University of Pune

Three Year B. Sc. Degree Course in Electronic Science

Subject: Electronic Equipment Maintenance (Vocational)

1) Title of the Course:

F.Y.B.Sc. Electronic Equipment Maintenance (Vocational)

(To be implemented from Academic Year 2013-14)

(A Vocational Subject under the UGC Scheme of Vocationalization at First Degree Level)

2) Preamble:

The systematic and planned curricula from first year to the third year are aimed at focusing attention to the skills required for practicing the subject of Electronic Science. This is expected to make the student become more confident in working and shall motivate and encourage the student for pursuing higher studies in Electronics and for becoming self-employed.

3) Introduction:

At **first year of under-graduation** the basic topics related to the Electronic equipment, maintenance concepts, electronic system building blocks, components, assembly techniques are dealt with. The practical course is designed to emphasize practical skills required for circuit building, testing and trouble-shooting.
At **second year under-graduation**: The level of the theory and practical courses shall be one step ahead of the first year B.Sc. Courses based on content of first year shall be introduced.
At **third year under-graduation:** Two theory papers in each semester will appear as optional papers as part of B. Sc. Electronic Science. Proportionate number of laboratory exercises will be included in the laboratory course.

Objectives:

- To provide in-depth knowledge of technological aspects of electronics
- To familiarize with current and recent technological developments
- To enrich knowledge through programmes such as industrial visits, hobby projects, market survey, projects etc.
- To train students in skills related to electronics industry and market.
- To create foundation for perfecting practical skills in Electronics
- To develop analytical abilities towards real world problems
- To help students build-up a progressive and successful career in Electronics

4) Eligibility:

1 **First Year B.Sc.:** Higher Secondary School Certificate (10+2) Science stream or its equivalent Examination as per the University of Pune eligibility norms.

2 **Second Year B.Sc.:** Keeping terms of First Year of B. Sc. with Electronic Science as one of the subjects. Other students if they fulfill the conditions approved by the

equivalence committee of Faculty of Science of the University of Pune are also eligible.

3 **Third Year B. Sc.:** Student shall pass all First Year B. Sc. courses and satisfactorily keeping terms of Second Year of B. Sc. with Electronic Science as one of the subjects.

Note: Admissions will be given as per the selection procedure / policies adopted by the respective college, in accordance with conditions laid down by the University of Pune. Reservation and relaxation will be as per the Government rules.

5 A) Examination Pattern:

First Year B. Sc. Electronic Science

Pattern of Examination: Annual

Theory courses (VOC-EEM-101): Annual (VOC-EEM-102): Annual

Practical Course (VOC-EEM-103): Annual

Paper/ Course No.	Title	Total Number of lectures/practicals per Term	Standard of passing		
			Internal marks out of **20**	External marks out of **80**	Total marks out of **100**
Theory Paper I (VOC-EEM-101) (First term)	Maintenance Concepts, Instruments and Appliances	Three lectures/Week (Total 36 lectures per term)	08	32	40 *
Theory Paper I (VOC-EEM-101) (Second term)	Electronic Components, Circuit and Equipment Assembly	Three lectures/Week (Total 36 lectures per term)			
Theory Paper II (VOC-EEM-102) (First term)	Maintenance Concepts, Instruments and Appliances	Three lectures/Week (Total 36 lectures per term)	08	32	40 *
Theory Paper II (VOC-EEM-102) (Second term)	Electronic Components, Circuit and Equipment Assembly	Three lectures/Week (Total 36 lectures per term)			

Practical Paper III (VOC-EEM-103) (First & Second Term)	Practical	10 Practicals of 4 lectures in each term (20 practicals / year)	08	32	40 *

* Subject to compulsory passing in external examination and getting minimum 40 marks out of 100

Notes:

1. Total marks: Theory (100 + 100) = 200 marks
2. Total marks per year 200 (Theory) + 100 marks (practicals) = 300 marks
3. Internal marks for theory papers given on the basis of internal assessment tests and for practicals on internal assessment tests + journals + attendance + study visit reports/ market survey/ hobby projects etc.

Theory examination will be of three hours duration for each theory course. There shall be 5 questions each carrying equal marks. The pattern of question papers shall be:

Question 1	8 sub-questions, each of 2 marks; answerable in 2 -3 lines and based on entire syllabus
Question 2, 3 and 4	4 out of 6– short answer type questions; answerable in 8 – 10 lines
Question 5	4 out of 6 – problem type question; answerable in numerical or analytical fashion or circuit/logic diagrams

Internal examination: Internal assessment of the student by respective teacher will be based on written test, 10 marks each term. The written test shall comprise of objective type questions – Multiple Type Questions, True / False, Definitions, Answer in Two or three line question (Describe/Explain).There shall be 20 questions.
Practical: one internal assessment test + marks for journals + attendance + activity.

Practical Examination: Practical examination shall be conducted by the respective college at the end of the academic year. Practical examination will be of 6 hours duration (2-Sessions). Certified journal is compulsory to appear for practical examination. There shall be two expert and two examiners per batch for the practical examination.

Second Year B. Sc. Electronic Science

Pattern of examination: Semester

Theory courses (Sem I: VOC-EEM211 and VOC-EEM212): Semester

(Sem II: VOC-EEM221 and VOC-EEM222): Semester

Practical Course (VOC-EEM223): Annual

Paper/ Course No.	Title	Total Number of lectures/practicals Per Semester	Standard of passing		
			Internal marks out of 10 (theory) Out of 20 (practicals)	External marks out of 40 (theory) Out of 80 (practicals)	Total passing marks out of 50 (theory) and out of 100 (practicals)
Theory Paper I (VOC-EEM 211)	**Paper I**	Four lectures/Week (Total 48 per Semester)	04	16	20 *
Theory Paper II (VOC-EEM 212)	**Paper II**	Four lectures/Week (Total 48 per Semester)	04	16	20 *
Theory Paper I (VOC-EEM 221)	**Paper I**	Four lectures/Week (Total 48 per Semester)	04	16	20 *
Theory Paper II (VOC-EEM 222)	**Paper II**	Four lectures/Week (Total 48 per Semester)	04	16	20 *
Practical paper III (VOC-EEM 223) (First & Second Semester)	**Paper III**	12 Practicals of 4 lectures in each Semester (24 practicals / year)	08	32	40 **

* Subject to compulsory passing in external examination and getting minimum 20 marks out of 50

** Subject to compulsory passing in external examination and getting minimum 40 marks out of 100

Notes:

1. Total marks: Theory for each semester (50 + 50) = 100 marks
2. Total marks per year 200 (Theory) + 100 marks (practicals) = 300 marks
3. Internal marks for theory papers given on the basis of internal assessment tests and for practicals on internal assessment tests + journals + attendance + study visit reports/ market survey/ hobby projects etc.

Theory examination will be of two hours duration for each theory course. There shall be 4 questions each carrying marks as per the table. The pattern of question papers shall be:

Question 1	4 sub-questions, each of 1 marks and 4 sub-questions, each of 2 marks on entire syllabus	12 marks
Question 2 and 3	2 out of 3 sub-questions, each of 4 marks; short answer type questions; answerable in 8–10 lines	8 marks each
Question 4	2 out of 3 sub-questions, each of 6 marks; long answer type questions (12-16 lines), problems, circuit/logic diagrams and designs	12 marks

Internal examination: Internal assessment of the student by respective teacher will be based on written test, 10 marks each Semester. The written test shall comprise of objective type questions – Multiple Type Questions, True / False, Definitions, Answer in Two or three line question (Describe/Explain) There shall be 20 questions.
Practicals: one internal assessment test + practical journal + attendance + activity
Practical Examination: Practical examination shall be conducted at the respective college at the end of the academic year. Practical examination will be of 6 hours (2-Sessions) duration. Certified journal is compulsory to appear for practical examination. There shall be one expert and two examiners per batch for the practical examination. One of the examiners will be external.

Third Year B. Sc. Electronic Science

Pattern of examination: Semester

Theory courses:
(Sem III: VOC-EEM335-VOC-EEM336): Semester (Sem IV: VOC-EEM345-VOC-EEM346): Semester
Practical Course:
(VOC-EEM347-VOC-EEM349): Annual

Theory Papers					
Paper/Course No.	Title	Total Number of lectures Per Semester	Standard of passing		
			Internal marks out of 10 (theory) Out of 20 (practicals)	External marks out of 40 (theory) Out of 80 (practicals)	Total passing marks out of 50 (theory) and out of 100 (practicals)
SEM III					
VOC-EEM-335	Paper V	48	4	16	20*
VOC-EEM-336	Paper VI	48	4	16	20*
SEM IV					
VOC-EEM-345	Paper V	48	4	16	20*

VOC-EEM-346	Paper VI	48	4	16	20*
Practical Papers					
Part of EL-347 and EL-348 and EL- 349 (Semester III & IV)	Practical Paper III	12 Practicals of 4 lectures in each Semester (24 / year)	08	32	40 **

* Subject to compulsory passing in external examination and getting minimum 20 marks out of 50

** Subject to compulsory passing in external examination and getting minimum 40 marks out of 100

Notes:

1. Total marks: Theory for each semester (50 $\times$ 6) = 300 marks
2. Total marks per year 600 (Theory) + 300 marks (practicals) = 900 marks
3. Internal marks for theory papers given on the basis of internal assessment tests and for practicals on internal assessment tests + journals + attendance + study visit reports/ market survey/ hobby projects etc.

Theory examination will be of two hours duration for each theory course. There shall be 4 questions each carrying marks as per the table. The pattern of question papers shall be:

Question 1	4 sub-questions, each of 1 marks and 4 sub-questions, each of 2 marks; on entire syllabus	12 marks
Question 2 and 3	2 out of 3 sub-questions, each of 4 marks; short answer type questions; answerable in 8–10 lines	8 marks each
Question 4	2 out of 3 sub-questions, each of 6 marks; long answer type questions (12-16 lines), problems, circuit/logic diagrams and designs	12 marks

Internal examination: Internal assessment of the student by respective teacher will be based on written test, 10 marks each Semester. The written test shall comprise of objective type questions – Multiple Type Questions, True / False, Definitions, Answer in Two or three line question (Describe/Explain) There shall be 20 questions.
Practicals: one internal assessment test + practical journals + attendance + activity.

Practical Examination: Practical examination shall be conducted at the respective college at the end of the academic year. Practical examination will be of 6 hours (2-Sessions) duration. Certified journal is compulsory to appear for practical examination. There shall be one expert and two examiners per batch for the practical examination. One of the examiners will be external.

5 B) Standard of Passing:

i. In order to pass in the first year theory examination, the candidate has to obtain 40 marks out of 100 in each course. (Minimum 32 marks out of 80 must be obtained in the University Theory Examination.)
ii. In order to pass in the Second Year and Third Year theory examination, the candidate has to obtain 20 marks out of 50 in each course of each semester. (Minimum 16 marks out of 40 must be obtained in the University Theory Examination.)
iii. In order to pass in practical examination, the candidate has to obtain 40 marks out of 100 in each course. (Minimum 32 marks out of 80 must be obtained in the University Examination.)

5 C) ATKT Rules:

While going from F.Y.B.Sc. to S. Y. B. Sc. at least 8 courses (out of total 12) should be passed; however all F.Y.B.Sc. courses should be passed while going to T. Y. B. Sc.
While going from S. Y. B. Sc. to T. Y. B. Sc., at least 12 courses (out of 20) should be passed (Practical Course at S. Y. B. Sc. will be equivalent to 2 courses).

5 D) External Students: There shall be no external students.

5 E) Setting question papers:

F.Y.B.Sc.: For theory papers I and II annual question papers shall be set by the University of Pune and assessment done at the respective colleges. Questions should be designed to test the conceptual knowledge and understanding of the basic concepts of the subject. For Practical Paper III, papers shall be set by the University of Pune and assessment done at the respective colleges.

S. Y. B. Sc. and T. Y. B. Sc.: For theory papers I and II for each semester and also for the annual practical examination question papers set by the University of Pune. Centralized assessment for theory papers done as per the University instructions. Questions should be designed to test the conceptual knowledge and understanding of the basic concepts of the subject. For Practical Papers, papers shall be set by the University of Pune and assessment done by the internal examiner and external examiner appointed by University of Pune.

5F) Verification and Revaluation Rules:
As per university Statues and rules for verification and revaluation of marks in stipulated time after declaration of the semester examination result.

6) Course Structure:

Duration: The duration of B.Sc. Electronic Science Degree Program shall be three years.

a) Compulsory Papers : All Theory and Practical Papers

b) Optional Papers **:** Nil

c) Question Papers **:**

F.Y.B.Sc. Theory paper:
University Examination – 80 marks (at the end of 2nd term)
Internal Examination – 20 marks

S.Y / T.Y. - B.Sc. Theory paper:
University Examination – 40 marks (at the end of each term)
Internal Examination – 10 marks

F.Y. / S.Y / T.Y. - B.Sc. Practical Paper:
University Examination – 80 marks (at the end of 2nd term)
Internal Examination – 20 marks

d) Medium of Instruction: The medium of instruction for the course shall be **English.**

7) Equivalence of Previous Syllabus:

Old Course (2008 Pattern)	**New Course (2013 Pattern)**
Paper I: T & M Instruments and Consumer Products	VOC-EEM-101: Maintenance Concepts, Instruments and Appliances
Paper II: Maintenance Concepts and Assembly Methods	VOC-EEM-102: Electronic Components, Circuit and Equipment Assembly
Paper III: Practical	VOC-EEM-103: Practical

8) University Terms: Dates for commencement and conclusion for the first and second terms will be declared by the University authorities. Terms can be kept by only duly admitted students. The term shall be granted only on minimum 75 percent attendance at theory and practical course and satisfactory performance during the term.

9) Qualification of Teachers: As per UGC rules and guidelines on the scheme of Vocationalization of First Degree Education enumerated in the booklet published by the UGC.

10) Detail Syllabus with Recommended Books:

F. Y. B. Sc (Vocational)
(Proposed to be implemented from June 2013)
Electronic Equipment Maintenance (EEM)
PAPER I: Maintenance Concepts, Instruments and Appliances

Objectives

1. To understand Maintenance Concepts terminology and definitions, and corresponding numerical problems. (Unit I)
2. To understand functioning (using block diagram) and method of setting up the frequently used T & M Instruments in the laboratory, their respective salient features and important technical specifications as also the terminology of measurement and its significance(Unit 2, 3, 4 & 5)
3. To understand functioning (using block diagram / construction diagram) and method of setting up the frequently used Home/Office Appliances and Power and Line Protection Devices (Unit 6)

Term I

Unit 1 : Electronic Equipment and Maintenance Concepts Electronic Equipment, Potential Problems, Quality, Terminology and definitions of : Reliability, Failure, Failure Rate, Mean Time between Failures(MTBF), Mean Time to Fail(MTF), Mean Time To Repair(MTR), Maintainability, Availability, Redundancy, Fail Safe Design Idea of Test and Measurement instruments and their role in maintenance	**4 lectures**
Unit 2 : Basic Meters Study of Construction, working Principle, connections in circuit, interpretation of information printed on the body of the meter, standard operating method and safety precaution and simple indicative numerical problems of - PMMC movement, dc ammeter and dc voltmeter, ohmmeter, Resistance of moving coil, resistance of ammeter, of voltmeter, AC ammeter and voltmeter, Analog multi-meter, Megger Conditions under which a meter may be damaged, preventive measures	**14 lectures**

Unit 3 : Measuring instruments Study of Block Diagram, working Principle, connections in circuit, interpretation of information printed on the body of the instrument, standard operating method and safety precaution and simple indicative numerical problems of - Digital Voltmeter, Digital Multimeter, Concept of auto ranging, Analog Cathode Ray Oscilloscope, Digital Storage Oscilloscope (DSO), DFM –universal timer/counter, Front panel – controls, selector switches, terminal connectors and setup procedure for typical measurements, accessories and cables, Analog versus Digital Instruments	**18 lectures**

Term II

Unit 4 : Language of Electrical Measurements, Experimental Data and Errors Measurement Recording and Reporting, Graphical Representation of Data, Precision and Accuracy, Resolution and Sensitivity, Errors in Measurement, Statistical Evaluation of Measurement Data and Errors, Loading effect	**5 lectures**
Unit 5 : Test Instruments Study of Block Diagram, working Principle, connections in circuit, interpretation of information printed on the body of the instrument, standard operating method and safety precaution of - AF signal generator, RF signal generator, Pulse generator, Function generator, DC power supply (linear & switch mode)	**10 lectures**
Unit 6 : Various Appliances and protection devices Study of Block Diagram, working Principle, connections in circuit, interpretation of information printed on the body of the appliance, standard operating method and safety precaution and simple indicative numerical problems of - Digital Clock (watch), Microwave oven, Mixer, grinder, Roaster, Electric geyser, Electric iron, Telephone instrument, Headphone, Hearing aids, Electronic ignition system, Washing machine, induction cooker, Emergency lights Circuit breakers, Home protector, spike protector, Stabilizers, Online UPS and Off Line UPS.	**26 lectures**

Recommended Books:

1. Electronic Instruments and Systems: Principles, Maintenance and Troubleshooting by R. G. Gupta Tata McGraw Hill Edition 2001
2. Student Reference Manual for Electronic Instrumentation Laboratories by Stanley Wolf, and Richard F.M. Smith, Prentice Hall of India Pvt. Ltd. New Delhi

3. Electronic Instrumentation and Measurement Techniques by WD Cooper, AD Helfrick, Prentice Hall of India Pvt. Ltd. New Delhi
4. Digital Instrumentation A. J. Bouwens, Tata McGraw Hill
5. Consumer Electronics by S. P. Bali, Pearson
6. Modern Electronic Equipment: Troubleshooting, Repair and Maintenance by Khandpur, TMH
7. Electronic Testing and Fault Diagnosis by G. C. Loveday, A. H. Wheeler Publishing

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Electronic Equipment Maintenance (EEM)

PAPER II: Electronic Components, Circuit and Equipment Assembly

Objectives

1. To get acquainted with different electronic components, their uses, referring data sheets, methods of applying simple functional check, fault findings (Unit 1 and 2)
2. To understand methods of soldering and de-soldering techniques and related tools (Unit 5)
3. To know Different types of PCB's and preparation of PCB's methodology (Unit 4)
4. To understand wiring and its importance and to learn the skill of wiring in different typical electrical gadgets (Unit 6)

Term I

Unit 1 : Passive Components, accessories and tools Resistor, capacitor, inductors, AF transformers, IF transformers, switches, connectors, relays, solenoids, visual identification and color codes, device marking schemes and interpretation of information printed on the body of devices Motors (DC), contactor, circuit breakers, Fuses, MCB, ELCB Connectors and jacks in PC, Cellphone, still camera, video Camera, Car audio/video system, Home audio/video system Electrochemical cells – Chargeable, nonrechargeble, AA, AAA, Button, Cellphone battery, Typical voltages, Amp-Hour rating, precautions during use and disposal Tools: Screw-drivers, Allen key, Automatic centre punch, files, cutters, pliers, wire-strippers, hacksaw, soft tools(chemicals for electronics)	**16 lectures**
Unit 2 : Semiconductor Devices semiconductor device numbering, data sheets, absolute maximum rating, reading of data sheets, packages and lead information, causes and indications of failure Displays - LEDs, LCDs, 7-segment, dot matrix, bar graph, LEDs for lighting	**12 lectures**
Unit 3 : Drawings Circuit symbols, standards, circuit diagram, front and rear panel	**04 lecture**

Term II

Unit 4 : Circuit Assembly techniques Circuit boards, Types of PCB, Single sided, Double sided and multilayer, Layout techniques (Examples of using discrete components and IC's to be used), Processes on PCB (Pattern transfer), Surface Mount Devices (SMD) packages and assembling SMDs on PCB, CAD tool for PCB design. Bread board, Internal connections of breadboard, Assembling Circuit on breadboard,	**14 lectures**
Unit 5 : Soldering and Desoldering Techniques Solder joint, dry solder joint, cold solder joint, Good and bad solder, solder material soldering tools, soldering gun, soldering station, ultrasonic soldering station soldering techniques, tools for desoldering, desoldering techniques, testing of soldering joints, Precautions during soldering and desoldering	**08 lectures**
Unit 6 : Electrical wiring and Equipment enclosures/cabinets Types of Wires, Gauges, Selection of wires, Types of cables, UTP, STP, Armoured, flat ribbon type etc with examples of common applications e.g. cables in a PC, safe voltage and current ranges, Colour conventions, Wire harnessing. Typical Simple Household Wiring, Wiring of tube light, switchboard wiring, stair case wiring, fan regulator and fan wiring, Power cable wiring, grounding and shielding, Earthing – necessity and methods. Electric shock and precautions. Enclosure Types: Cabinet racks (incl. NEMA 12) ,Server racks, Co-location racks, Open racks (Large open racks, table-top racks, swing-frame, relay racks), Wall mount cabinets Rack mount enclosures, Card racks, Portable cabinets, Chassis, Small metal enclosures, Cast metal enclosures, Plastic boxes, NEMA 4x enclosures	**14 lectures**

Recommended Books:

1. Student Reference Manual for Electronic Instrumentation Laboratories by Stanley Wolf, and Richard F.M. Smith, Prentice Hall of India Pvt. Ltd. New Delhi
2. Electronics Shop Practices, Equipment and Materials By Clyde N. Herrick Prentice Hall Inc
3. Electronic Instruments and Systems: Principles, Maintenance and Troubleshooting by R. G. Gupta Tata McGraw Hill Edition 2001
4. Modern Electronic Equipment: Troubleshooting, Repair and Maintenance by Khandpur, TMH

5. Electronic Instrumentation and Measurement Techniques by WD Cooper, AD Helfrick, Prentice Hall of India Pvt. Ltd. New Delhi
6. Electronic Testing and Fault Diagnosis by G. C. Loveday, A. H. Wheeler Publishing
7. Art of Electronics by Horowitz and Hill, Cambridge University Press

Useful websites:

http://www.howstuffworks.com/
http://in.rsdelivers.com/
http://www.vishay.com/
http://www.hardwarebook.info/
http://www.digikey.com/Web%20Export/Supplier%20Content/BUD_377/PDF/Bud_handbook.pdf?redirected=1

F. Y. B. Sc. (Vocational)

(Proposed to be implemented from June 2013)

Electronic Equipment Maintenance (EEM)

PAPER III: Practical

Objectives

- To acquire skills of proper use of the tools, equipment etc.
- To acquire skills of circuit assembly and disassembly.
- To acquire skills of referencing from data-books, operating instruction manuals and other referencing material.
- To develop technical report writing skills by creating professional laboratory reports and PowerPoint presentations.
- To learn to make efficient use of computers for supporting various laboratory exercises related activities.
- To inculcate good, safe and disciplined work practices.
- To be aware of the importance of cost effective work practices by avoiding wastages and by recycling of material.
- To learn to carry out error assessment and analysis and to learn to draw inferences based on the same.

  Group Discussions are recommended for creating a general atmosphere to appreciate and practice the points mentioned here.

F. Y. B. Sc (Vocational)
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Electronic Equipment Maintenance (EEM)

PAPER III: Practical

Group A	**T and M instruments: Connection in circuits, using all modes and precautions therein (use of Operating instructions manual is mandatory)**
1	Simpson 260 or equivalent analog multimeter
2	Digital multimeter with variety of ranges
3	Cathode Ray Oscilloscope/Signal Generator/Power Supply
Group B	**Terminal identification and functional checking using multimeter** (use of Operating instructions manual / component datasheet is mandatory)
4	Rheostat, Potentiometer And Switches, EM Relay, Transformer, Auto-Transformer (Dimmerstat),Fuses
5	Diode, Zener, Transistor (At least 3 different packages each) and LEDs(different wattages and colours), LED strips, Neon indicator lamp
6	DC Sources: Battery (5 Different types), Solar PV cell, Battery Eliminator, CVCC Power Supply.
Group C	**PCB Preparation, Soldering and desoldering**
7	Lay out preparation process on graph paper (Art work) - use of open source PCB making software expected
8	Process of Transferring layout on copper clad laminate, PCB Etching and Drilling
9	Soldering and Desoldering of Components from given PCB
Group D	**Electrical Wiring (including drawing schematic), Home appliances (Schematic, Identification of parts, disassembly and assembly)**
10	Tube light testing
11	Switch board wiring
12	Electric iron (semi automatic or fully automatic)
Group E	**Power line protection devices and gadget (Schematic, Identification of parts, disassembly and assembly)**

13	MCB, ELCB (Demonstration of operation by creating test fault condition)
14	Spike protector
15	Home protector (tracing parts and sections)
Group F	**Preventive Maintenance**
16	PMMC/ Analog multimeter /Digital multimeter
17	Single Power Supply or Dual Power Supply
18	PC

- Group A, B, C, D experiments are compulsory. Any 2 experiment from Group E, any 2 experiment from Group F and any 2 experiment from Group G are to be performed.
- Safe working practice drill is desired on more than one occasion per term.
- Energy Audit of the laboratory in which students work be carried out by each student once in the year.
- In each experiment use of datasheet/operating instruction manual is mandatory.
- Hand tool practice exercise is desired as a preparatory exercise.

Note:

These and any other equivalent experiments with a view to inculcating good, safe and disciplined work practices are desired.