	03
17.	Refrigerator	01
18.	Autoclave	01
19.	Dissecting Tray	05
20.	Ocular Stage Micrometer	10
21.	Hot Plate	01
22.	Hot Air Oven	01
23.	Bacteriological Incubator	01
24.	Microtome (With All Accessories)	01
25.	Hot Water Bath	01
26.	Weighing Balance	01
27.	Respirometer	01
28.	Secchi Disk	01
29.	Laminar Air Flow	01
30.	Stopwatch	02
31.	Magnifying Glass	02
32.	Thermometer	02

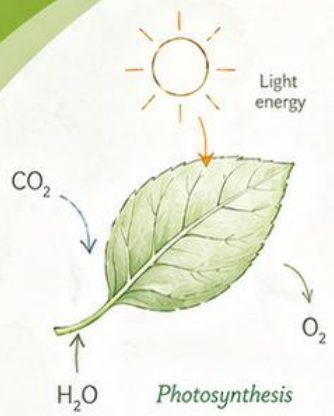
33.	UV Trans Illuminator	01
34.	Sphygmomanometer	01
35.	Cell Culture or CO_2 Incubator	01

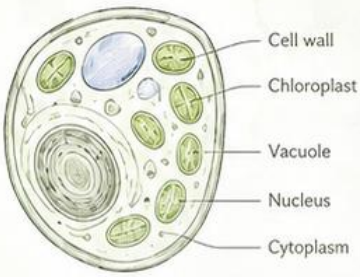
II. Laboratory Requirement Semester-wise:

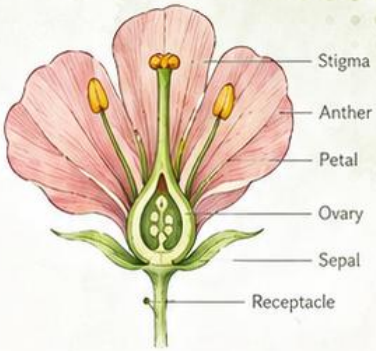
Semester	Course Name	Category	Details
I	**ZOO504: Lab on Biochemistry, Cell Biology & Applied Zoology Part-I**	**Specimen / Chart / Samples**	Saliva, Onion root tips, Human blood, culture of *Amoeba proteus*, Live Specimens - *Anopheles*, *Culex*, *Aedes*, Housefly, Live Silkworms - Tasar, Eri and Muga etc.
		Glassware	Standard flask, Test Tubes, Beaker, Dropper, Graduated Pipette, 96 well flat-bottom plate, polycarbonate tubes, Wheaton Type B, Cover Slips, Watch Glass, Blade, Brush, Blotting Paper, Spirit Lamp, Sterilized Pin/Lancet, Cotton etc.
		Chemicals	Bovine serum albumin (BSA), cupric sulphate, Sodium potassium tartrate, Potassium iodide, vanilline powder, sulphuric acid, Chloroform, methanol, sodium chloride, phosphoric acid, cholesterol, Trichloro acetic acid, Sodium hydroxide, Ninhydrin, acetate buffer, Standard amino acid, HCL, Anthrone, H_2S0_4, D. glucose, Starch, Standard Iodine, Phosphate buffer, $NaH_2PO_4.H_2O$, Nicotinamide adenine dinucleotide (NADH), Sodium pyruvate, Lactate dehydrogenase, Mitochondria Isolation Kit, sucrose, EDTA, Hepes-NaOH, KCl, $MgCl_2$, Ethanol, Mannitol, Glacial acetic acid, carmine, Acetocarmine, Leishman's stain, Glycerin, Alcian blue, Sodium azide, Petroleum jelly, Glutaraldehyde (fixative), Osmium tetroxide (stain), Ethanol (dehydrating agent), Epoxy resin (embedding medium), Uranyl acetate (contrast stain) etc.
		Instruments	Spectrophotometer, hot water bath, Centrifuge, Tissue homogenizer, colorimeter, Spectrophotometric multiwell plate reader, Refrigerator, Low-speed refrigerated centrifuge, swinging-bucket rotor, Dounce homogenizer, Ultracentrifuge, Transmission Electron Microscope, ultra-microtome, Specimen grids, Tweezers,
II	**ZOO512:**	**Samples/ Kit**	DNA extract from *E.coli*, goat liver, Bacterial culture, plasmid DNA isolation kit, Bacterial cell culture containing plasmid etc.

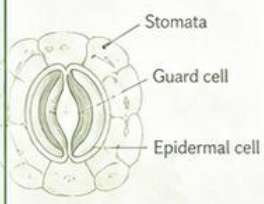
	Lab on Molecular Biology, Genetics & Applied Zoology Part-II	**Instruments**	Cuvette, Tabletop centrifuge, 1.5 ml Eppendorf tube, Centrifuge tubes, UV spectrophotometer, Electrophoretic unit, UV trans illuminator, Microwave Oven, Water Bath, Incubator, Cooling Centrifuge, vertical gel electrophoresis apparatus, power pack etc.
		Chemicals	Agarose, 6x staining dye, 50x TAE, Ethanol, Saline, EDTA, NaCl, SDS, phenol, ethanol, DNA Isolation Kit, TE Buffer, Proteinase K, chloroform, RNAase, Luria Broth, Isopropanol, Luria Bertani medium, Bactotryptone, Bacto Yeast extract, Sodium Chloride, Tris Cl, Glucose, K acetate, Glacial acetatic acid, RNA isolation kit, Trizol, β Mercaptoethanol, bromophenol blue, Acrylamide, bis acrylamide, APS, coomassie brilliant blue R^{250}, methanol, Tris, Blood groups testing kit etc.
III	**ZOO604: Lab on Immunology, Endocrinology and Biodiversity & Conservation**	**Specimen / Samples**	Permanent slides: Lymphoid Tissue - Spleen, Thymus, Lymph Node, Bone Marrow, Permanent slide of Endocrine glands (Pituitary, Thyroid, Parathyroid, Thymus, Adrenal, Pancreas, Ovary & Testis And Uterus), pasteurized milk, UHT pasteurized milk etc.
		Instruments	Microscope, Centrifuge, Incubator, pH meter, Balance, Electrophoresis Unit, Power supply, Gel documentation system, Adequate fume hoods or ventilation systems, Cell culture incubator (37°C, 5% CO_2), Liquid scintillation counter, Weighing Balance, Incubators, Spectrophotometer, homogenizer with Teflon pestle and Warburg apparatus, Secci Disk, Jacksons Candle Turbid meter, Ekman's Dredger etc.
		Glassware	Test Tubes, Micro titer Plates, Pipettes, Disposable Gloves, Beakers, Stirring rod, glass rod, Pipettes, Filter paper, funnel, Safety goggles, gloves, Lab coat, Sterile culture plates, pipette tips, culture plates, Sterile syringes, needles, 96-well tissue culture plates, Whatman filter paper no.4, BOD bottle, Nylon or Jute ropes, Petri dishes, Sterile applicators (swabs) etc.
		Chemicals	Reagents, Buffers or Diluents, Agglutination Test kit, pH paper, Silver nitrate solution ($AgNO_3$), Sodium chloride solution (NaCl), Agarose or Polyacrylamide gel, Antibodies and Antigen samples, Staining solution, Distaining solution, Ficoll-Paque or similar density gradient medium, culture medium, PBS, Dulbecco's Modified Eagle Medium (DMEM),

			RPMI 1640 medium, Fetal bovine serum (FBS), Trypan blue, Heparin, EDTA Mitogens (e.g., PHA), [3H]-Thymidine (radioactive isotope), Scintillation fluid, 2, 3, 5-dinitrosalicylic acid, sodium hydroxide, benzoic acid, glucose, Ammonium oxalate, Ammonia, Potassium permanganate, oxalic acid, Sulphuric acid, Magnus sulphate, Alkaline iodide azide, Sodium thiosulphate, Suphuric acid, Starch indicator, nutrient agar etc.
IV	**ZOO611: Lab on Animal Physiology & Ichthyology**	**Specimen / Chart / Samples**	blood sample, Urine sample, mice, Pancreas perfusion and islet isolation, Chart / specimen (Catla, Rohu, Mrigala and Pomfret) etc.
		Glassware	Neubauer counting chamber, Cover glass, WBCs Pipette, mixing chamber, aspiration tube (rubber sucking tube), Capillary, RBC pipette, Watch glass, Haemoglobinometer, Hb pipette, Test tube, Glass rod, Dropper, Glass slides, coplin staining jar, Fine capillary glass tubes, Aquarium jar, beakers, Erlenmeyer flask, Graduated cylinder, Glass dishes/ bowls etc.
		Chemicals	Turkey's Solution, RBC diluting fluid (Hayem's fluid), HCl, Distilled water, Alcohol, Immersion Oil, Leishman Stain, Cedarwood oil, acetic acid, Na_2CO_3, Urease powder, Measuring cylinder, Phenol red indicator, Penicillin, Streptomycin, Collagenase, Glucose, Krebs-ringer buffer, KCl, Hand sanitizer, KHO,
		Instruments	Microscope, Compound microscope, Portable lactate meter, Lactate sensors, Stop watch, Digital Blood Pressure monitor or sphygmomanometer, Lense, Stethoscope, Blood pressure cuff, Probes, Dissecting microscope, squirt bottle, stereomicroscope etc.
		Other materials	Cotton, Lancet, Sterile gauze piece, cotton swabs, Filter paper, Spatula, Dissection box or material, Taxonomic /Identification Key, Dissecting trays or cutting boards, Rubber stopper, Para film or plastic wrap, Deionized Water, Ruler to measure fish size, fine-tipped forceps, Dissecting scissors, Scalpel etc.



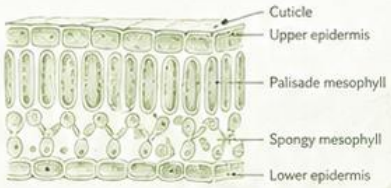






BOTANY LAB

EQUIPMENTS, SPECIMENS & CHEMICALS



V156: M.Sc. (Botany) {2023 Pattern}

I. Recommended Quantities of Miscellaneous Instruments for All Semesters for Batch of 15 Students.

Sr. No.	Instrument Name	Quantity
1.	Compound Microscope	10
2.	Dissecting Microscope	5
3.	Hand Lens (10x–20x)	2
4.	Autoclave	1
5.	Laminar Air Flow Cabinet	1
6.	Growth Chamber	1
7.	Incubator	1
8.	Hot Water Bath	2
9.	Hot Air Oven	1
10.	Spectrophotometer	1
11.	Colorimeter	1
12.	Centrifuge	1
13.	Hemocytometer	1
14.	pH Meter	2
15.	Digital Weighing Balance	2
16.	Rotary Evaporator	1
17.	Vortex Mixer	1
18.	Microtome	1
19.	TLC Chamber	2
20.	Distillation Apparatus	1
21.	Soxhlet Extraction Apparatus	1
22.	Reflux Apparatus	1
23.	Air Condenser	1

24.	Desiccator	2
25.	Bunsen Burner	2
26.	Seed Germinator	1
27.	Seed Cleaner	1
28.	Seed Grader	1
29.	UV Lamp	2
30.	Filtration Apparatus (Buchner Setup)	2

II. Laboratory Requirement Semester-wise:

Semester	Course Code & Course Name	Category	Details
I	**BOT504: Lab Activities on BOT501, BOT502 & BOT503**	**Specimens / Plant Materials**	Soil, Papaya infected leaf, Infected leaves of tobacco plant, *Riccia* thallus, Infected plant material (root) Cauliflower, *Rhizopus,* infected material or culture, Lichen Wheat and Rice Straw, mushroom spawn (seed), gram flour, wheat grains, Infected potato plant
		Instrument/ Equipments	Lenses, Compound Microscope, Electron microscope, herbarium sheet, thread, needle, and herbarium chamber, Autoclave, Laminar air flow cabinet (aseptic chamber), Culture racks, Culture room, Dark room, Gas burner, Filters and Sieves, Growth Chambers
		Chemical / Reagents	Distilled Water, Culture medium, Agar, hoe, string, alcohol, Stains, sclerotia, cotton blue stain, saffranine and light green stains, acetone, 0.1 N Hydrochloric acid Magnesium carbonate powder
		Glassware & Other material	Slides, Cover Slips. Beakers, Test tubes plastic bags, razor, forcep, Pipettes, Petri plates, Plasticware, and Utensils, paint brush, culture plates, needle etc.

II	**Lab Activities on BOT509, BOT510 & BOT511**	**Specimens / Plant Materials**	Spinach leaves (*Spinacia olerecia*)**,** *Bacopa monnieri, Centella asciatica, Tinospora cordifolia, Garcinia indica, Eclipta alba, Gymnema sylvestris, Cymbopogon citrate, Vetiveria zizanioides, Coleus forskohlii, Piper longum, Phyllanthus amarus, Cassia angustifolia (Tiruven vellisenna), Morinda citrifolia (Noni), Andrographis paniculata*, and *Stevia reboudiana*
		Instrument/ Equipments	Hand lens, Magnifying glass, Dissecting microscope, Ruler, callipers, scissors, Compound microscope etc.
		Chemicals	Distilled water, 80% acetone, DMSO (Dimethyl sulphoxide), Copper Sulphate, Sodium Potassium Tartarate, and Sodium Hydroxide; Potassium Iodide and Sodium Hydroxide, BSA, Ninhydrin ethanol, leucine, TRIS, pH 8 (buffer), PMS/INT/NAD, Lactic Acid (substrate) Lactate dehydrogenase ammonia, propan-2-ol, aluminium foil, ninhydrin spray (2% solution of ninhydrin in ethanol), glycine, tyrosine, leucine and aspartic acid, HCI, Methanol, Petroleum Ether hydrofluoric acid (10%), Nitrocellulose solution, Cellulose acetate film Oxidizing agent.
		Glassware & Other material	Gloves, Microscope slides, cover slips, forceps, scalpel, Dissection tray or dissecting board, lab coats,
III	**Lab Activities on BOT601, BOT602 & BOT603**	**Specimens / Plant Materials**	*Citronella sp.* Leaves, Plant samples subjected to salt stress, Legume root samples, Magnoliaceae species. Botanical specimens of organized plant drugs (e.g., roots, leaves, stems) Botanical specimens of unorganized plant drugs (e.g., gums, resins, latex)

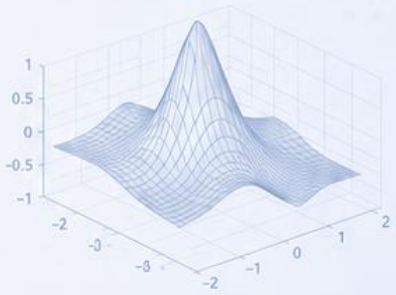
		Instrument/ Equipments	Microscope, Centrifuge, Hemocytometer Rotary evaporator, Analytical balance, Spectrophotometer, Nitrogen gas source Water bath, Vortex mixer, Pipettes and micropipettes, pH meter, Incubator, Cuvettes Analytical balance, Hotplate/stirrer Reflux apparatus, Air Condenser, Spectrophotometer Liquid chromatography equipment, Centrifuge, Extraction apparatus (Soxhlet extractor or similar) Chromatography equipment (HPLC or GC-MS) TLC plates, Developing chamber, , Solvent system (mobile phase), UV lamp or suitable visualization method, Silica dish (100ml cap.), Chemical balance- 1mg sensitivity, Hot plate or burner, Muffle furnace Desiccator
		Chemicals	Staining reagents, Distilled water, sodium/potassium phosphate buffer, pyridine, Sodium dithionite: Potassium Hexacyano ferrate, bile salts (Sodium taurocholate), acetone, ether, acetone powder Sodium hydroxide (NaOH) solution, Potassium hydroxide (KOH) solution, ethanol, Starch solution, Iodine solution, Fatty acid sample (oil), Hydrochloric acid 0.5 N, KOH Phenolphthalein indicator, methanol, Aluminium chloride ($AlCl_3$), Sodium acetate, Rutin (standard for calibration curve), Distilled water, Sodium nitrite, Aluminum Chloride, sodium hydroxide Quercetin, Sulfosalicylic Acid, Ninhydrin, chloroform), solanine, acetic acid, NH_4OH, ethanol, Na_2SO_4, formaldehyde, H_2SO_4 Ruthenium red, Iodine, Acetic acid, Phloroglucinol, conc. HCl (1:1), strong KOH, Sudan red-III.
		Glassware & Other material	Beakers, flasks, Burettes, test tubes, Mortar and pestle, Separatory funnel, Capillary tubes, Ruler or calipers.
IV	**Lab Activities on BOT609 & BOT610**	**Specimens / Plant Materials**	Plant Material List (Examples from Families): Fresh or preserved specimens representing each family: *Acer* species – Leaves, samara fruits (if available) Combretaceae: *Terminalia catappa* or *Terminalia arjuna* – Leaves, flowers *Quisqualis indica* (Rangoon creeper) – Flowering twigs Umbelliferae: (Apiaceae) *Coriandrum sativum* (Coriander) – Whole plant

			Foeniculum vulgare (Fennel) – Leaves and flowers Seed samples (e.g., wheat, rice, maize, soybean, bean, pea) Seed lots (e.g., wheat, paddy, sunflower, soybean) Myrtaceae: *Psidium guajava* (Guava) – Leaves, flowers *Eucalyptus globulus* – Leaves, floral buds Meliaceae: *Azadirachta indica* (Neem) – Leaves, flowers *Melia azedarach* – Leaves, inflorescence Sapindaceae: *Sapindus mukorossi* (Soapnut) – Leaves, fruits, Seeds of cereal FYM(Farm Yard Manure)
		Charts/ Graph	Observation sheets Pencil/pen Graph paper, Reference charts for Linnaeus and Bentham & Hooker classification, Colored pencils and Preserved plant specimens or live samples from key angiosperm groups
		Instrument/ Equipments	Hand Lens (10x–20x) Dissecting Microscope, Grinding Mill, Gamet divider Boerner divider Riffle (chute) divider Centrifugal (spinning) divider Germinators with thermometers: Seed cleaner (air screen cleaner), Specific gravity separator Seed grader (sieve sets), Hot air oven Moisture-proof containers , Weighing balance (sensitive up to 0.01 g), Calculator, Seed mixer (rotary, cone type) Polythene bags, cloth bags Hand scoop, shovel, Mixing pans, trays, Moisture-proof containers with lids (metal, glass) Desiccator, Tongs, heat-resistant gloves Petri dishes, germination trays Filter paper, cotton wool Thermometer, Crucible, aluminium dish Light source, Measuring scoop or spatula Incubator, growth chamber.
		Chemicals	Glycerine, FAA, Safranin, Sudan III stain, Iodine solution, Biuret reagent Concentrated sulfuric acid (H_2SO_4) Alcohol (70-90%), Tetrazolium chloride (TZ), Silica gel, Carbendazim
		Glassware & Other material	Needles and Forceps, Scalpel or Razor Blade, Glass Slides and Cover Slips, Watch Glasses / Petri Dishes, Droppers Seed blower, and Brushes Blotting Floral Diagrams Bunsen burner or spirit lamp Notebook and Pencil for Drawing and Floral Formula Chart / Reference Book Paper / Tissue Paper, Mounted Needle / Seeker, Filter paper, Absorbent paper, Seed storage bags or containers

$$\int_a^b f(x)\,dx$$

$$A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$$

$$\sum_{i=1}^{n} i$$



MATHEMATICS LAB



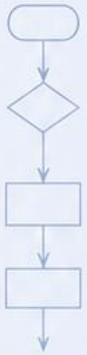
```
import numpy as np
import matplotlib.pyplot as plt

x = np.linspace(0, 2*np.pi, 400)
y = np.sin(x)

plt.plot(x, y)
plt.grid(True)
plt.show()
```

SOFTWARES AND PROGRAMMING LANGUAGES





Python | MATLAB | Scilab | SageMath | MS-Excel with Copilot

```
\documentclass{article}
\usepackage{amsmath}

\begin{document}

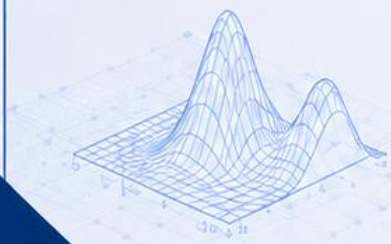
  Euler's Identity:
  $e^{i\pi} + 1 = 0

\end{document}
```

LaTeX | GeoGebra | C | R

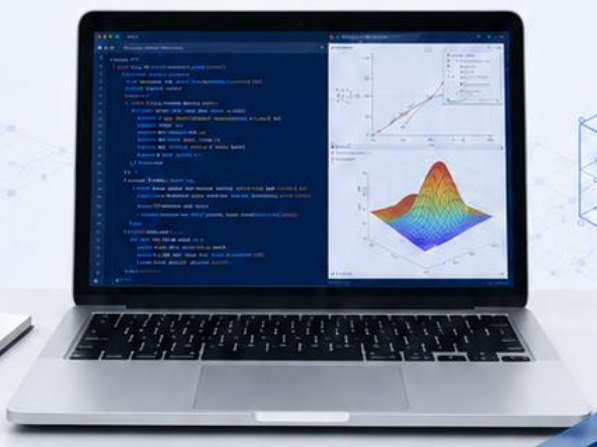
```
x <- c(1,2,3,4,5)
y <- c(2,4,5,4,3)
plot(x, y, type='b')
```











V157: M.Sc. (Mathematics with Computer Applications) {2025 Pattern}

I. Recommended Quantities of Miscellaneous Instruments for All Semesters for Batch of 15 Students.

Semester	Course Code & Name	Equipment/ Instrument/ Software/ Programming Language
	Computer Lab of 15 Computers with:	
I	MAT611: Programming in Python	1) Python - Programming Language (Open source)
II	MAT512: LaTeX & Programming in SageMath	1) LaTeX - TeXstudio, Overleaf, or MiKTeX. (Open source) 2) SageMath - Software (Open source)
III	MAT618: Practical on AI and ML	1) Python - Programming Language (Open source)
IV	MAT623: SQL for Data Science	1) MySQL – Database Management System (Open source)