

Theme paper
Ad-hoc Board of Studies in Vocational Courses

Introduction

The vocational stream is specialized in the sense of being non-conventional. It is multi faculty as well as multidisciplinary. It is necessary for Board to have a wholistic view and integrated approach. The board is aware that the courses are different also because they are incorporated into conventional disciplines. They establish a linkage with main stream disciplines, market and industry. The theme paper that follows reflects all the above ideas.

The idea of vocationalization at the undergraduate level was introduced by UGC in 1994. The main aims were:

1. to promote the possibility of self employment
2. to bridge up the gap between knowledge based conventional education and market demands and to provide an alternative to those pursuing higher education.

The University of Pune positively responded to the UGC guidelines and introduced vocational courses in the three faculties of conventional graduation, namely Arts, Commerce and Science.

There has been a significant phase in the implementation of the vocational programme and more than 30 colleges offer different courses under various disciplines. A sizable number of students offered these courses since their inception and have had gainful employment. Currently the following courses are conducted in various moficil as well as urban colleges affiliate to the University of Pune.

The details of the programmes are as follows:

ARTS	COMMERCE	SCIENCE	Mental & Moral Sciences and Humanities
1. Funtional English	1. Computer Applications	1. Electronic Equipment and Maintenance	1. Tourism and Travel Management
2. Functional Hindi	2. Advertising, Sales Promotion and Sales Management	2. Computer Maintenance	2. Soil Conservation and Water Management
	3. Principles and Practices of Insurance	3. Still Photography and Audio Results	
	4. Office Management and Secretarial Practice	4. Biotechnology	
	5. Tax Procedure and Practice	5. Seed Technology	
		6. Industrial Chemistry	
		7. Industrial Microbiology	

The contents of these courses are quite different from that of the conventional courses taught at the first degree level. The vocational courses emphasize the applicational aspects of the contents. These courses can be offered in place of some conventional courses.

In the year 2003, UGC has revised the scheme of vocationalisation of undergraduate courses and introduced career-oriented Add-On course in the form of Certificate, Diploma and Advanced Diploma Courses. At present the colleges are offering the vocational courses by following both the schemes. The Ad-voc Board of Studies for Vocational Course, therefore has to play a multiple role, with reference to the existing syllabi of vocational courses and the above mentioned prospective syllabus of add-on career oriented courses.

The Board, while preparing syllabus for various courses will have to lay down the standards required by employers and ensuring the quality and credibility of the qualification gained through vocational courses.

Comprehensive view of Objectives for the Vocational Course:

Definition : Vocational Education in a much broader sense cover education and skill development at all levels from post primary to tertiary education- both through formal and non formal programmes.

The aims and objectives before the existing syllabi have been very realistic; yet considering the changing global scenario, they need revision and addition.

The following are identified as general objectives of vocational course:

- To fulfill the national goals of development and the removal of unemployment and destitution
- To impart education relevant to productivity, economic development and individual prosperity
- To meet the needs of skilled and middle level man power for the growing sectors of economy, both organized and unorganized
- To prepare students for self-reliance, gainful employability and self employment
- To reduce mismatch between demand and supply of skilled manpower

The Stock of Present Syllabi:

Though the details of syllabus varied from faculty to faculty, all the syllabi reflected and successfully fulfilled the broad aim and objectives of the vocational courses. Training was imparted in every course enabling students to seek gainful employment in their respective fields. The syllabi of all vocational courses were revised in the year 2003 and now need a fresh revision . The proportion of theory and practical differed from course to course and varied from 30-70 to 40-60 percent.

Comparison with the best Universities of world:

The international scene is varied and differs from one country to another. The courses are designed to fulfill the needs of the respective societies. Vocational training is no longer treated as a social stigma in other countries.

Some colleges offer education in a few, select vocation related fields, while others provide numerous career-oriented subjects. The subjects offered vary from courses in Art, Design, Performing Art, Business Services, Service Industries, Science and Technology. The courses are conducted by trained professionals or industry experts and help the graduates to excel in specific, chosen vocations. Assessment of vocational courses is on a continuous basis and students are required to complete practical tasks and assignments throughout the year.

A survey of the international scene indicates that the national scene is almost atpar except the funding provided for the vocational education. Governments and businesses are increasingly investing in the future of vocational education through publicly funded training organizations and subsidized apprenticeship or traineeship initiatives for businesses.

Suitability for the credit system:

The credit system can be incorporated only if the system is at par with conventional courses.

Possibility of conversion into web based courses :

The vocational courses could be made available online provided the course material and online assistance is available. This may be feasible for only a few courses.

Reorientation and the changes required to meet the goals:

* Changes required in the syllabus:

It is felt necessary to impart a few basic skills in students irrespective of the vocation. So the Board proposes to frame a common and compulsory course entitled “Key Competency Course” spanning three years. This aims to develop employment related skills needed by an educated work-force.

* The Board feels that the practical component of every course needs to be increased in order to meet the goals and this concept needs to reflect in syllabi, teaching methodology and evaluation.

* In order to meet the above, extensive teacher-orientation and training is a must.

* The on the job training needs to become wider and more flexible with reference to the global needs and local opportunities.

* The student of vocational stream is more privileged due to his vocational learning along with conventional knowledge-based syllabus. This fact should be considered while framing the syllabus. Proper emphasis should be on the theoretical component vis-a-vis application keeping up the academic foundation.

* So as to be able to keep pace with market demands, at least part of the syllabus should be more flexible and need-based; giving freedom to the Institute and teachers.

Ingredients of the “Key Competency Course”:

1. Communication Modules
 - Oral Communication
 - Written Communication
2. Personality Modules
3. Intelligence Ability Modules
4. Ethics and Law
5. Entrepreneurship Development
6. Computer Literacy

Summing Up

The Board of Studies is aware that, as such, the policy making and implementation of vocational courses is a challenge in itself and the outline syllabi that the Board proposes will satisfactorily reflect the goals and objectives of vocational courses.

PROPOSED SYLLBUS

Subject Title:

PHOTOGRAPHY AND AUDIO VIDSUAL PRODUCTION (Vocational)
(Previously, Still Photography & Audio Products)

SUMMARY CHART:

Class	Paper I	Paper II	Paper III
F. Y. B.Sc. (First term)	Basic Photography	Introduction to Mass Communication	Assignments, Laboratory/Studio work & Key Competency Course.
F. Y. B.Sc. (Second term)	Photo Appreciation	Media Scene in India	Assignments, Laboratory/Studio work & Key Competency Course
S. Y. B.Sc. (Sem I)	Advanced Photography	Acoustics	Assignments, Laboratory/Studio work & Key Competency Course
S. Y. B.Sc. (Sem II)	Colour Photography & Digital Photography	Fundamentals of Video	Assignments, Laboratory/Studio work & Key Competency Course
T. Y. B.Sc. (Sem III)	Fundamentals of Communication & Propagation	Video Production	Assignments, Laboratory/Studio work & Key Competency Course
T. Y. B.Sc. (Sem IV)	Entrepreneurship Development	Audio Production	Assignments, Laboratory/Studio work & Key Competency Course

PROPOSED SYLLBUS

Subject Title:

PHOTOGRAPHY AND AUDIO VISUAL PRODUCTION (Vocational) (Previously, Still Photography & Audio Products)

Class: F. Y. B. Sc.

Paper I: Basic Photography and Photo Appreciation

Objective:

- A:** To create general awareness and interest in Photography.
- B:** To make students aware of the fundamentals of the Photographic process.
- C:** To make students familiar with the Photographic equipment and technique.
- D:** To appreciate the role of the Photographic image as a means of communication.

Section I: Basic Photography

- 1. Introduction:** The Photographic process, different elements involved in Photography and their role.
- 2. Light:** Photographic significance of light and its properties, Image formation by a pinhole and a simple lens,.
- 3. Simple lens:** Properties, defects, methods of correcting these defects, image formation, magnification.
- 4. Camera:** Requirements of a camera, Pinhole camera, Box camera, SLR camera, Studio camera, Digital camera. Camera formats.
- 5. Camera Controls:** Photographic image and its technical evaluation. Need for camera controls. Aperture (Iris Diaphragm, f numbers), Depth of field and depth of focus. Shutter (Shutter speed, slow and fast shutter speed), and Focusing (Focusing aids and Mechanisms, Image stabilization)
- 6. Exposure:** Incident and reflected light, Exposure and equivalent exposures, Brief idea of exposure meter.
- 7. Camera lenses:** Normal, wide, telephoto and zoom lenses.
- 8. Recording medium:** Film, CCD & C-MOS, Printing papers, Different types of file Formats for the digital images.
- 9. Enlarger:** Basic B/W enlarger, Condenser & diffuser enlarger.
- 10. Processing:** Developing, Fixing process and chemicals used for the process. Developer D-76, D-163, Fixer and other chemical formulae.

Section II: Photo Appreciation

- 1. History of Photography:** Evolution of photographic technology, land mark events and processes

- 2. Application areas of Photography:** Use of a photographic image in different walks of life.
- 3. Scope for a Photographer:** Evolution of a photographer from a freelancer to the independent Photographer.
- 4. Photographic Composition:** Elements of composition, Rule of thirds, Placement of subject, Framing.
- 5. B/W versus Colour Photography:** Their limitations and advantages as independent medium.
- 6. Painting versus Colour Photography:** Comparison, Limitations and advantages of one over the other.
- 7. Advertising Photography:** Role of a photographic image in advertising.
- 8. Photojournalism:** Role of a photographic image in print media. Photo news and 'News', Handling soft and hard news, special events, photojournalistic norms.
- 9. Photographic image as a means of communication:** Role of photograph and photographer in the process of visual communication.
- 10. Work of famous photographers through history and the impact of their work on society.**

References:

1. Focal encyclopedia of Photography, Focal Press.
2. Basic Photography, M. J. Langford, Focal Press.
3. The National Geographic Archival Images.
4. The Time Magazine Archival Images,

PROPOSED SYLLBUS

Subject Title:

**PHOTOGRAPHY AND AUDIO VIDSUAL PRODUCTION (Vocational)
(Previously, Still Photography & Audio Products)**

Class: F. Y. B. Sc.

Paper II: Introduction to Mass Communication and Media scene in India

Objective:

- A. To introduce students to the Communication Process and expose them to various aspects of Mass Communication.
- B. To develop clear-cut understanding of current media trends, its potentialities and impact.
- C. Equip students with basic skills to take up any advanced level programme at a later stage.

Section I: Introduction to Mass Communication

- 1. Definitions of Communication.
Understanding the elements and processes of Communication.
- 2. Functions Role and Significance of Communication.
- 3. Barriers of Communication.
- 4. Types of Communication: Verbal and Non-verbal, Interpersonal, Intrapersonal, Group, and Mass Communication.
- 5. Role and significance of Communication in Society.
- 6. Writing for media.

Section II: Mass Media

- 1. **Print Media:** News agencies and their role. Role of a news paper as medium of mass communication and its impact on the society. A brief history of the press in India. News papers: Dailies, Periodicals. News paper as an organization/industry. Role of different people in a news paper. General nature/Layout of a news paper. Code of conduct/ethics. Overview of the Newspaper Industry.
- 2. **Radio:** Purpose role and responsibility of radio. Radio as a medium of mass communication and its characteristics. Radio as an organization. Structure of a radio station. Role of each individual working at different levels. Types of radio programmes. Target audience and the nature of radio programmes. Radio features Commercial and Non commercial programmes. Vividh Bharati, Radio Mirchi and other FM Radio channels. Community Radio, Internet Radio, Campus Radio. All India radio and Private Channels. General Code of Conduct/Ethics for radio broadcast. Overview of the Radio Industry.
- 3. **Television:** Purpose role and responsibility of TV. TV as a medium of mass communication and its characteristics. TV as an organization. Structure of a TV station. Role of each individual working at different levels. Types of TV programmes. Target audience and the nature of TV programmes. Commercial and Non commercial programmes. Doordarshan and Private Channels. General Code of Conduct/Ethics for TV broadcast. Overview of the TV Industry.

4. Internet as a medium of mass communication. Use of Internet by the media.

5. Information and Publicity: Need of publicity. Changing role of Public Relations Officer. Corporate Communication. Internet as medium of publicity.

References:

1. Mass Communication: Keval J. Kumar
2. mass Communication in India: Keval J, Kumar
3. Indira Gandhi National Open University: Notes
4. Yashavantrao Chavan Maharashtra Open University: Notes

PROPOSED SYLLBUS

Subject Title:

PHOTOGRAPHY AND AUDIO VIDSUAL PRODUCTION (Vocational)
(Previously, Still Photography & Audio Products)

Class: F. Y. B. Sc.

Note: All the assignments and practicals should be designed and conducted so that the student develops effective soft skills. This should include: Use of basic computer related skills, presentation skills and communication skills.

Practicals

1. Study of SLR camera.
2. Study of B/W enlarger.
3. Study of exposure meter.
4. Effect of aperture on depth of field.
5. Effect of shutter speed.

6. Using equivalent exposures.
7. Projection printing.
8. Contact printing.
9. Developing a B/W film.
10. News writing for News Paper, TV and Radio. (Difference between news for different media should be discussed during these sessions.)
11. Subbing.
12. Writing a letter to the editor.
13. Front page layout of a news paper.
14. Assignments: a) 5 Ws & 1 H.
b) Report writing
c) Deconstruction of the front page of a Newspaper.
15. Assignments for Mass Communication.(e.g., Interacting with people)
16. Feature writing for print media. (e.g., Features for specific occasions)
17. Review writing for print media. (e.g., Review of a book)
18. Radio presentation and interview skills.
19. Onscreen presentations for TV. (e.g., presenting a news item)
20. Assignments should be designed to develop Written, Oral and Visual presentation skills

PROPOSED SYLLBUS

Subject Title:

COMPUTER HARDWARE AND NETWORK ADMINISTRATION

Objectives:

- A. To know fundamentals of Computer and Organization of Hardware and Software
- B. To know Microprocessor, Programming and Interfacing of various Components, Networking Connections etc
- C. To know how to troubleshoot Computer and Networks,
- D. Installation of various drives and operating systems.

SUMMARY CHART

Year	Paper	Term/ Semester	Title of the Paper
First	1		Essentials of Computer
First	2		Computer Organization (Hardware & Software Aspects)
First	3		Practicals based on the above papers and Assignments on Computer Literacy, Communication Skills & Personality Development.
Second	1	I	Microprocessor & Interfacing Techniques I

Second	2	I	Computer System Administration I
Second	1	II	Microprocessor & Interfacing Techniques II
Second	2	II	Computer System Administration II
Second	3	I & II	Practicals based on the above papers and Assignments on Intelligence Ability Development, Communication Skills & Personality Development.
Third	1	III	Computer Service Management
Third	2	III	Networking I
Third	1	IV	Entrepreneurship Development
Third	2	IV	Networking II
Third	3	III & IV	Practicals based on the above papers and Preparation of a Small Business Model

PROPOSED SYLLBUS

Subject Title:

COMPUTER HARDWARE AND NETWORK ADMINISTRATION

Class: F. Y. B. Sc.

Paper I: Essentials of Computers

1. Functional Block Diagram, History, Evolution.
2. An Overview of System and Components:
 - CPU Cabinet: Power supply, SMPS, Motherboard, CPU and other components, Cables and connectors, Main and auxiliary memory, Front and rear panel study.
 - Input devices: Keyboard, Mouse, Joystick, Scanner, Digitizers, Light pen, Touch screen, Camcorder.
 - Output devices: Monitor, LCD Panel, Printer: Dot Matrix, Inkjet, LASER, Thermal, Plotter, Sound devices, Speaker.
3. CPU:
 - Microprocessor as CPU, General block diagram of CPU, CPU bus system, Packing, Cooling, Sockets and slots, Comparative study of Microprocessors.
4. Computer Memory and Memory Management Techniques:
 - Types and characteristics, Classification, Semiconductor, Magnetic, Optical ROM and its types. RAM and its types: SDRAM, EDORAM, DDR< Flash RAM.
 - Memory modules, SIMM and DIMMs.
 - Secondary Memory: Hard Disc Drive, Floppy Disc, CDROM, CD R/W, DVD, Zip Drive, Pen Drive.
 - Formatting and Utility Tools.
5. Basic Computer Structure and Communication inside Computer, MAR, MBR and

- Memory mapping, ALU, Control Unit (Concept of Microprogramed and Hardwired Control)
6. Instruction fetch, Interrupts, Input Output Techniques, Device Controllers.

PROPOSED SYLLBUS

Subject Title:

COMPUTER HARDWARE AND NETWORK ADMINISTRATION

Class: F. Y. B. Sc.

Paper II: Computer Organization (Hardware and Software Aspects)

1. Introduction and Concepts:

Hardware and Software, System Software, Application Software, Firmware, BIOS, POST, Operating Systems, Program, Flow Charts, Loader, assembler, Compiler, Linker, Editor, Simulator, Emulator, Debugger, Device Drivers, Software Packages and Programming Languages.

2. Operating System: Types and Functions.

DOS – Introduction, Versions, DOS Commands, Internal, External, Root Directory.
Windows – Introduction, Working with desktop, Control Panel settings.

3. Microprocessor Study:

8086 – Architecture, Instruction set, 80286, 80386, 80486.

4. Chipset and Controllers:

Chipsets, Keyboard controller, Super IO controller, Math Co processor, Clock Generator, Bus controller, PPI, Timer, Interrupt controller, DMA, Tristate buffers and Latches.

5. Interfaces:

FDC, HDC, CRT Controller, Serial and Parallel Interface, UART, USB, RS-232, GPIb.

6. Multimedia, Networking and Internet:

Networking: Concepts, Need, Types, Topologies, Protocols, Introduction to Network Interface Card and Network Operating Systems.

Multimedia: Medium concept, Types, Multimedia Computer Systems.

Internet: Concept, Different Connection types, Applications.

PROPOSED SYLLBUS

Subject Title:

COMPUTER HARDWARE AND NETWORK ADMINISTRATION

Note: All the assignments and practicals should be designed and conducted so that the student develops effective soft skills. This should include: Use of basic computer related skills, presentation skills and communication skills.

Class: F. Y. B. Sc.

Practicals

1. Site Preparation, Electrical Connections and use of Maintenance kit, Cable Maintenance, Connecting Keyboard, Mouse, Printer, Scanner, Multimedia components and make it working
2. Identification of system, Explanation of system components: Motherboard Onboard controllers, 2) Add on controllers. (Drives, RAM, CMOS battery, SMPS, BIOS RAM, Chipset, Controllers)
3. DOS based practicals Internal External commands, Directory handling and Practical on AUTOEXEC. BAT and CONFIG.SYS files (Only Demo)
4. Desk top and control panel settings of windows operating system.
5. MS office: 3 practicals. (Students are expected to be familiar with MS office. Practical based on MS Word, Excel, Power Point.
6. Assembly and disassembly of computer.
7. Identification and verification and Study of Disc drives.
8. Study of FD and formatting and making it bootable.
9. Assembly and maintenance of Dot matrix printer.
10. Assembly and maintenance of Inkjet printer.
11. Assembly and maintenance of LASER printer.
12. Internet, search engines and E-mail.
13. Study of SMPS and checking of Different voltages, Power Good Signal
14. Study of BIOS and POST Sequence (Only Demo) and Standard CMOS setup for different configuration
15. Installation of device drivers for Mouse / printer / scanner / pen drive / CD- Combo and Checking hardware and software components and working with multimedia

Mandatory Assignment: Prepare and give a presentation after doing market survey using Power Point tools (and comparative study) for the latest computer configuration.

References: (For Paper I, II and III)

1. Computer Fundamentals by P. K. Sinha
2. Upgrading and Repairing of PCs by Scott Muller
3. IBM PC and Clones by B. Govindrajalu
4. Microprocessor and Interfacing by D. V. Hall
5. Microprocessor X 86 Programming by Venugopal
6. Computer Motherboard Testing and Fault finding by S. K. Gupta
7. PC Hardware (A+ Certificate guide) by Mike Mayer
8. PC Hardware interfaces by Michael Gook

PROPOSED SYLLBUS

Subject Title:

SEED TECHNOLOGY

Objectives:

- A. To get introduced to Morphology, Seed Physiology, Plant Breeding, Seed Production
- B. To get introduced to the concept of Hybrid Seed, Testing, Quality Control
- C. To learn Seed Pathology and Entomology, Seed farm Management, Processing and Storage
- D. To learn the concept of Biotechnology & Intellectual Property

SUMMARY CHART:

Class	Paper	Paper	Paper
F. Y. B.Sc. (First term)	Paper I: Morphology, Seed Development, and Testing for Cultivar Genuineness.	Paper II: Seed Physiology	Paper III: Practicals Based on Paper I & II
F. Y. B.Sc. (Second term)	Paper I: Plant Breeding for Crop Improvement	Paper II: Seed Production	Paper III: Practicals Based on Paper I & II
S. Y. B.Sc. (Sem I)	Paper IV: Hybrid Seed Production	Paper V: Seed Testing	Paper VI: Practicals Based on Paper IV & V
S. Y. B.Sc. (Sem II)	Paper IV: Vegetable Seed Production	Paper V: Seed quality Control	Paper VI: Practicals Based on Paper IV & V
T. Y. B.Sc. (Sem III)	Paper VII: Seed Pathology and Entomology	Paper VIII: Seed farm Management, Processing and Storage	Paper IX: Practicals Based on Paper VII & VIII
T. Y. B.Sc. (Sem IV)		Paper VIII: Biotechnology & Intellectual Property Rights	Paper IX: Practicals Based on Paper VII & VIII

Visit to a seed company in the First and the Second year.

PROPOSED SYLLBUS

Subject Title:

SEED TECHNOLOGY

Class: F. Y. B. Sc.

Theory Paper I (First term): Morphology, Seed Development, and Testing for Cultivar Genuineness.

- 1. Flower:** Definition. Parts of a Typical Flower and their Functions.
- 2. Microsporangium:** Definition. Structure (TS of typical anther) and development of male gametophyte.
- 3. Mega sporangium:** Definition. Structure (LS of Ovule). Types of Ovules. Development of female gametophyte.
- 4. Study of Families:** a) Dicotyledons: Malvaceae (Cotton), Fabaceae (Soyabean/Tur), Solanaceae (Brinjal/Tomato), Astreaceae (Sunflower)
b) Monocotyledons: Liliaceae (Onion) and Poaceae (Maize/Bajra)
- 5. Pollination: Definition.** Types of pollination (Autogamy and Allogamy) Agencies of Allogamy. Covariance in pollination. Advantages and disadvantages.
- 6. Fertilization:** Definition. Process of fertilization in angiosperms.
- 7. Endosperms and embryo development.**
- 8. Polyembryony.**
- 9. Fruit and seed:** Definition. Development of fruit and seed. Structure of seed. Difference between seed and grain. Criteria for harvesting of fruits and seeds. (Morphological and Physiological changes)
- 10. Classification of fruits.**
- 11. Testing for Cultivation**
 - i) Examination of seed: a) Morphological characters. b) Chemical tests. (Phenol colour test and peroxide test) c) Biochemical test (Electrophoresis, RFLP).
 - ii) Examination of seeding.
 - iii) Grow out test (Cotton).
- 12. Dus System.**

Theory Paper I (Second term): Plant Breeding for Crop Improvement.

- 1. General Introduction to Plant Breeding:** Definition, Scope, Objectives.
- 2. Mode of Reproduction in Plants:** Vegetative- Natural and artificial propagation. Sexual reproduction.
- 3. Genetic Basis of Crop Improvement:** Mendelian principle of inheritance of character (Segregation, Independent assortment), Inheritance of quantitative traits.

- 4. Methods of Plant Breeding:** Definition of introduction. Objectives of introduction. Types of introduction (Primary and Secondary). Procedure for introduction. Merits and demerits of introduction.
- 5. Pure Line Selection:** Definition of pure line. Characters of pure line. Advantages and limitations. Achievement through clonal selection in some crop species.
- 6. Clonal Selection:** Definition of a clone. Characters of a clone. Advantages and limitations. Achievements.
- 7. Mass Selection: Definition.** Procedure of mass selection. Merits and demerits. Difference between pure line selection, clonal selection and mass selection.
- 8. Hybridization Followed by Selection in Self Pollinated Crops:** History, definition and types of Hybridization. Application and objectives. Hybridization techniques in self pollinated crops. Heterosis in self pollinated crops. Advantages and limitations.
- 9. Hybridization Procedure in Cross Pollinated Crops:** Development of inbred lines. Effect of Self pollination. (Selfing). Development of single cross & double cross hybrids. Achievement in field crops.
- 10. Mutation in Crop Movement:** Definition of mutation, mutagen, mutant etc. Classification of mutations (Point mutation, Chromosomal somatic mutations, spontaneous and induced mutations). Artificial induction of mutation. Mutagens (Physical chemical, radioactive isotopes). Significance of induced mutation in crop improvement. Achievements through induced mutations.
- 11. Breeding for Disease Resistance:** Definition. Methods of Breeding for disease resistance. Scope and application.
- 12. Advanced Techniques in Plant Breeding:** Anther culture. Tissue culture. Soma clonal variation.

Practicals: Morphology, Seed Development, and Testing for Cultivar Genuineness.

1. Study of dicot families. (Malvaceae, Fabaceae, Solanaceae, Astreaceae) and Morphology of dicot seed.
2. Study of monocot families. (Poaceae and Liliaceae) and morphology of monocot seed.
3. Seeding morphology and adult plant morphology in some major crops for identification of a variety in green house experiment.
4. Phenol test in wheat.
5. Peroxide test.
6. NaOH test.
7. Electrophoresis (Demonstration)

References:

1. Allard R. W. 1960, Principles of Plant Breeding, John Wiley & Sons INC New York.
2. Chandrasekharn S. N. and Parthasarthy S. V. , 1960 Cytogenetics and Plant Breeding, P. Vardachary and Co. Madras.
3. Chaudhary H. K. 1971, Elementary Principles of Plant Breeding, Oxford and IBH Publishing Co. New Delhi.
4. Chaudhary R. C. 1982, Introduction to Plant Breeding, Oxford and IBH Publishing Co. New Delhi.
5. Chopra V. L. Plant Breeding: Theory and Practice, Prentice Hall of India Pvt. ltd. New Delhi.
6. Elliot F. C. Plant Breeding and Cytogenetics, McGraw Hill Book Co. Inc. New York.
7. Gardner E. J. and D. P. Sunstad 1984, Principles of Genetics, John Willey & Sons, New York.
8. Singh B. D. Plant Breeding Principles and Methods. Kalyani Publishers, New Delhi.
9. Simmonds N. W. 1979, Principles of Crop Improvement, Longman, New York.
10. Strickberger M. W. 1985, Genetics, Mc Millian Publishing Co. New York.

11. Gupta P. K. 1991, Genetics, Rastogi Publishers, Meerut.
12. Principles of Seed Science and Technology LD Copland Business Publishing Co. USA.
13. Viability of Seeds, E. H. Roberts.
14. Germination of Seeds, Mayer and Poljakoff Mayber.
15. Seed Technology: Vol. I & II. T.T. Kozlowski, Academic Press.
16. Physiology and Biochemistry of Seeds, Bewley and Black.
17. Seed Technology, R. L. Aggrawal, Oxford IBH.

PROPOSED SYLLBUS

Subject Title:

SEED TECHNOLOGY

Class: F. Y. B. Sc.

Theory Paper II (First term): Seed Physiology.

1. Constituents of Seed

2. Physiology of Seed Development and Maturation Process.

3. Germination: a) Introduction and definition, b) Physiological changes during seed Germination: i) Imbibition, ii) Metabolic changes, Synthesis of food reserves, Breakdown, c) Types of germination (Epigeal and Hypogeal), d) Factors affecting germination and its application, e) Seedling abnormalities and its causes.

4. Dormancy: a) Introduction and Definition, b) Types of dormancy, c) factors affecting dormancy, d) Methods of breaking seed dormancy, e) Role of simulators and inhibitors in seed germination.

5. Seed Storage: a) Physiology of seed storage, b) Seed deterioration during storage.

6. **Seed Vigour:** a) Definition, b) Physiology of seed vigour, c) Factors affecting seed vigour, d) Measurement and crop productivity.
7. **Invigoration treatment to improve seedling establishment and its effect-planting value.**
8. **Seed Longevity Behaviour:** Orthodox and recalcitrant seeds.
9. **Seed Aging.**
10. **Seed Pelleting and Coating, Production of Artificial Seeds (Synthetic Seeds)**

Theory Paper II (Second term): Seed Production

1. **General Introduction:** a) Seed as basic input in agriculture. b) Seed quality concepts, quality control in seed production. c) System & methods of production of nucleus, breeder, foundation and certified seed. d) General system of seed multiplication.
2. **Genetic purity and its maintenance:** a) Genetic purity of varieties concepts. b) Life span of seeds & factors responsible for their deterioration. c) Methods of maintenance of genetic Purity. d) Seed village concept
3. **Agronomic management in seed production:** a) Selection of land for seed production. b) Previous crop effects. c) Harvesting and thrashing of seeds. d) Factors affecting time of harvesting at these, operations especially in high value seeds.
4. **Soil:** a) Introduction to soil and its types. b) Soil contents basic fertility of soil. c) How to maintain and enrich soil fertility. d) Crop wise soil requirement.
5. **Land Preparation:** a) What is land preparation? b) Land preparation for different crops (Cotton, Bajara, Wheat, Chilli, Cauliflower)
6. **Nursery:** a) Crops require transplantation of seedlings. b) Raising good nursery beds. c) Plant protection of seedlings in nursery. d) Water and nutrient management in nursery.
7. **Sowing:** a) Importance of quality sowing. b) Methods of sowing for straight varieties. b) Hybrid and transplanted crops. c) Calculation of seed rate. d) Crop wise depth of sowing. e) Requirement and arrangements for desowing. f) Basal dosages. g) Monitoring germination & emerging seedlings.
8. **Transplanting:** a) Seedling age for transplanting. b) Preparation of land for transplanting. c) Care of immediately transplanted seedlings.
9. **Irrigation and Drainage:** a) Importance of moisture. b) Preservation of moisture. c) Crop wise critical stages of irrigation. d) Sources of irrigation. e) Methods of irrigation. f) How to save water losses. f) Quality of irrigation water. g) Importance and causes of drainage. h) Losses due to excessive irrigation. i) Drainage as preventive measure.

References:

1. Principles of Seed Science and Technology: L. D. Copland Business Publishing Co. USA.
2. Viability of Seeds: F. H. Roberts.
3. Germination of Seeds, Mayer and Poljakoff Mayber.
4. Seed Biology: T. T. Kozlowski.
5. Physiology and Biochemistry of Seeds: Bewley and Black.
6. Seed Technology: R. L. Agarwal

Practicals: Plant Breeding for Crop Improvement

1. Study of natural vegetative plant parts used for propagation.
2. Study of artificial vegetative propagation.
3. Cytological technique for the study of chromosomes in plants: Preparation and use of pretreatment solution (Colchicines, 8IIQ PDB). Fixative. Preservatives. Stains (Accto orccin, acctoarminc, propino carmine Feulgen etc.). Study of somatic chromosomes in shoot tip and root tip merisentms.
4. Preparation of slides for the study of mitosis and meiosis: Mitosis in root or shoot meristem (Aceto carmine method, Feulgen method.) Meiosis in micro sporogenesis (Smcar preparation in acctocarminc/propinocarminc)
5. Hybridization techniques: Floral Biology. Selection of parents with specific objectives. Study of anthesis, pollen fertility & viability. Collection of pollen. Dusting of pollen and bagging. Harvest of FO (hybrid) seed. Raising F, Progeny. Screening of F1 hybrids.
6. Studies if segregation using mixture of coloured seeds: Separation and counting of two coloured seeds. Finding a segregation ration between two classes. Testing of goodness of fit of the ratio by X2 test.
7. Studied on independent assortment: Using seeds of different shape and colour. Seed hardiness. Separation and counting of seeds in each class. Finding a ratio among different categories. Seed structure/texts. Testing the goodness of fit of the ratio by X2 test.
8. Embryo rescue & media preparation for cultures: Embryo rescue techniques.

Preparation of media for embryo culture and tissue culture.

9. Visit to research farms to observe: Experimental layout. Varietal trials for yield evaluation. Segregation of characters in standing F₂ generation. Germ plasm evaluation for traits, diseases, resistance, insect resistance etc. Breeding methods used.

Practicals:

1. Factors affecting seed germination temperature: Moisture, Substratum light pattern of water absorption (Starch, Protein & Oil)
2. Dormancy behaviour & its release hard seedness.
3. Quick variability test.
4. Accelerated aging test.
5. Invigoration Treatments.
6. Meristem Culture

Practicals:

1. Study of different kinds of nursery beds for raising seedlings.
2. Study of seed production practices of- cereals, pulses, oil seeds & fiber crop in relation to planting, irrigation, weed controls rouging, harvesting & thrashing e.g. Bajra, Sorghum, Cotton and Ground nut.
3. Demonstration of different types of sowing for straight varieties of hybrid seeds.
4. Identification of different crop seeds.
5. seed production planning for hybrids and varieties. Comparison of & seed requirements for seed production of certified class.
6. Study of inflorescence & flower structure of self & cross pollinated crops.
7. Study of pollination and fertilization, insect pollination- their identification, management of insect pollinators especially honey bees, isolation distance.
8. Visit to nucleus, breeder seed plots and study of maintenance of varieties.
9. Visit to foundation & certified seed plots and study of techniques of seed production.

PROPOSED SYLLBUS

Subject Title:

REVISED SYLLABUS OF INDUSTRIAL CHEMISTRY

Objectives:

To learn Surface Chemistry & Catalysis and Material & Energy Balance & Phase Rule, Industrial Fuels and Chemical & Extractive Metallurgy

To know Unit Operations and Process Instrumentation, Unit Processes in Organic Chemical Industries

To Study Industrial Methods of Chemical Analysis and ISO Norms and Inorganic & Organic Based Industries

Summary Chart

Paper	Year	Paper	Name of the Paper
1	I	Theory	Surface Chemistry & Catalysis and Material & Energy Balance & Phase Rule
2	I	Theory	Industrial Fuels and Chemical & Extractive Metallurgy
3	I	Practicals	Based on theory papers and key competency course
4	II	Theory (Voc-IND-CHEM-211)	Utilities & Unit Operations and Process Instrumentation
5	II	Theory (Voc-IND-CHEM-212)	Inorganic Process Industries AND Quality Control
6	II	Theory (Voc-IND-CHEM-221)	Unit Processes in Organic Chemical Industries
7	II	Theory (Voc-IND-CHEM-222)	Industrial Pollution
8	II	Practicals	Based on theory papers and key competency course
9	III	Theory (Voc-IND-CHEM-335)	Basic Information about starting a new Industry and Inorganic & Organic Based Industries - I
10	III	Theory (Voc-IND-CHEM-336)	Industrial Methods of Chemical Analysis-I
11	III	Theory	ISO Norms and Inorganic & Organic Based

		(Voc-IND-CHEM-345)	Industries - II
12	III	Theory (Voc-IND-CHEM-346)	Industrial Methods of Chemical Analysis-II
13	III	Practicals	Based on theory papers and key competency course

PROPOSED SYLLBUS

Subject Title:

INDUSTRIAL CHEMISTRY

Class: F. Y. B. Sc.

Surface Chemistry & Catalysis and Material & Energy Balance & Phase Rule

Theory:

Paper-1: Section I : Surface Chemistry and Catalysis

Topic-1: Surface Chemistry and interfacial phenomenon: (18)

Adsorption, Phenomenon of Adsorption, its types, Adsorption Isotherms, Adsorption from Solutions, Applications, Ion- exchange Adsorption Colloidal Dispersions-Sols-Optical properties, electrical Properties, Electrophoresis, electro-osmosis, kinetic properties, precipitation of sols, Emulsions, Gels, Micelles, Surfactants, Aerosol.

Topic-2: Catalysis: (18)

Introduction, Types-Homogeneous and Heterogeneous catalysis, Characteristics of catalytic reactions, Catalytic poisoning, Autocatalysis, Negative catalysis, Activation Energy and Catalysis, Theories of Catalysis, Acid-Base-catalysis, Enzyme catalysis, Mechanism, Industrially important reactions. Introduction of phase-transfer catalysis.

References: –

- 1) K.C. College Handbook.
- 2) Catalysis : Homogeneous and Heterogeneous : B Delmon and G.Jannor.
- 3) Catalysis, Science and Technology : J Anderson.
- 4) Aerosol Science and Technology. H.R. Shepherd.
- 5) Surface Chemistry J.J. Bikermann.

Theory:

Paper-1: Section II :

Material & Energy Balance and Phase Rule:-

Topic-1:Dimensions and Units: (4)

Basic chemical calculations, atomic weight, molecular weight, equivalent weight , mole concept, compositions of liquid and gaseous mixtures.

Topic-2:Material Balance without Chemical Reactions: (10)

Flow diagram for material balance, simple material balance with or without recycle or by-pass for chemical engineering separations such as distillation, adsorption, crystallization, evaporation, extraction etc.

Topic-3:Material Balance involving Chemical Reactions: (8)

Concept of limiting reactions, conversions, yield, liquid and gas phase reactions, with or without recycle or by-pass-

Topic-4:Energy- Balance : (8)

Heat capacity of pure gases and gaseous mixtures at constant pressures, sensible heat changes in liquids, enthalpy changes.

Topic-5:Phase Rule: (8)

Definition of phases, compounds and degrees of Freedom Gibbs Phase Rule- Derivation and its application to one component system like water and sulphur system.

References :-

- 1) Stoichiometry. Bhat and Vora
- 2) Chemical Process Principles Part-I. Hougen O.A, Watson K.M. and Ragats R.A.
- 3) Physical Chemistry 8th edition. Atkins and Paul.

F.Y.B.Sc. Paper- 2:-

**Industrial Fuels and Chemical &
Extractive Metallurgy**

Theory:

Paper-2: Section I: Industrial Fuels

Topic- 1: Industrial Fuel : (6)

Introduction, Calorific value and its determination classification. Selection and properties, methods of processing fuel, numerical problems.

Topic- 2: Solid fuels : (12)

Wood, destructive distillation of wood, peat lignite, different types, formation, classification of coal, advantages and disadvantage of solid fuel, analysis of coal, manufacture of coal gas, distillation of coal tar, fractional distillation of coal oil.

Topic- 3:Liquid fuels : (12)

Characteristics, petroleum, origin and source
Composition and classification, distillation, thermal
And catalytic (moving and fixed bed) cracking,
aviation, gasoline, kerosene, diesel, gas oil, rocket
fuel, octane number, knocking and antiknock
compounds, flash point and octane number.

Topic-4: Gaseous fuels : (6)

Classification, types, water gas-carburetted water
gas, producer gas, semi- water gas, oil gas, LPG,
biogas, coal gas, blast furnace gas, advantages
and disadvantages, analysis of fuel gases.

References :-

- 1) Industrial Chemistry : B.K. Sharma.

Theory:

Paper-2: Section II

Chemical and Extractive Metallurgy

Topic-1 : Chemical Metallurgy:

(6)

Introduction, Basic metallurgical operations ,
pulverization, Calcination, Roasting, Refining Divisions
of metallurgy, occurrence of metals, ore-
dressing , extraction, Smelling , Calcination,
Roasting Reduction, Fluxes, Slags, Refining processes,
types of furnaces.

Topic 2: Physico-chemical Principles of Exatracion of:

(16)

Iron, Aluminium, Silver, Lead, Copper, Magnesium

Topic 3 :Inorganic materials of Industrial Importance : (14)

Alumina, Silica, Silicates, Clays, Asbestos, talc, carbon,
Zeolites, carbon Dielectrics or Electrical insulating
materials.

References:

- 1) K.C. College Handbook
- 2) Industrial Chemistry. Shama B.K.
- 3) Industrial Chemistry. Rieger

F.Y.B.Sc. Practical Course Paper-3 :
Based on theory papers and key competency course

1. Determination of exact normality of HCl solution.
2. Crystallization of given organic compounds. (6 samples).
3. Preparation and standardization of NaOH solution-
(Using standard HCl).
4. Purification of given organic liquid by simple distillation.
(6 samples).
5. To determine exact normality of NaOH solution using Oxalic acid.
6. Purification of given mixture of organic liquids by fractional distillation method (3 samples).
7. Preparation and standardization of KMnO_4 solution Using oxalic acid.
8. Purification of naphthalene by process of sublimation.
(2 samples).
9. Purification of given mixture of organic liquids by fractional crystallization (2 samples).
10. Standardization of H_2SO_4 solution.
11. To determine molecular weight of sulphur by freezing point of naphthalene.
12. To find out molecular weight by elevation in boiling point method.
13. Determination of partition coefficient of iodine between water and carbontetrachloride.
14. Determination of partition coefficient of ammonia between chloroform and water.
15. To separate and identify a mixture of o-nitro-aniline and p-nitroaniline by T.L.C.
16. To separate and identify a binary mixture of inorganic cations by paper chromatography (2 sample mixture)
17. To determine relative viscosities of given salt solution (molar) of NaCl, Na_2SO_4 and AlCl_3 .
18. To find out molecular weight of high polymer by viscosity method.
19. Safety rules in laboratory.
20. From a given mixture separate the cations by column chromatography using cellulose.(
2 sample mixtures)
21. Determination of freezing point curve of—
a) Orthonitrophenol b) Paratoludine
22. To find out boiling point composition curve of liquid mixture (Alcohol:Water)

23. To calibrate the given thermometer.
24. Determination of H_2SO_4 and H_3PO_4 in a mixture.
25. To determine percentage of optically active substance in sucrose solution.
26. Determination of specific refractions of liquids A & B and determination of percentage composition of mixture C (Benzene + CCl_4).
27. Determination of Ca^{2+} and Mg^{2+} in dolomite solution.
28. Determination of Cu and Ni in Cu-Ni alloy solution.

Along with this lab work following skills can be developed in the student.

1. Device exercise to be done as part of experiment.
 2. Computer literacy (MS word, Power Point, Internet browsing, downloading etc.)
 3. Technical and writing skill
 4. Personality development related work.
- They may select above listed experiment for adopting above skills

PROPOSED SYLLBUS

Subject Title:

VOCATIONAL BIOTECHNOLOGY

Objectives:

To study basics of Biochemistry and Biophysics & instrumentation, Microbiology And Mathematics, statistics, & computer for biologists

To study Cell and molecular biology, Recombinant DNA technology and Bioinformatics, tissue culture, Immunology etc

To know about Entrepreneurship

SUMMARY CHART

Paper	Year	Paper	Name of the paper
1	I	Theory	Biochemistry and Biophysics & instrumentation
2	I	Theory	Microbiology And Mathematics ,statistics, & computer for biologists
3	I	Practicals	Practical Course Based on theory papers and key competency course
4	II	Theory (Voc-BIOTECH- 211)	Cell and molecular biology
5	II	Theory (Voc- BIOTECH - 212)	Recombinant DNA technology and Bioinformatics
6	II	Theory (Voc- BIOTECH - 221)	Animal and plant tissue culture
7	<i>II</i>	Theory (Voc- BIOTECH - 222)	Immunology
8	II	Practicals	Practical Course Based on theory papers and key competency course
9	III	Theory (Voc- BIOTECH - 335)	Plant Biotechnology
10	III	Theory (Voc- BIOTECH - 336)	Environmental biotechnology & Microbial biotechnology
11	III	Theory (Voc- BIOTECH - 345)	Animal biotechnology
12	III	Theory (Voc- BIOTECH - 346)	Entrepreneurship
13	III	Practicals	Practical Course Based on theory papers and key competency course

PROPOSED SYLLBUS

Subject Title:
VOCATIONAL BIOTECHNOLOGY

Class: F. Y. B. Sc.

Biochemistry and Biophysics & instrumentation

Theory:

Paper-1: Section I: Biochemistry

Chapter-1 Introduction to Biochemistry: (01)
History and development of subject, cell and organism
and biochemical entities

Chapter-2 Properties of water : (01)
Polarity, Hydrogen bond formation, Heat of vaporization,
Heat of fusion, melting point, boiling point.

Chapter-3 Carbohydrates : (06)
Defination, classification, properties of carbohydrates,
monosaccharides, disaccharides, and polysaccharides
and their functions.

Chapter-4 Amino acids and proteins: (06)
Defination ,properties and classification of amino acids.
Defination, physical and chemical properties of proteins,
structure of protein, Classification of proteins based on
their functions. Role of proteins.

Chapter –5 Lipids : (04)
Defination, Classification, properties and functions of lipids

Chapter-6 Enzymes : (06)
Defination, classification, properties, factors affecting
activity of enzymes, role of enzymes in industry,
Coenzymes and role in biological systems.
Isoenzymes and their role.

Chapter-7 Nucleic acids : (02)
Defination, components of nucleic acids, structure of
DNA and RNA, Biological functions.

Chapter –8 Introduction to metabolism : (02)
Concept of free energy, energy rich compounds,
free energy and oxidation reduction reactions.

Chapter-9 Carbohydrate metabolism : (08)
Glycolysis and pentose phosphate pathway, Regulation
of glycolysis, TCA cycle.

References:

- 1) Principles of Biochemistry by Nelson and Cox
- 2) Outlines of biochemistry, Conn, Stumph, Bruening, Doi by Wiley international publication.

Paper 1 : Section II : Biophysics and instrumentation

Chapter -1 Introduction to Biophysics (02)

Chapter -2 Chromatographic techniques (08)

- 1) adsorption techniques- (thin layer and column chromatographic)
- 2) Partition chromatography (Paper ,gas chromatography)
- 3) Ion exchange chromatography
- 4) Affinity chromatography
- 5) Gel filtration chromatography

Chapter -3 Spectrophotometry (12)

- 1) uv and visible spectrophotometry
- 2) Infra-red spectrophotometry
- 3) Nephelometry
- 4) Turbidometry

Chapter-4 Centrifugation (06)

- 1) Theory ,
- 2) Preparative and zonal centrifugation
- 3) Tubular and disc bowl centrifugation
- 4) Analytical centrifugation

Chapter –5 Microscopy (04)

- 1) Introduction to microscopy
- 2) Compound microscopy
- 3) Dark field, phase contrast microscopy,
- 4) SEM and TEM.

Chapter –6 Radioisotopes (02)

- 1) Radioisotopes in biology and their applications.

Chapter - 7 Miscellaneous methods

- 1) Ph and Eh measurements
- 2) Conductivity measurements
- 3) Filtration as a lab tool

References:

- 1) Wilson Keith and Kenneth H.Goulding (1994) principles of techniques of practical biochemistry. 4TH Edn. Cambridge University Press, London.
- 2) Khandpur R.S. (1989) Handbook of Analytical Instruments Tmh Pub Co. Ltd.New Delhi.

F.Y.B.Sc. Paper-2 : Microbiology And Mathematics, statistics and computer for Biologists:

Theory :

Paper 2 : Section I : Microbiology

Chapter - 1 Historical background of microorganisms (02)

Discovery of microbial world, Controversy over spontaneous generation , contributions of Pasteur, Germ theory of Koch, Contributions of Lister, Discovery of N₂-fixing bacteria, Discovery of pathogens, and advantages in immunology.

Chapter – 2 Phylogeny (03)

Three domain, five kingdom, eight kingdom classification, Salient features of prokaryotes, eukaryotes, plants, animal fungi, Archeae bacteria.

Chapter – 3 Methods of observation of bacteria. (06)

Staining procedures
Types of stains- Simple, monochrome, gram capsule, cyst, flagella, spore staining.
Isolation of bacteria – T, spread plate technique, Pour plate technique,

Chapter-4 Enrichment culture techniques (08)

Extremophiles- Thermophiles, Acidophiles,
Algae, Fungi, Blue green algae-(Phosphate solubilising organisms, Rhizobium,
Azotobacter)
Colliforms (MPN/Presumptive)
Screening of antibiotic producer by crowded plate
technique, Replica plate technique for screening of
mutants (Vit B12, Auxins and Gibberellins).

Chapter-5 Culturing of microorganisms. (06)

Preparation of media, Nutritional classification, Types
of media, Different components of media, Simple media,
enrichment media, selective media, differential media
NA, PDA, BAP, MAC, SS)

Chapter –6 Sterilization and disinfection (04)

Physical agents, Chemical agents Radiation

Chapter-7 Symbiosis and pathogenesis (04)

Commensalism, amensalism, Mutualism, Co-operation,
Syntrophism, antagonism, predation.
Pathogenesis
Mechanism of pathogenesis, overview of bacterial and viral pathogenesis

Chapter-8 Viruses (03)

Structure of viruses, Classification with representative example.

REFERENCES:

- 1) Pelzer 'Principles of microbiology
- 2) Prescott and Harley "Introduction to microbiology"
- 3) Atlas and Bartha "Microbial ecology"
- 3) K.R. Aneja "Experiments in Microbiology, plant pathology and biotechnology.
- 5) Biswas and Biswas "Introduction to viruses."

Paper2 : Section II : Mathematics, statistics and computer for Biologists:

1) Mathematics:

Chapter -1 Concept of differentiation and integration (14)

Chapter-2 Concepts of scales and variables

Chapter -3 Sequence and series

Chapter -4 Limits and derivatives

Chapter-4 Trigonometric functions

Chapter -5 Permutations and combinations

2) Statistics: (14)

Chapter-1
Descriptive statistics

Chapter -2
Frequency distribution- Introduction to normal, binomial and poisson distribution. Test for goodness of fit.

Chapter-3
Comparison of two sample means, T-Tests, nonparametric tests,

Chapter-4
Regression and correlation

Chapter-5 Experimental design and sampling

3) Computers (08)

1) General introduction to computers, organization of computers, digital and analogue, Programming.

- 2) Applications of computers in industry.
- 3) Introduction of internet and accessing databases.

REFERENCES:

- 1) Wardlaw A.C. Practical statistics for experimental biologists.
- 2) Cochran W.G. and G.W. Snedeco statistical methods –Sixth Ed.

F.Y.B.Sc. Paper-3 : Practical Course Based on theory papers and key competency course

Practicals based on Paper-1, section I: Biochemistry

- 1) Qualitative tests for carbohydrates.
- 2) Quantitative estimation of reducing sugars from a given sample.
- 3) Quantitative estimation of carbohydrates by using anthrone reagent
- 4) Quantitative estimation of proteins by using Folin Lowry method.
- 5) Quantitative estimation of proteins by using Biurate method
- 6) Quantitative estimation of DNA using Diphenyl amine reagent.
- 7) Quantitative estimation of RNA using Orcinol reagent.
- 8) Paper / TLC chromatographic technique for amino acids.
- 9) TLC of chlorophyll pigments.
- 10) TLC of sugars
- 11) Assay of Amylase enzyme.
- 12) Demonstration of column chromatography.

Practicals based on Paper-1, section II: Biophysics and instrumentation

- 13) Determination of molar extinction coefficient using colorimeter, visible spectrometer
- 14) Estimation of PH, Eh and conductivity of natural and commercial preparations.
- 15) Determination of dry weight, total solids and moisture content by gravimetric method
- 16) Demonstration of instruments :
 - Ultracentrifuge
 - SEM
 - TEM
 - Gas chromatography
 - IR spectroscopy

Practicals based on Paper-2, section I : Microbiology

- 17) Cleaning of glassware ,Preparation of media, cotton plugging & sterilization
- 18) Monochrome & Gram staining.
- 19) Capsule and Spore staining.
- 20) Isolation of micro organisms from water or soil samples by Streak Plate method. Study of colony characteristics.
- 21) Isolation of bacteria from food sample by pour plate method.
- 22) Enrichment & Isolation of Rhizobium from root nodule.
- 23) Enrichment & Isolation of Azotobacter from soil using Ashby's mannitol agar.
- 24) Isolation of antibiotic producers using Crowded plate method.

- 25) Potability Test for water. Presumptive, Confirmed, Completed.(Demonstration)
- 26) Production of wine or alcohol from any of the following carbohydrates.
Apple/Grape/Pineapple/Starch containing medium.
- 27) Preparation of jam from fruit pulp.
- 28) Enrichment of different organisms using Winogradsky's column.

Practicals based on Paper-2, section II : Mathematics, statistics and computer for Biologists

- 29) Data entry and statistical analysis using excel
- 30) Data sorting
- 31) Tabulation
- 32) Plotting frequency distribution,
- 33) T-Test
- 34) Regression and correlation
- 35) Growth curve

Practicals based on Key Competency Course :

- 36) Listening skill component
- 37) Reading skill component
- 38) Writing skill component

PROPOSED SYLLBUS

Subject Title:

INDUSTRIAL MICROBIOLOGY

Objectives :

To study Instrumentation and material & Design, Microbial Diversity & Cultural Methods and Mathematics & Statistics for Biologists

To know about Bio-reactors –Design & Operation, Fermentations & Down-stream processing, Screening & Process Optimization

To learn about Pollution Control Technology, Tissue Culture, Molecular Biology & Genetic Engineering

To study Industrial management , law & taxation

Summary Chart

Paper	Year	Paper	Name of the Paper
1	I	Theory	Instrumentation and material & Design
2	I	Theory	Microbial Diversity & Cultural Methods and Mathematics & Statistics for Biologists
3	I	Practicals	Based on theory papers and key competency course
4	II	Theory (Voc-IND-MIC-211)	Bio-reactors –Design & Operation
5	II	Theory (Voc-IND-MIC-212)	Screening & Process Optimization
6	II	Theory (Voc-IND-MIC-221)	Fermentations & Down-stream processing
7	II	Theory (Voc-IND-MIC-222)	Quality Assurance and analytical methods
8	II	Practicals	Based on theory papers and key competency course
9	III	Theory (Voc-IND-MIC-335)	Pollution Control Technology
10	III	Theory (Voc-IND-MIC-336)	Plant & Animal Tissue Culture
11	III	Theory (Voc-IND-MIC-345)	Molecular Biology & Genetic Engineering
12	III	Theory (Voc-IND-MIC-346)	Industrial management ,law & taxation
13	III	Practicals	Based on theory papers and key competency course

PROPOSED SYLLBUS

Subject Title:

INDUSTRIAL MICROBIOLOGY

Class: F. Y. B. Sc.

Instrumentation and Design & manufacture of a fermenter

Theory:

Paper-1: Section I : Instrumentation

- 1) General consideration in analysis :** (05)
- a) Sensitivity and detection limits
 - b) Precision and accuracy
 - c) Comparison with standards
 - d) Standard additions and subtractions
 - e) Data plotting
 - f) Standard operating procedure (SOP) equipments and analytical instrument
- 2) Chromatographic techniques :** (10)
- a) Adsorption chromatography (thin layer and column chromatography techniques
 - b) Partition chromatography (e.g. paper chromatography, gas chromatography, etc)
 - c) Ion-exchange chromatography
 - d) Affinity chromatography
 - e) Gel permeation chromatography
- 3) Spectrophotometry :** (09)
- a) U.V. and Visible spectrophotometry
 - b) Infra-red Spectroscopy
 - c) Flame photometry
 - d) Flurometry
 - e) Nephelometry
 - f) Turbidometry
 - g) Polarimetry
- 4) Centrifugation :** (08)
- a) Theory
 - b) Bottle centrifuge
 - c) Preparative ultracentrifuge
 - d) Zonal centrifuge
 - e) Analytical ultracentrifuge
 - f) Tubular bowl centrifuge
 - g) Disc bowl centrifuge
 - h) Conveyor discharge centrifuge
 - i) Basket centrifuge
- 5) Miscellaneous methods :** (04)
- a) pH and Eh measurements
 - b) Conductivity measurements
 - c) Filtration as a laboratory tool

References :

1. Wilson Keith and Kenneth H.Goulding (1994) Principles and techniques of practical biochemistry. 4th Edn. Cambridge University Press, London.

2. Dean J.A. (1995) Analytical Chemistry Handbook, McGraw Hill Inc. New York.
3. Khandpur R.S.(1989) Handbook of Analytical Instruments, TMH Pub. Co.ltd. New Delhi.
4. Ewing G.W.(1985) Instrumental Methods of Chemical Analysis 5th Edn. McGraw Hill Book Co. New York.
5. Willard H.H., L.L. Merrit and J.A. Dean (1971) Instrumental Methods of Analysis, Affiliated East-West Press Pvt. Ltd. New Delhi.

Paper 1 : Section II : Materials and design

1) Materials and Polymers : (13)

A. Materials :

- a) Metals and alloys used in bioprocessors physical, chemical and biological properties
- b) Metal toxicity, oligodynamic action, corrosion and biofouling of metals.
- c) Microbial leaching and recovery of metals.

B. Polymers :

Thermoplastics : Physical, chemical and biological properties, biomedical and biotechnological applications.

- a) Thermostable polymers : Physical , chemical and biological properties and applications.
- b) Plastic molding and die making
- c) Glass, rubber and other materials : Grades, their physical, chemical and biological properties.
- d) Techniques of glass blowing and latex curing

2) Engineering Drawing and Bio illustrations :

(05)

- a) Introduction
- b) Instruments for Drawing
- c) Lines, lettering & dimensions
- d) Geometrical construction
- e) Scales
- f) Curves and in drawings
- g) Orthographic projection
- h) Projection of solids
- i) Isometric projection
- j) Sectional view

3) Design:

(13)

- a) Volume and area calculations, drawings, piping and instrumentation diagrams, electrical and civil diagrams.
- b) Computer Aided design (CAD) Peripherals
- c) Introduction of Auto-CAD

References :

1. Mcneil ,B. and Harvey, L.M. (eds) Fermentation. A practical Approach Irl Press,Oxford
2. Aiba,S. Humphrey,A. E. and Millis, N.F.(1973). Biochemical Engineering (2nd Edn.) Academic Pres,New York.
3. Stanbury , P.F.,Whitekar A. and Hall, S.J.(1995) Principles of Fermentation Technology (2nd Edn.) Pergamon Press.
4. Perlman,D. Advances in Applied Microbiology, Academic Press, New York.

Theory :

Paper 2 : Section I : Microbial Diversity & Cultural Methods

1) Enrichment Culture Methodology : (14)

- a. Enrichment techniques for algae, protozoa, fungi, yeast, diatoms, rotifers, actinomycetes, phototrophs, chemolithotrophs and anaerobic bacteria.
- b. Single cell protein and its importance.
- c. Types of growth media – minimal, enriched, synthesis, complex, selective, dehydrated media.

2) Extremophiles : (12)

- a. Natural habitat and ecology of methanogens, acidophiles, alkalophiles, thermophiles, halophiles, psychrophiles, thermoacidophiles.
- b. Industrial importance of extremophiles.
- c. Extrimozymes, their potential applications and methods of modification, e.g. Taq polymerase.
- d. Physiology, mode of survival / adaptation and evolutionary lineage.
- e. Oligophiles.
- f. Unculturable bacteria.

3) Culture preservation and Stability : (10)

- a. Culture collection and nomenclature – National and International culture collection.
- b. Operation and Management of culture collection.
- c. Special methods of storage for fungi, algae, bacteria, protozoa, phages.

References :

1. Venkataraman G. S. Cultivation of algae :-
Indian Council of Agricultural Research – 1969, New Delhi.
2. Cooney D. Emerson R Thermophilic Fungi
W. H. Freeman and company – San Fra
3. Stanier R., Ingraham J., Wheelis M. Painter P. General Microbiology
5th Edition, 1993, Macmillan.
4. Bold H and Wynne M. Introduction to algae :- Structure and
reproduction. Prentice Hall of India – New Delhi 1978.
5. Chapman V. J. and Chapman D. J. The Algae-2nd Edition
English Language Book Society and Macmillan.
6. Algal Cultures and Phytoplankton Ecology J. University of London-
Anthlone Press 1965.
7. Loddder J. The Yeasts :- A Taxonomic Study – 2nd Edition
North Holland Publishing Company – Amsterdam.
8. Gibbs B. M. and Shapton D. A. Identification methods for
microbiologists. Academic Press 1968.
9. Indurkar A. K. Protozoa 1979. Practical Course in Cytology
Narendra Prakashan, Pune.
10. Westphall A. Protozoa 1976.
Blackie and Son, Glasgow.
11. Norris J. r., Ribbons D. W. Methods in Microbiology Vol. 3A, Vol 3B, Vol 4.
Academic Press – London and New York.
12. Holt J., Kreig N., Sneath P., Staley J., William S. Bergey's Manual of
Determinative Bacteriology :- 9th Edition.
Williams and Wilkins – A waverly company.
13. Kreig N., Holt J. Bergey's Manual of Systematic Bacteriology :- Vol 1,
Williams and Wilkins – Baltimore / London.
14. Sneath P., Mair N., Holt J. Bergey's Manual of Systematic Bacteriology :-
Vol. 2, Williams and Wilkins
15. Stanley J., Bryant M., Pfenning N., Holt J. Bergey's Manual of Systematic
Bacteriology :- Vol 3, Williams and Wilkins
16. William S., Sharpe E., Holt J. Bergey's Manual of Systematic Bacteriology
:- Vol 4, Williams and Wilkins
17. Barnett H., Hunter B. Illustrated Genera of Imperfect Fungi – 3rd Edition.
Burgass Publishing Company.
18. Laskin A., Lechevalier H., CRC Hndbook of Microbiology – Vol I. Bacteria-
2nd Edition. CRC Press, Inc.
19. Laskin A., Lechevalier H., CRC Hndbook of Microbiology – Vol II, Fungi,
Algae, Protozoa and Viruses – 2nd Edition. CRC Press, Inc.
20. Gould G., Corry J. Medical Growth and Survival in Extremes of
Environment – 1980. Academic Press.

Paper2 : Section II : Mathematics and Statistics for Biologists

1. Mathematics : (12)

- a) Concepts of differentiation and integration
- b) Concepts of scales and variables
- c) Linear Programming
- d) Probability
- e) Permutations and Contribution
- f) Sequence and Series
- g) Limits and derivatives
- h) Integration and Matrix Algebra
- i) Trigonometric functions

2) Statistics : (14)

- a) Descriptive statistics
- b) Frequency distributions : Introduction to normal, binomial and Poisson distribution. Test for goodness of fit.
- c) Comparison of two sample means : t-tests, nonparametric tests
- d) Regression and correlation
- e) Categorical data and proportion data : Chi square test
- f) Factorial design (ANOVA and F test)
- g) Experimental design and sampling

3) Modeling in Biology : (10)

- a) Concept and applications of modeling, Population models
- b) Exponential, Logistic and chemostat models
- c) Models in population genetics. Hardy-Weinberg equation.
- d) Optimization models

References :

1. Cochran W.G. & G.W. Snedeco statistical methods-Sixth Edition
2. Wardlaw A.C. Practical statistics for experimental biologists.

F.Y.B.Sc. Paper-3: Practical Course
Based on theory papers and key competency course

Practicals on Paper-1, section I: Instrumentation

- 1) Paper and thin layer chromatography of amino acids, sugars, steroids, etc.
- 2) Determination of molar extinction coefficient using colorimeter U.V.-visible spectrophotometer.
- 3) Estimation of pH, Eh and conductivity of natural and commercial preparations.
- 4) Determination of dry weight, total solids, moisture content by gravimetric methods.
- 5) Demonstration of instrumentation of :
 - a) Ultracentrifuges
 - b) HPLC / FPLC

Practicals on Paper-1 , section II : Materials and Design :

- 6) Drawing and equipment and instruments
- 7) Introduction of computer aided design
- 8) Mechanical workshop, fabrication techniques
- 9) Demonstration of plastic molding and glass blowing

Practicals on Paper-2, section I : Microbial Diversity and Cultural Methods

- 10) Enrichment and isolation of thermophilic fungi, bacteria, actinomycetes.
- 11) Cultivation of anaerobes – *Clostridium*, Methanogens.
- 12) Enrichment of chemolithotrophs – sulphur oxidizers, ammonium and nitrite oxidizers, iron oxidizers.
- 13) Cultivation of cyanobacteria and types of algae.
- 14) Demonstration of cyst of *Azotobacter*. Isolation of symbiotic and non symbiotic nitrogen fixers
- 15) Enrichment techniques for photo hetero trphs- purple or green sulphur bacteria.
- 16) Phase contrast microscopy- observation of unstained bacterial cell, yeast- protoplast and spore.

- 17) Enrichment technique for oil degrading bacteria, halophile and halo tolerant bacteria.
- 18) Isolation of fungal and bacterial plant pathogen.
- 19) Methods of preservation of cultures of microorganisms.
- 20) Enrichment of sulphite reducers.

Practicals on Paper-2, section II : Mathematics and Statistics for Biologists

- 21) Data entry and statistical analysis using excel
- 22) Data sorting
- 23) Tabulation
- 24) Plotting frequency distribution, scatter plot
- 25) T-test
- 26) Regression and correlation
- 27) ANOVA & F-test
- 28) Growth curve

Practicals based on key competency course :

Along with this lab work following skills can be developed in the student.

1. Device exercise to be done as part of experiment.
 2. Computer literacy (MS word, Power Point, Internet browsing, downloading etc.)
 3. Technical and writing skill
 4. Personality development related work.
- They may select above listed experiment for adopting above skills

Electronic Equipment Maintenance

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

SUMMARY CHART:

Year	Paper	Term/ Semester	Title of the Course
First	I		Test and Measurement Instruments and Consumer Products.
First	II		Maintenance Concepts and Repairs I
First	III		Laboratory
Second	I	I	Audio, Video and Office Equipments A
Second	II	I	Maintenance Concepts and Repairs IIA
Second	I	II	Audio, Video and Office Equipments B
Second	II	II	Maintenance Concepts and Repairs IIB
Second	III	I & II	Laboratory
Third	V	III	Electronic Equipment – Trouble shooting and Repairs
Third	VI	III	Electronic Instrumentation
Third	V	IV	Entrepreneurship Development
Third	VI	IV	Medical Instrumentation
Third	VII	III & IV	Laboratory

F. Y. B. Sc (Vocational)
(Proposed to be implemented from June 2008)
Electronic Equipment Maintenance (EEM)
PAPER I: T & M INSTRUMENTS AND CONSUMER PRODUCTS

Objectives

- To understand Measurement Concepts terminology and definitions, related Techniques and corresponding numerical problems. (Module I)
- To understand functioning (using block diagram) and method of setting up the frequently used Electronic Instruments in the laboratory, their respective salient features and important technical specifications. (Module 2 & 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 (Module 4 & 5)

F. Y. B. Sc. (Vocational)
(Proposed to be implemented from June 2008)
Electronic Equipment Maintenance (EEM)
PAPER I: T & M INSTRUMENTS AND CONSUMER PRODUCTS

<p>Module 1</p> <p>Measurement Concepts and Techniques</p>	<p>Definitions of the terms, applications and related numerical problems</p> <p>Accuracy, Precision, Resolution, Sensitivity, Errors, Analysis, Limitations, Loading effect, Noise pick up, EMI, Shielding and Grounding</p> <p>Analog versus Digital Instruments, Concept of auto ranging, Measurement techniques and relevant measurements</p>
<p>Module 2</p> <p>Electronic Instruments for Measuring Basic Parameters</p>	<p>Construction, Principle, typical applications and related typical numerical problems</p> <p>PMMC Multimeter, FET input voltmeter, RLC bridges</p> <p>i.e. Introduction, Wheastone bridge, Kelvin bridge, Maxwell bridge, Hay bridge, Schering bridges and Wein bridge, Cathode Ray Oscilloscope, Digital Storage Oscilloscope (DSO), Digital Voltmeter, Digital multimeter, Time measurement, frequency counter, Power meter, Q meter, Megger</p>
<p>Module 3</p> <p>Electronic Instruments for Testing Circuits/ Equipments</p>	<p>Construction, Principle, typical applications and related typical numerical problems</p> <p>AF signal generator, RF signal generator, Pulse generator, Function generator, Power supply</p>
<p>Module 4</p> <p>Home/Office & Other Appliances</p>	<p>Construction, Principle of working and typical applications</p> <p>Digital Clock (watch), Microwave oven, Mixer, grinder, Roaster, Electric geyser, Electric iron, Telephone instrument, Hearing aids, Electronic ignition system, Electronic door bell, Burglar alarm system, Electronic calculator, Electronic object counter</p>
<p>Module 5</p> <p>Power Line Protection Appliances/ Devices</p>	<p>Construction, Principle of working and typical applications</p> <p>Circuit breakers, Home protector, spike protector, Power supply, Stabilizers, Servo stabilizer Online UPS and Off Line UPS.</p>

F. Y. B. Sc (Vocational)
(Proposed to be implemented from June 2008)
Electronic Equipment Maintenance (EEM)
PAPER II: MAINTENANCE CONCEPTS AND ASSEMBLY METHODS

Objectives

- *To understand maintenance concepts and commonly used terms (Module 1)*
- *To get acquainted with different electronic components, their uses, reading of data sheets, methods of applying simple functional check, fault findings and (Module 2)*
- *To understand methods of soldering and desoldering techniques and related tools (Module 3)*
- *To know Different types of PCB's and preparation of PCB's methodology (Module 4)*
- *To understand wiring and its importance and to learn the skill of wiring of different typical electrical gadgets (Module 5)*

F. Y. B. Sc. (Vocational)
(Proposed to be implemented from June 2008)
Electronic Equipment Maintenance (EEM)

PAPER II: MAINTENANCE CONCEPTS AND ASSEMBLY METHODS

<p>Module 1 Electronic Equipment Maintenance Concepts and</p>	<p>Types of Electronic Equipment, Potential problems, Quality, reliability and failures, Mean time between failures (MTBF) and Mean time to fail (MTTF), Maintainability, Mean time to repair, Availability, Redundancy, Fail safe design, Maintenance policy and stages of maintenance</p>
<p>Module 2 Electronic Components, Devices And fault findings</p>	<p>Resistor, capacitor, inductors, AF transformers, IF transformers, visual identification and color codes, interpretation of information printed on body of devices, semiconductor device numbering, data sheets absolute maximum rating, reading of data sheets, packages and lead information, causes and indications of failure</p>
<p>Module 3 Soldering and Desoldering Techniques</p>	<p>Solder joint, dry solder joint, cold solder joint, Good and bad solder, solder material soldering tools, soldering gun, soldering station, ultra sonic soldering station soldering techniques, tools for desoldering, desoldering techniques, testing of soldering joints, Precautions during soldering and desoldering</p>
<p>Module 4 Printed Circuit Boards (PCB)</p>	<p>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), Idea of SMD, Bread board, Internal connections of breadboard, Circuit on breadboard, causes and indications of failure</p>
<p>Module 5 Electrical wiring and repairing</p>	<p>Types of Wires and its color convention, Gauges, Selection of wires, Types of cables, safe voltage and current ranges, Electric shock and precautions, Wire harnessing. Typical Simple Wiring, Wiring of tube light, switchboard wiring, stair case wiring, fan regulator and fan wiring, house wiring, Power cable wiring, Earthing.</p>

Reference Books:

1. Electronic Instruments and Systems: Principles, Maintenance and Troubleshooting by R. G. Gupta Tata McGraw Hill Edition 2001
2. Modern Electronic Equipment: Troubleshooting, Repair and Maintenance by Khandpur, TMH
3. Electronic Instrumentation and Measurement Techniques by WD Cooper, AD Helfrick, Prentice Hall of India Pvt. Ltd. New Delhi
4. Student Reference Manual for Electronic Instrumentation Laboratories by Stanley Wolf, and Richard F.M. Smith, Prentice Hall of India Pvt. Ltd. New Delhi
5. Electronics Shop Practices, Equipment and Materials By Clyde N. Herrick Prentice Hall Inc
6. Electronic Testing and Fault Diagnosis by G. C. Loveday, A. H. Wheeler Publishing

Useful websites:

<http://www.howstuffworks.com/>

F. Y. B. Sc (Vocational)
(Proposed to be implemented from June 2008)
Electronic Equipment Maintenance (EEM)
PAPER III: LABORATORY

Objectives

- *To learn to practice what is done in the theory courses.*
- To acquire skills to use the tools, equipment etc.
- To acquire circuit assembling and disassembling skills.
- 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 develop HR skills through the non-laboratory specially devised experiments/exercises.
- 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)
(Proposed to be implemented from June 2008)
Electronic Equipment Maintenance (EEM)
PAPER III: LABORATORY

Group A	<i>T and M instruments: Connection in circuits, using all modes and precautions therein</i>
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
4	Rheostat, Dimmerstat, Potentiometer And Switches
5	Diode, Zener, Transistor and LEDs
6	Dc Sources: Battery, Battery Eliminator, CVCC Power Supply.
Group C	PCB Preparation, Soldering and desoldering
7	Lay out preparation process on graph paper (Art work)
8	Process of Transferring layout on copper clad
9	Process of PCB Etching and Drilling
10	Soldering and Desoldering of Components from given PCB
Group D	Electrical Wiring (including drawing schematic)
11	Tube light testing
12	Switch board wiring
Group E	Home appliances (Schematic, Identification of blocks, fault finding, repairing and assembly)
13	Electric iron (semi automatic or fully automatic)
14	Electric geyser (Instant or storage)
Group F	Power line protection appliances (Schematic, Identification of blocks, fault finding, repairing and assembly)
15	MCBs
16	Spike protector
17	Home protector
Group G	Preventive Maintenance and Fault finding & Repairing
18	PMMC/ Analog multimeter /Digital multimeter
19	Single Power Supply or Dual Power Supply
Group H	Energy audit

20	Concept of Energy Audit and actual work on energy audit.
Group I	Educational excursion or Industrial visit (Equivalent to two exercises)
21	Visit a small or big scale Electronic company and prepare a brief report
22	Education excursion / Survey of Local Electronic companies / Interview of Eminent person from industry of this field and prepare a brief report

Note:

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