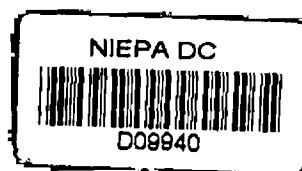


**VOCATIONALIZATION  
OF  
FIRST DEGREE EDUCATION**

**VOLUME - III**

**CURRICULUM FOR  
ENGINEERING AND TECHNOLOGY  
SUBJECTS**



**UNIVERSITY GRANTS COMMISSION,  
NEW DELHI**

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## TECHNOLOGY SUBCOMMITTEE

### IDENTIFIED SUBJECTS

1. ELECTRIC MAINTENANCE
2. COMPUTER MAINTENANCE
3. ENVIRONMENT AND WATER MANAGEMENT
4. REFRIGERATION AND AIR - CONDITIONING MAINTENANCE
5. AUTOMOBILE MAINTENANCE
6. MANUFACTURING PROCESSES
7. ELECTRICAL EQUIPMENT MAINTENANCE
8. CONSTRUCTION MANAGEMENT AND TECHNOLOGY
9. RURAL TECHNOLOGY

**1**

**VOCATIONAL SUBJECT**

**IN**

**ELECTRIC MAINTENANCE**

**TECHNOLOGY GROUP**

**CHART SHOWING RECOMMENDED COMBINATIONAL SUBJECTS WITH THE VOCATIONAL  
SUBJECTS**

<b>Sl. No.</b>	<b>Combinational subjects</b>	<b>Subject A (Science Group)</b>	<b>Subject B (Science Group)</b>
	<b>Vocational subjects</b>		
1.	Electronics Equipment Maintenance	Physics	Mathematics
2.	Computer Maintenance	Physics	Mathematics
3.	Rural Technology	Any subject	Any subject
4.	Construction Technology and Management	Any subject	Any subject
5.	Electrical Equipment Maintenance	Physics	Mathematics
6.	Environment & Water Management	Chemistry	Botany/Geography/ Geology/Physics/ Maths
7.	Automobile Maintenance	Any subject	Any subject
8.	Air-conditioning & Refrigeration Maintenance	Any subject	Any subject
9.	Manufacturing Process	Any subject	Any subject.

**TECHNOLOGY GROUP**

**CHART SHOWING THE PAPERS DISTRIBUTION IN B.Sc FOR THE COMBINATION OF  
2 CONVENTIONAL SUBJECTS AND ONE VOCATIONAL SUBJECT**

	Subject A		Subject B		Vocational subject*
	Pass course	Hons. course	Pass course	Hons course	
	2 Th	2 Th	2 Th	2 Th	2 Th
B.Sc. Pt.I	+	+	+	+	+
	1 lab.	1 lab.	1 lab.	1 lab.	1 lab.
					[4-6 weeks hands on training in an Industry.]
	2 Th	2 Th	2 Th	2 Th	2 Th
B.Sc. Pt. II	+	+	+	+	+
	1 lab.	1 lab.	1 lab.	1 lab.	1 Practice (Hands on training oriented work)
					[4-6 weeks summer training]
	2 Th	6 Th	2 Th	6 Th	1 Th
B.Sc. Pt.III	+	+	+	+	+
	1 lab.	3 lab.	1 lab.	3 lab.	Hands on Practice I training Practice II oriented work

\*Note: If a University is desirous to provide HOns. in a vocational subject, it may offer it after providing an intensive hands-on training by attaching the student to an industry for about six months. The student may then submit a detailed report of his training (supervised by a teacher + a person from the Industry) on a small industry which he may intend to set up.

## FINANCIAL REQUIREMENT

### 1. Non-Recurring:

- A) Equipment
- a) Rs.6.00 lakhs for each vocational subject
  - b) Rs.2.00 lakhs for workshop common to all the subjects.

B) Space:

- i) Laboratory 500 Sq.ft. for each vocational subject.
- ii) Workshop 1200 Sq.ft. common to all the vocational subjects.

### 2. Recurring (A) For each vocational subject.

- i) Honorarium to the Faculty Rs.1.00  
@ Rs.100/- per lecture
- ii) TA/DA to the invited Faculty and Rs.0.60  
Rail fare to the deputed students.
- iii) Consumable/Contingency Rs.0.40

Rs.2.00 lakh per year

### (B) Common to all the vocational subjects:

- i) Honorarium to the Co-ordinator @ Rs.500/-p.m. - Rs.6000.00
- ii) 2-4 permanent faculty member in different discipline at a centralised place when the University is offering more no. of vocational courses.



**ELECTRONIC EQUIPMENT MAINTENANCE****SUMMARY CHART**

Sr.No.	Year/ Semester	Paper	L (Period/Week)	P
1.	I/I	Principles of Electronics - I	3	-
2.	I/I	Electronic Devices, Components and Assemblies - I	3	-
3.	I/I	Basic Electronics Devices Laboratory	-	6
4.	I/II	Principles of Electronics - II	3	-
5.	I/II	Electronic Devices, Components and Assemblies - II	3	-
6.	I/II	Electronic Circuits Laboratory	-	6
7.		On the Job Training - I	Summer	One Month
8.	II/I	Operational Principles of Audio/ Video Equipment - I	3	-
9.	II/I	Microprocessor based Instrumen- tation and Control - I	3	-
10.	II/I	Repair and Maintenance Practice of Audio Equipment.	-	6
11.	II/II	Operational Principles of Audio/ Video Equipment - II	3	-
12.	II/II	Microprocessor based Instrumentation and Control - II	3	-
13.	II/II	Repair and Maintenance Practice of Microprocessor based equipment	-	6

14.		On the Job Training - II	Summer	One Month
15.	III/I	Trouble Shooting and Maintenance of Audio/Video Equipment	3	-
16.	III/I	Project Development	-	6
17.	III/I	Repair & Maintenance Practice of Video Equipment	-	6
18.	III/II	Trouble Shooting and Maintenance of Audio/Video Equipment - II	3	-
19.	III/II	Repair and Maintenance Practice of General Purpose Electronic Equipment	-	6
20.	III/II	Project Work based on Hands on Training	-	6

## ELECTRONIC EQUIPMENT MAINTENANCE

### PRINCIPLES OF ELECTRONICS - I

#### RESISTORS:

4 L

General Information: Symbol, Colour Code, Types (such as carbon, metal film, thin-film, thick-film, wire-wound). Variable resistors. Potentiometers (logarithmic linear multi-turn wire wound rheost

Physical Properties: Temperature Dependence (Thermister), Light Dependence (LDR), Voltage Dependence (VDR).

Technical Specifications Wattage and working Voltage. Methods of Measurement of Resistance: Very Low to Very High Values.

#### INDUCTORS:

3 L

General Information: Symbol, Types such as Air Core, Iron Core, Ferrite Core, Chocking Inductors (coil), Frequency response of an inductor.

Method of Measurement of Inductance: Using Universal Bridge, Design and Fabrication Rules.

#### TRANSFORMERS:

5 L

General Information: Principle, Types of Transformers such as Single Phase, Auto, Mains and Isolation Transformers. Frequency dependence of Transformers (Audio, IF and RF). Design of Mains Transformer and CVT

#### CAPACITORS:

4 L

General Information: Symbols, Colour Code, Types of Capacitors such as Air, Paper, Electrolytic, Mica, Tantalum Polyesterene. Fixed and Variable Capacitors.

Specifications of Capacitor: Power Factor, Working Voltage, Measurement of Capacitance: Universal Bridge. Application Areas.

#### RELAYS:

4 L

General Information: Symbol, Types of Relays, such as Reed, Electromagnetic.

Specifications, Rating, Application Areas.

#### MICROPHONES AND LOUDSPEAKERS

5 L

General Information: Principle, Types.

Specifications: Frequency Response, Input and Output Impedance, Power Rating, Size, Directionality (Omni and Uni - directional). Application Areas.

**TRANSDUCERS:**

3 L

Commonly used Transducers like LDR, Thermistors, Thermocouples, Photodiodes, Photo Transistors, IR Detectors, LVDT

**SWITCHES, CABLES AND CONNECTORS:**

3 L

SPDT, DPDT, Band Switches, Touch Switches, Thump-wheel Switches, Micro-Switches, Specifications, Application Areas.

**BATTERIES:**

1 L

Dry Cells, Lead-Acid Accumulators, Nickel Cadmium Cells, Standard Cells, Principle, Specifications.

**FUSES:**

Fast and Slow Fuses, Pilot Lamps.

**PCB**

2 L

Types of PCB

Layout Techniques, Cables and Connectors for PCB

**NETWORK THEOREMS:**

6 L

Kirchhoff's Current and Voltage Law, Maximum Power Transfer Theorem.

Thevenin's Theorem, Norton's Theorem, Superposition Theorem.

## PRINCIPLES OF ELECTRONICS - II

### LCR AND WAVESHAPING CIRCUITS:

10 L

Serial and Parallel Response, Idea of Black Box, Equivalent Circuits, Idea of Two Terminal and Two Port Networks, Equivalent Circuits, Integration, Differentiation using RC Circuits, Clipping Clamping.

### NUMBER SYSTEMS:

3 L

Introduction to Decimal, Binary, Octal, Hexadecimal Number Systems, BCD Codes, Interconversions of Decimal, Binary and BCD Numbers, Parity. Excess-3, Grey and Johnson Codes.

### LOGIC GATES:

3 L

Positive and Negative Logic.

Different Logic Gates such as AND, OR, NOT, NAND, NOR, EXOR,

Symbol and Truth Tables, Inverting and Non-Inverting Buffers.

### BINARY ARITHMETIC AND BOOLEAN ALGEBRA

4 L

Boolean Axioms, D Morgan's Theorems: Statement, Verification and Applications.

One Complaint, Half Adder, Full Adder, Half Subtractor.

### LOGIC FAMILIES:

6 L

~~TTL, ECL & CMOS Parameters Like Power Dissipation, Speed, Supply Requirements, Logic Level, Fan In, Fan Out, Noise Immunity.~~

### COMBINATIONAL CIRCUITS:

4 L

Encoders, Decoders.

### SEQUENTIAL CIRCUITS:

8 L

Flip Flops (RS, K, D, T, N, S) Shift Registers, Counters.

### Semiconductor memories

6 L

## ELECTRONIC DEVICES, COMPONENTS AND ASSEMBLIES - I

### INTRODUCTION TO SEMICONDUCTORS:

2 L

Energy Band Diagram: Conductor, Semiconductor, Insulator, Intrinsic and Extrinsic Semiconductors (p.n. Type), Diffused Junctions, Depletion Layer, Barrier Potential.

### JUNCTION DIODES:

6 L

Rectifying Diode, Forward and Reverse Bias Characteristic, Switching Diode, Varactor Diode, Photo Diode, Light Emitting Diode, IR sources and detectors, Optical Isolators, Zener Diode.

### BIPOLAR JUNCTION TRANSISTOR:

4 L

Basic Working Principle (Qualitative), Characteristics, Basic Configurations and Biasing, Operating Point, Load Line, Biasing for Stabilization of Operating Point.

### JEFT & MOSFET:

4 L

Basic Working Principle (Qualitative), Characteristics, Pinchoff Voltage.

### UNIJUNCTION TRANSISTOR:

2 L

Basic Working Principle (Qualitative), Characteristics, Applications, as a Switch.

### POWER CONTROL DEVICES:

2 L

Four Layer Diode (PNPN), Silicon Controlled Rectifier (SCR) Tracis, Diac, Principles & Characteristics.

### AMPLIFIERS:

7 L

Different Terms used in Amplifiers, such as Signal, Source, Input, Output, Voltage and Current Gain, Power Gain, Decibel, Input and Output Impedance.

Classification According to the Frequency Response, RC Coupled Class A Common Emitter Amplifier, Introduction to the Class B Operation.

### FEEDBACK IN AMPLIFIER:

2 L

Effect of Negative Feedback on Amplifier Performance.

**POWER AMPLIFIERS:**

6 L

Transformer Coupled Equivalent Circuit Only in Brief; Class A, Class B, Class AB and Class C. The Constant Power Hyperbola, The AC Load Line Input and Output Considerations, Determination of Non-Linear Distortion.

Push-Pull Amplifiers: Phase Splitter Circuits, Complimentary Push-Pull, Thermal Runway, Heat Sinks.

Class B and C Resonant Load Amplifiers, Graphical Class C Analysis, Resonant Load Requirements.

## ELECTRONIC DEVICES COMPONENTS AND ASSEMBLIES - II

### OPERATIONAL AMPLIFIER: 10 L

Basic idea of an OPAMP with black box concept, inverting and non-inverting inputs, virtual ground.

Parameters such as input impedance, output impedance, open loop gain, measurements of parameters.

Qualitative description of OPAMP as inverting and non-inverting amplifier, summing and difference amplifier, comparator and linear integrator, Instrumentation amplifier.

### OSCILLATORS: 5 L

Positive feedback, Barkhausen criteria, Phase shift oscillators, Wien Bridge oscillator, Tuned oscillator, Hartley, Colpits-oscillators, Crystal oscillator.

### POWER SUPPLIES: 6 L

Regulated power supply, zener regulated power supply, series and shunt regulated power supply, block diagram of IC 723, regulated supply using IC 723. Three terminal ICs power supply. Study of power supply. w.r. to variation in load and line voltage.

Switched mode power supply; Design principle and application.

### MODULATION: 4 L

AM and FM: Principles, modulation index, modulation bandwidth, balanced modulator.

### DEMODULATION: 4 L

AM & FM detectors, diode detector, ratio detector, balanced demodulator.

### IC 555: 3 L

Operation and applications.

### INTRODUCTION TO COMMUNICATION SYSTEMS: 4 L

Basic principles and operation of communication system.



## OPERATIONAL PRINCIPLES OF AUDIO AND VIDEO EQUIPMENT - I

Revision of AM and FM, communication bands, signal sources, Basic principles of propagation of e.m. wave through atmosphere and ionosphere; ground wave, sky waves, space waves, dead zones etc.  
4 L

RECEIVING ANTENNAE: 6 L

Antenna parameters like gain, load width, radiation pattern, effective aperture. Ferrite AE. Types of antennae like wire, loop, dish, yagi, telescopic, their construction and operating principles.

SUPERHETERODYNE RECEIVERS: 12 L

Principles, advantages, block diagram, RF input and AE coupling arrangements, RF amplifiers, mixer, local oscillator, IF amp. detector, audio amplifier, loud speaker, power requirements, tuning/aligning of receivers, waveforms and voltages at different check points. Circuit reading of various radio sets, repair and trouble shooting, automobile radios.

ELEMENT OF A TELEVISION SYSTEM: 22 L

Picture transmission, sound transmission, picture reception, sound reception, synchronization.

COMPOSITE VIDEO SIGNAL: 3 L

Scanning sequence details, sync details of the 525 line system, channel bandwidth, vestigial sideband transmission, reception of vestigial sideband signals, frequency modulation, FM channel bandwidth, channel bandwidth for colour transmission, allocation of frequency bands for television signal transmission, television standards.

PICTURE TUBES-Monochrome and Colour: 2 L

Beam deflection, screen phosphor, face plate, picture tube characteristics, picture tube circuit controls.

TELEVISION RECEIVERS: 15 L

Types of television receivers, receiver sections, video detector, video section fundamentals, video amplifiers-design principles, video amplifier circuits, automatic gain control and noise cancelling circuits, sync separation circuits, sync processing and AFC circuits, deflection oscillators, vertical deflection circuits, horizontal deflection circuits, sound system, RF tuner, video IF amplifiers, receiver power supplies, television receiver antennae, colour television antennae.

## OPERATIONAL PRINCIPLES OF AUDIO AND VIDEO EQUIPMENT - II

### TELEVISION APPLICATIONS:

8 L

Television broadcasting, cable television, closed circuit television, theatre television, picture phone and facsimile, video tape recording (VTR), television via satellite, TV games, HDTV, flatpanel TV, teleconferencing.

### TAPE RECORDERS:

12 L

Principles of magnetic recording, characteristics of magnetism, the hysteresis loop, recording head, recorded wavelength, response of head during reply, the effect of gap length, low frequency loss, other losses, equalization, the effect of non-linear characteristic of magnetisation, recording bias, A.C. bias, erasing the tape, block diagram of audio tape recorder. Oscillator, preamplifier, dolby, amplifier, record (play back) head, erase head, tapes (metal polymer), mechanical transport system, stereo recording, double deck, single deck, microphones (RF, cable), noise, maintenance of mechanical parts, head cleaners, head alignment, graphic equalisers.

### TELEPHONES:

10 L

Modulation, demodulation, modem, subscriber frequency allotment, channel organisation, signalling, switching, manual exchanges, STD, ISD, EPABX, Intercom-stress on equipment and EPABX, Value added services like FAX, mail.

### MEASURING INSTRUMENTS:

10 L

Multimeters analog/digital, oscilloscopes, signal generators, noise and sound level meters, frequency counters, error sources and precautions during measurement.

#### General Note:

Familiarisation with catalogues, standard specification, knowledge about companies referring to service manual.

#### Reference Books:

1. Fundamentals of acoustics-Kinsler and Frey.
2. Systems Trouble Shooting Handbook-Luces M.Faulkenberry.  
(John Wiley & Sons, 1986).

## MICROPROCESSOR BASED INSTRUMENTATION AND CONTROL - I

MICROCOMPUTER FUNDAMENTALS : 10 L

Introduction, simplified microcomputer architecture, simplified memory organization, instruction set, simplified CPU organisation, microcomputer operation.

THE MICROPROCESSOR : 8 L

Data sheet descriptions, pin diagram and function, microprocessor architecture, using the data/address register, using the stack pointer.

INTERFACING THE MICROPROCESSOR : 10 L

Introduction, interfacing with ROM, interfacing with RAM, input/output interfacing basics, interfacing with practical I/O ports, synchronizing I/O data transfers using interrupts, address decoding.

PROGRAMMING THE MICROPROCESSOR : 10 L

Machine and assembly languages, simplified instruction set, instruction set, arithmetic operations, instruction set-logical operations, instruction set-data transfer operations, instruction set-branch operations, instruction set-subroutine call and return operations, instruction set-miscellaneous operations, writing a program, addressing modes, program branching, program looping, using subroutines.

## MICROPROCESSOR BASED INSTRUMENTATION AND CONTROL - II

### THE INTEL 8080/8085 MICROPROCESSOR :

8 L

Introduction, the 8085 pin diagram and functions, the 8085 architecture, addressing modes, the 8080/8085 instruction set, the 8080/8085 data transfer instructions, the 8080/8085 arithmetic instructions, the 8080/8085 logical instructions, the 8080/8085 branch instructions, the 8080/8085 stack, I/O, and machine control instructions.

### PROGRAMMING THE 8080/8085 MICROPROCESSOR :

8 L

Introduction, straight-line programs, looping programs, mathematical programs.

### APPLICATIONS TO ILLUSTRATE THE USE OF MICROPROCESSOR IN

15 L

- i) traffic control
- ii) temperature control
- iii) digital clock
- iv) stepper motor control
- v) washing machine control

### PERSONAL COMPUTER ORGANISATION AND WORD PROCESSOR

10 L

**TROUBLE SHOOTING AND MAINTENANCE OF AUDIO AND VIDEO EQUIPMENT - I**

**REMOTE CONTROL AND SPECIAL CIRCUITS:**

**6 L**

Remote control, electromechanical control system, electronic control systems, electronic touch tuning, frequency synthesizer, TV tuner, automatic fine tuning (AFT), booster amplifiers, automatic brightness control, instant-on circuitry, picture-tube boosters.

**ALIGNMENT AND SERVICING EQUIPMENTS:**

**15 L**

Antistatic and low leakage Multimeter, Soldering Iron, Vacuum Tube Volt Meter (VTVM), Cathode Ray Oscilloscope (CRO), Signal Generator, Video Pattern Generator, Colour Bar Generator, Vector Scope, High Voltage Probe, Cable-Connectors, Shielding and Grounding.

## TROUBLE SHOOTING AND MAINTENANCE OF AUDIO/VIDEO EQUIPMENTS - II

- TELEVISION** 6 L
- Trouble shooting procedure, trouble shooting monochrome receivers, servicing of various functional blocks, trouble shooting colour receivers, servicing circuit modules, safety precautions in television servicing.
- TELEVISION CAMERA TUBES:** 2 L
- Basic principles and maintenance, direct recording
- BLOCK DIAGRAM OF VCR:** 5 L
- Requirement of VCR, rotating video drums, helical scan, guard band, frequency response, servo systems, tape tension regulator, reel servo, system control.
- Different formats, the quadruplex format, type B segmented format, type C format, the U matic format, the 1/2" V.H.S format, B-max system.
- SIGNAL PROCESSING, CHROME PROCESSING:** 5 L
- Colour under technique, recovery of down converted chrome signals, luminance processing-frequency modulation, deviation and bandwidth, automatic gain correction, limited, pre-emphasis, replay of luminance signal, Y/C delay, drop out compensator, block diagram of main requirements, zero guard band system, turners and modulators, the modulator.
- SERVO MECHANISMS AND SYSTEM CONTROL:** 3 L
- Recording, playback, tracking, capstan servo system control, loading and threading and play mode, record mode, auto stops, counter, audio video mutingy.
- CARE OF MECHANICAL SYSTEM:** 2 L
- Cleaning of heads and tape path, lubrication, replacement of parts, replacement of audio/CTC head, replacement of video drum, dihedral error, table height, tape tension, reel drive tongue, stop breaks.
- ELECTRONIC SYSTEM ALIGNMENTS:** 6 L
- Instruments, fault finding-the power supply, free running speed, the servo system, tracking, video system, playback section alignment, amplifier balance and gain, luminance signal adjustment, D.O.C., F.M. demodulator, limited balance, carrier leak, noise canceller, colour processing, up conversion, automatic colour correction, automatic phase connection, recording, luminance, sync, tip or clamping frequency, deviation set, white clip, chrominance, summary.

NEW TECHNOLOGIES:

4 L

Industrial aspects of consumer electronics, jigs and fixtures, quality control/management, production techniques, business cycle, new technologies, compact disc, laser disc.

REFERENCE BOOKS:

1. TV Servicing Handbook - Gordon J. King  
Mewhnes Butterworths
2. TV Fault Finding compiled by the staff  
of the radio constructors. - Data Publications
3. How to Trouble-shoot a TV Receiver  
D.B. Taraporevale and Co. Pvt. Ltd. - J.R. Johnson
4. Effective TV Production - Gerald Millerson

## PRACTICE - I

(At B.Sc. Part II level)

1. Development of soldering skill by constructing a few circuits and testing.
2. PCB making
3. Study of modulator
4. Study of oscillator
5. Tape recorder-testing, assembly and dis-assembly
6. Radio receiver - testing
7. Study of PA system and its testing
8. Study of EPABX, wiring and connectivity with telephone instruments.
9. Familiarisation with 8085 based microprocessor trainer kit. Location of 8085, 8279, 8253, Keyboard, display fields, EPROM Programmer, expansion slot, TTY and serial lines.
10. Entering and executing an assembly language program, codes for insertion, deletion, memory move, block fill, setting and examining registers and memory, single step execution of a program.
11. Writing of a program to add, subtract and multiply two numbers stored in memory (hnnn & nnnn + 1) and place the result in the subsequent memory, (nnnn + 2)
12. Writing of a program to test RAM for errors by writing 0's & 1's in alternate location and reading it for checking.
13. Making of a board with 8 LED's and four switches to connect to the 8085 kit on the expansion slot (8279).
14. Making of a board with 8 LED's and four switches to connect to the 8085 kit on the expansion slot (8255).
  - a) Program the 8255 to glow/switch off LED's.
  - b) Program the 8255 to switch ON and OFF the LED's every few seconds according to a given pattern (Hint: The pattern can be 01010101 and 10101010 or 00100100, or any other)
15. Design and assembly and testing of P based instruments (each equipment to 4 lab work).
  - i) Digital clock
  - ii) Temperature controller
  - iii) Washing machine controller



## LABORATORY EXPERIMENTS

- 1) Practice for use of
  - a) Multimeter (ordinary and electronics)
  - b) Power supply
  - c) Oscilloscope
  - d) Signal generator
- 2) Study of Resistor, Capacitor and Diodes
- 3) Study of Transistors
- 4) Study of LDR, Thermistor
- 5) Study of Zener diode and power supply
- 6) Study on Amplifier
- 7) Studies on Oscillator
- 8) Studies on AM/FM Modulator
- 9) Study of SCR and its firing characteristics
- 10) Familiarisation with bread board, IC types, pin number, IC manual and its use.
- 11) Determination of logic level thresholds for the inputs and outputs. To observe the propagation delay.
- 12) Familiarisation and use of different types of LED's seven segment display.
- 13) Use of 7447 BCD to 7 segment decoder.
- 14) Verification of truth tables for two inputs NOT, AND, OR, NOR Gates.
- 15) Study of shift registers.
- 16) Study of counter IC chips
- 17) Study of FLIP-Flop IC's
- 18) Study of A/D & D/A converters.

## LIST OF EQUIPMENT

1. TV Receivers	--	2 Nos.
2. Public Address System	--	2 Nos.
3. Signal Generators/Function Generator	--	4 Nos.
4. Oscilloscopes (20 MHz)	--	4 Nos.
5. VCR/VCP	--	2 Nos.
6. Tape Recorders (Stereo)	--	2 Nos.
7. Radio Receivers	--	2 Nos.
8. Colour Pattern Generator	--	1 No.
9. Digital and Analogue Multimeters	--	4 each
10. Power Supplies	--	4 Nos.
11. Bread Board	--	10 Nos.
12. Electronics Devices & Components, Resistors, Diodes, Capacitors, Transistors, Logic Gates, LED, Seven segment display devices, 555 timer, Voltage regulators, OP-Amps, Thyristors.		
13. Demonstration Kits for Amplifier, AM and FM Modulator, Oscillators.	--	2 each

## PRACTICE - II

(B.Sc. Part III Level)

### A: TELEVISION

1. Orientation and connection of TV antenna. Knowledge of booster connection and replacement. Knowledge of bloom unit-different types (for different TV sets) and replacement of baloon. Replacement of front end.
2. Power supply and resistance-cold tests. Voltage measurement at different points. To build SMPs for voltage between 6-15 volts (using IC's)
3. Horizontal and vertical oscillator checking and testing using CRO.
4. To see and read circuit diagram and to identify (locate) various blocks on P/S, H and V deflection, video amplifier, audio section, chroma section, IF section, IF section, tuner, tube and deflection yokes (centering and adjustment).
5. Audio section waveform testing step by step-sound separator, sound take off from IF section and then onwards to detector amplifier, IF alignment and loud speaker (intercarrier sound take off).
6. IF stage testing: IF alignment, tuner and band select.
7. Chroma processor: testing signals at various IC's.
8. Remote control studies - range, direction various controls, IR transmitter and receiver, coding of signal.
9. Fault finding: Cold testing and voltage testing at various parts. (Revision of parts 1 to 9).

### B: VCP/VCR

1. Study of block diagram and identification of various parts in VCR
2. Knowledge of simple audio type recorders, head replacement, bias adjustment, head alignment for reducing cross-talk of stereo.
3. Belt changing, head cleaning, replacement and alignment of heads.
4. Motor study and its replacement
5. Audio testing.

6. Servo system - electronic alignment using CRO. Tape drive, tape sync-system, head replacement [video drum, control head and audio head].
7. Play back system alignment.
8. Record system alignment.
9. Alignment and fault finding of audio section.

### PRACTICE - III

(B.Sc. Part III Level)

Project Work: Project work will relate to the design, fabrication, testing, repairing, report writing for setting up small industry by taking loan from financial institution, etc.

**2**

**VOCATIONAL SUBJECT**

**IN**

**COMPUTER MAINTENANCE**

**COMPUTER MAINTENANCE**

**SUMMARY CHART**

Sr.No.	Year/ Semester	Paper	L (Period/Week)	P
1.	I/I	Basic Analogue and Digital Electronics - I	3	-
2.	I/I	Computer Organisation - I	3	-
3.	I/I	Electronic Devices and Circuits Lab.	-	6
4.	I/II	Basic Analogue and Digital Electronics - II	3	-
5.	I/II	Computer Organisation - II	3	-
6.	I/II	Digital Electronics Laboratory	-	6
7.		On the Job Training - I	Summer	One Month
8.	II/I	Microprocessor Interfacing and Computer Hardware - I	3	-
9.	II/I	Testing and Debugging Methods and Tools - I	3	-
10.	II/I	Testing and Maintenance Practice of Microprocessor Based System	-	6
11.	II/II	Microprocessor Interfacing and Computer Hardware - II	3	-
12.	II/II	Testing and Debugging Methods and Tools - II	3	-
13.	II/II	Maintenance Practice of Computers	-	6
14.		On the Job Training - II	Summer	One Month

Sr.No.	Year/ Semester	Paper	L (Period/Week)	P
15.	III/I	P.C. Maintenance and Trouble shooting-I	3	-
16.	III/I	Project Development	-	6
17.	III/I	Computer Maintenance Practice	-	6
18.	III/II	P.C. Maintenance and Trouble Shooting - II	3	-
19.	III/II	Computer Assembly and Maintenance Practice	-	6
20.	III/II	Project Work	-	6

## COMPUTER MAINTENANCE

### BASIC ANALOG AND DIGITAL ELECTRONICS - I

**ELECTRONIC COMPONENTS (PASSIVE ELEMENTS):** 8 L

Working principles, symbols, types technical specifications, parameter value identification/measurement techniques and application areas for Resistors, inductors, capacitors, transformers, relays, switches, cables, connectors, batteries, PCBs, fuses, etc.

**TEST AND MEASURING INSTRUMENTS:** 4 L

Block diagram, working principles and user's guidelines for CRO, multimeter, function generator.

**NETWORK THEOREMS:** 4 L

Kirchhoff's current and voltage laws, maximum power transfer theorem, super position theorem, Thevenin's and Norton's theorems.

**LCR AND WAVESHAPING CIRCUITS:** 6 L

Series and parallel LCR resonance circuits, low pass, high pass, band pass and band pass filters, clipping and clamping circuits, charging and discharging of capacitor in a RC circuit-concept of time constant.

**ELECTRONIC COMPONENTS (ACTIVE ELEMENTS):** 8 L

Working principles, symbols, types, technical specifications, parameter value identification and application areas for

PN junction diodes-linear, varacter, photodiode, LED, zener diode, opto-isolators, BJTS-characteristics, basic configurations, biasing, operating point, load line, biasing for stabilization of operating point. UJT, JFET, MOSFET, SCR, Diac, Triac.

**AMPLIFIERS:** 4 L

Different terms used with amplifiers, such as signal, source, input, output, voltage and current gain, power gain, decibel, input output impedance, classification according to frequency response, biasing point.

**OPERATIONAL AMPLIFIERS:** 4 L

Basic idea of an OPAMP with black box concept, inverting and non-inverting inputs, virtual ground.

OPAMP parameters, qualitative description of OPAMP applications such as inverting, non-inverting, summing and difference amplifier, comparator and linear integrator.



## BASIC ANALOG AND DIGITAL ELECTRONICS - II

### POWER SUPPLIES:

4 L

Basic block diagram of a power supply-transformer, rectifier, filter, regulator, bridge rectifier.

Regulated power supplies: Zener regulator, series and shunt regulation, IC-723 based ERPs, CVCC, short circuit protections, fold back.

Switched mode power supply, operational principles and design

### OSCILLATORS AND MULTIVIBRATORS:

6 L

Positive feedback, Barkhausen criteria, phase shift, Wein bridge and crystal oscillator.

Multivibrators - Astable, monostable and bistable multibrators.

### LOGIC GATES AND FAMILIES:

6 L

AND, OR, NOT, NAND, NOR, EXOR gates symbols and truth tables.

TTL, ECL, CMOS logic families. Parameters, speed, power consumption packaging density, fan in/fan out, voltage levels, compatibility, noise margin level.

### COMBINATIONAL LOGIC CIRCUITS:

4 L

Encoders, decoders, demultiplexers, ICs from TTL, ECL & CD families.

### FLIP FLOPS:

RS, JK, master slave, D, T flip flops.

### SHIFT RESISTERS AND COUNTERS:

8 L

Parallel/serial in/out shift registers, ring counter, synchronous and asynchronous counters, scaling circuits stack.

### DATA CONVERTERS: ADCs, AND DAC:

4 L

With emphasis on commercially available/used ICs.

## COMPUTER ORGANISATION - I

NUMBER SYSTEMS: 4 L

Introduction to decimal, binary, octal, hexadecimal number systems, BCD codes, inter-conversions of binary, decimal and BCD numbers, excess-3, Gray and Johnson's codes. Concept of parity. ASCII code.

BOOLEAN ARITHMETIC AND THEOREM: 4 L

BLOCK DIAGRAM OF A COMPUTER I/O DEVICES, CPU, MEMORY: 4 L

PERSONAL COMPUTER ORGANIZATION, BLOCK DIAGRAM LEVEL: 10 L

Motherboard, supporting cards, keyboard, display, power supply, disk drives and BIOS.

MEMORY: 10 L

RAM, ROM, Mass storage media, commonly used chips (functional description only), units of storage-bit/byte, KB and MB, memory management: segmentation/partitioning, parity checking.

## COMPUTER ORGANISATION - II

FLOPPY/HARD DISKS: 8 L

Operational principle and sector information, medium density/high density floppy disks, hard disk configuration, disk formatting, data integrity.

OPERATING SYSTEM: 4 L

Introduction, functions of OS, time, sharing, multiprogramming, multitasking, multi-user O.S.

DOS: 6 L

Diskette operating system - MS-DOS, user environment, SBIOS, bootstrapping (general information).

DOS COMMANDS: 12 L

PERIPHERALS: Printer, plotter, mouse, tablet, light pen. 6 L

Introduction to UNIX and system administration 4 L

LAN 2 L

## MICROPROCESSOR INTERFACING AND COMPUTER HARDWARE - I

INTRODUCTION TO MICROPROCESSOR: 12 L

Microprocessor basic concepts, microprocessor architecture, instruction set, addressing modes, interrupts, memory mapping 8086, 8088, 80186, 80188, 80286, 80386.

Architecture of 16-bit processor - Intel 8086/8088, instruction set descriptors.

8086/8088 SYSTEM CONNECTIONS: Timing and trouble-shooting. 4 L

INTERRUPTS STRUCTURE OF 8086 - use of DOS interrupts of IBM-PC. 4 L

DIGITAL INTERFACING: 8 L

Programmable parallel ports and handshake input/output, interfacing displays and keyboards, centronics parallel port standards, printer interfacing and sharing.

ANALOG INTERFACING AND INDUSTRIAL CONTROL: 6 L

ADC AND DAC: Specifications. Interfacing and Applications. A Microcomputer-Based Industrial Process-Control System and Instrument.

Site Preparation, wiring, diagram and control of earth to neutral voltage. 2 L

## MICROPROCESSOR INTERFACING AND COMPUTER HARDWARE - II

### MULTIPLE MICROPROCESSOR SYSTEM AND BUSES:

10 L

8086/8088 maximum and minimum modes, DMA data transfer. Interfacing and refreshing dynamic RAM. Math coprocessor-8087 and I/O processor-8089. Multiple bus microcomputer systems VME bus concepts, IEEE 488 HPIB, PC Bus, EISA Bus.

### DATA COMMUNICATION:

8 L

Asynchronous serial data communication (Intel 8251 chip study). Serial data transmission methods and standards: RS-232, RS-422, RS-423A and RS-449. Telephone circuits and systems. CODECs. TDM and PCM. Asynchronous communication software on the IBM PC 8250 Chip, Synchronous serial data communication and protocol using 8251 chip.

### MICROCOMPUTER SYSTEM PERIPHERALS:

8 L

CRT terminals. Graphic terminals. Choice of display cards MGA, CGA, EGA and monitors (monochrome and colour). Floppy disk. Magnetic hard disk and optical disk data storage. Printer mechanisms. Speech synthesis and recognition with a computer.

### HARDWARE LAYOUT OF IBM-PC/XT:

6 L

Mother board, disk control, multiseriial I/O card, FAX and Telex Card EGA/VGA.

### CASE STUDIES OF DATA ACQUISITION SYSTEM, PCL<sup>4</sup>

4 L

### REFERENCE BOOKS:

1. Microprocessor and Interfacing: Douglas Hall (PHI).
2. Inside the OBM-PC : Peter Norton.
3. IBM-PC/XT Hardware: Reference Manual.
4. Data acquisition : Analog Devices, Burr-Brown.
5. Microprocessor Systems: The 8086/8088 Family Architecture, Programming and Design: Liu and Gibson (2nd Edition EEE, PHI).
6. Advance MS DOS: Ray and Duncan.

## TESTING AND DEBUGGING METHODS AND TOOLS - I

USING DEBUG, M/C LANGUAGE EXAMPLES, MASK.	5 L
INTRODUCTION TO 8088 ASSEMBLY LANGUAGE	4 L
PROGRAM INITIALIZATION: Algorithm, Flow Charting.	4 L
ASSEMBLING, LINKING, EXECUTING A PROGRAM	4 L
ADDRESSING MODES, DATA DEFINITION PSEUDO-OPS	3 L
MOV, ADD, SUB INSTRUCTIONS	3 L
LISTING PSEUDO-OPS, STACK OPERATIONS	3 L
SHORT/LONG JUMPS/BRANCHES, FLAG REGISTERS	4 L
LOOPING, SHIFT/ROTATE INSTRUCTIONS	4 L
INTRODUCTION TO PROGRAMMING IN 'C'	6 L

## TESTING AND DEBUGGING METHODS AND TOOLS - II

CALL PROCEDURES	3 L
READING FROM KEYBOARD, WRITING TO SCREEN	3 L
INTERRUPT 21H (DOS) 17H (BIOS)	4 L
STRING, HANDLING (MOVS, LODS, STOS, CMPS, SCAS)	4 L
TABLE HANDLING	4 L
MACRO PSEUDO-OPS, WRITING MACROS	4 L
ASSEMBLER PSEUDO-OPS	4 L
PROGRAMMING EXAMPLES	4 L
DEBUGGING ANY SOFTWARE	4 L

### REFERENCE BOOKS:

1. The PC Programming Language	- B. Kernighan, D. Ritchie
2. Programming in C	- Kris A. Jamsa
3. Assembly Language Programming	- Peter Able
4. Assembly Language Programming	- Miller
5. MS-DOS Handbooks	- King

## PC MAINTENANCE AND TROUBLE SHOOTING - I

### THE IBM PC:

4 L

The structure of the PC system, inside the system unit, video and sound, mass storage, system configuration.

### IBM PC OPERATIONS:

8 L

The basic parts of the IBM PC, chip location scheme, central processing unit, memory design, the IBM PC bus structure, input and output, the power supply, how the system works, software structure.

### BASIC TROUBLE SHOOTING:

11 L

Introduction to trouble-shooting, component recognition, component failures, how disk drives fail, how displays fail, repair-generated failures, how to localize failures and make repairs, safety precautions during trouble-shooting and repair.

### SPECIFIC TROUBLE SHOOTING AND REPAIR FOR THE IBM PC:

11 L

Trouble shooting index, start-up problems, run problems, display problems, monochrome monitor and adapter card, color/graphic monitor and adapter card, keyboard problems, other I/O problems.

REFERENCE: Repairing and upgrading of IBM PC: Miller (Que Publication)

## PC MAINTENANCE AND TROUBLE SHOOTING - II

### ROUTINE PREVENTIVE MAINTENANCE:

16 L

Contributors to system failure, heat, cold, dust and other particles, noise interface, power-line problems, corrosion, magnetism, disk maintenance, disk drive maintenance, using heat to spot potential troubles, display screens and health problems, Disc error, soft and hard error, Floppy head cleaning, Printer Maintenance and Maintenance of Cables.

### ADVANCED TROUBLE-SHOOTING TECHNIQUES:

16 L

Tools of the trade, components and how they fail, using tools to find failed components, other trouble-shooting techniques, soldering and unsoldering, circuit board repair, recommended trouble-shooting and repair equipment, spare parts.

### SOFTWARE:

8 L

Failure analysis and maintenance tools, PC tools, Norton Utilities, Viruses and Antivirus Vaccines.

**LIST OF EQUIPMENT**

1.	(a) Oscilloscopes (15/20 MHz)	- 3 Nos.
	(b) Oscilloscope (100 MHz)	- 1 No.
2.	Power Supplies	- 4 Nos.
3.	Digital and Analogue Multimeter	- 10 Nos.
4.	Bread Boards	- 10 Nos.
5.	Microprocessor Kit	- 4 Nos.
6.	Digital DC Tester	- 2 Nos.
7.	PC (80286,8086 XT)	- 3 Nos.
8.	Printer	- 2 Nos.
9.	Diagnostic Cards	- 4 Nos.
10.	P.C. Trainer	- 2 Nos.
11.	Add-On Cards	- 4 Sets
12.	Monitor	- 3 Nos.
13.	SMPS	- 2 Nos.
14.	UPS	- 2 Nos.
15.	CVT	- 4 Nos.
16.	Function Generator	- 2 Nos.
17.	Logic Probes	- 2 Nos.
18.	Virus Card/Filter	- 2 Nos.
19.	H.D.D.	- 2 Nos.
20.	Floppy Drive	- 4 Nos.
21.	MASM Assembler	- 2 Nos.
22.	MS DOS, UNIX & NOVAL	- 1 No.
23.	Misc. Hardware & Software	
24.	Antistatic Mat, Wrist Band	- 1 No.
25.	Vac. Cleaner	- 1 No.

## LABORATORY EXPERIMENTS

### B.Sc. Part - I

Practice for use of Multimeter, Power Supplies, Oscilloscopes and Signal Generator and Soldering.

2. Study of resistor, Capacitor Diodes.
3. Study of Transistor and Transistor Amplifier.
4. Study of Power Supplies and Voltage Regulator I.C.
5. Familiarisation of bread board, IC types, Pin Number, IC Manual and its use.
6. Study of logic gates AND, OR, NOT, NAND, NOR & EXOR
7. Study of operational amplifier as sum, difference comparator and integrator.
8. Study of shift registers.
9. Study of Counters.

### B.Sc. Part - II

1. Study of logic families and its application for logic realisation.
2. Design and study of Flip-Flop using logic gates
- 3.
- 4.
5. Microprocessor based experiments
6. 8085/8086, 80286 and 80386
- 7.
- 8.
9. Study of computer and its complete overview.
10. Replacement of M/B's switch and jumper settings, identification of various chips, location, removing and replacing. Pluggable chips.



## B.Sc. Part - III

1. Installation of OS and formatting of disc drive.
2. Replacing and fitting of HDD and FDD on the PC Fitting CTD and Media Maintenance.
3. Identification of HDPC Cards, WDC Cards, Multi I/O Cards.
4. Setting of jumpers for interrupt request on various boards. Problem caused by mixing up interrupt. Request on boards.
5. Trouble Shooting on PC.
6. PC Tools and its use.
7. Disc managers and its use.
8. Debug and its use.
9. Virus removal and disc scan.
10. Various viruses available and vaccines available.
11. Disassembling printer and study of its various sub-assemblies. Conversion of parallel I/F to serial I/F and vice-versa.
12. Connecting mouse and plotter and installing their driver software.
13. PC LAN Installation and Testing.
14. a) Setting up the file server and nodes. Installation of LAN Card, LAN Cable laying and connectivity. connecting active and passive hub.  
b) Installing the LAN OS, configuring the LAN Systems defining the File Server Nodes and peripherals. Tuning the LAN System. Diagnosing the proper functioning of LAN Hardware.
15. Digitiser and Scanner.



**3**

**VOCTIONAL SUBJECT**

**IN**

**ENVIRONMENT AND WATER**

**MANAGEMENT**

**ENVIRONMENT & WATER MANAGEMENT**

**SUMMARY CHART**

Sr.No.	Year/ Semester	Paper	L (Period/Week)	P
1.	I/I	Fundamentals of Environmental Sciences - I	3	-
2.	I/I	Environment & its Pollution - I	3	-
3.	I/I	Laboratory	-	6
4.	I/II	Fundamentals of Environmental Sciences - II	3	-
5.	I/II	Environment and its Pollution - II	3	-
6.	I/II	Laboratory	-	6
7.		On the Job Training - I	Summer	One Month
8.	II/I	Water Resource Management - I	3	-
9.	II/I	Water Quality Management - I	3	-
10.	II/I	Work Practice	-	6
11.	II/II	Water Resource Management - II	3	-
12.	II/II	Water Quality Management - II	3	-
13.	II/II	Work Practice	-	6
14.		On the Job Training - II	Summer	One Month
15.	III/I	Environmental Management - I	3	-
16.	III/I	Project Development	-	6
17.	III/I	Work Practice	-	6
18.	III/II	Environmental Management - II	3	-
19.	III/II	Work Practice	-	6
20.	III/II	Project Work	-	6

**ENVIRONMENT & WATER MANAGEMENT**

**B.Sc. Part - I**

**PAPER - 1(a): FUNDAMENTALS OF ENVIRONMENTAL SCIENCES - I**

**Introduction of Ecology:** 15 L

Ecosystem concept, ecosystem structure, development and evaluation of ecosystem, components of ecosystem, processes within the ecosystem, standing state of abiotic components.

Ecosystem functions, energy exchange between plant communities and their environment, trophic levels and energy flow.

Forest ecosystem, grass land ecosystem, fresh water ecosystem, agro-ecosystem, vegetation mapping.

**Environmental Chemistry:** 11 L

**Acid-base Equilibria**

Fundamentals, buffering in water systems, the carbonate and other systems of importance in water.

**Chemistry, Degradation and Degradative Pathways**

Inorganic and organic compounds-carbonates, sulphates, nitrates, nitrites, phosphates, salts, carbohydrates, fats, proteins, hydrocarbons.

Xenobiotic compounds-detergents, pesticides, plastics, etc.

**Environmental Microbiology** 10 L

Characteristics of growth and death of microbes in natural environment.

Significance of bacteria, fungi, algae, protozoa and other higher animals in environmental management.

Role of microbes in water degradation.

**PAPER - 1(b): FUNDAMENTALS OF ENVIRONMENTAL SCIENCES - II**

**Introduction to Fluid Mechanics** 15 L

Properties of fluids, velocity, acceleration, streamlines.

**One dimensional flow of fluids**

Conservation of mass and momentum-energy equations.

**Laminar and turbulent flows**

Resistance to flow in one dimensional systems Darcy-Weisbach, Manning and Hazen-William equations.

**Flow of Water in Open Channels and Pipes** 20 L

Open channel flow systems

Definitions, uniform flow in open channels, gradually varied and rapidly varied flows, velocity distribution, open channel sections

Flow in pipes

Calculations of flow velocity and head losses, flow in partially full pipes, flow distribution in pipe systems, pumping equipment for water.

Measurement of flow in pipes and open channels.

Characteristics of common pumps, maintenance of common pumps

**PAPER - 2(a): ENVIRONMENT AND ITS POLLUTION - I**

**Environment** 4 L

Definition

Components-Atmosphere, hydrosphere, lithosphere, their compositions and interactions.

**Environmental Pollution** 3 L

Definition

Causes of environmental pollution-population, resource consumption, deforestation, industrialization, agriculture, urbanization and transport.

Types of Pollution.

**Water Pollution** 15 L

Source of pollution of surface and ground water

Types of pollutants-organic including pesticides, surfactants, detergents and volatile compounds; inorganic pollutants including nutrients, salts and heavy metals; biological pollution; thermal pollution.

Effects of pollution on water quality and aquatic life in surface water bodies, oxygen economy, eutrophication in lakes and reservoirs.

**Solid Waste** 6 L

Municipal solid wastes, industrial solid waste (Non-hazardous), major waste producing industries.

<b>Hazardous Wastes and Their Major Sources</b>	2 L
<b>Off Shore Oil Pollution</b>	2 L
<b>PAPER -2(b): ENVIRONMENT AND ITS POLLUTION - II</b>	
<b>Air Pollution</b>	20 L
<b>Definition</b>	
Air quality standards, emission standard, sources and classification of air pollutants.	
<b>Criteria Pollutants</b>	
Carbon monoxide, oxides of nitrogen and sulphur, particulate matter, hydrocarbons, photochemical smog and ozone	
Effective of air pollution of human health, plants, materials, visibility and aquatic ecosystems.	
Climatic changes including global warming, green house effect, ozone layer depletion, acid rain.	
<b>Noise Pollution</b>	4 L
Sources, standards, measurement and control.	
<b>Soil Erosion and Land Degradation</b>	4 L
<b>Radio -active pollution-Ionic and Non-ionic radiations</b>	2 L

**B.Sc. Part - II**

**PAPER - 3(a): WATER RESOURCE MANAGEMENT - I**

**Water as a Resource Material**

2 L

Drinking water, water used as raw material, cooling water, irrigation water, fishing water, industrial water, recreation water, cultural water.

**Introduction to Hydrology**

20 L

Precipitation, infiltration, evaporation and transpiration, run off and hydrological cycle.

Hydrologic budget, water balance-global and regional surface water hydrology.

**Surface Water Hydrology**

Run off process, estimation of run off and hydrograph

**Ground Water Hydrology**

Aquifers, ground water hydraulics, safe yield, ground water collection system.

Collection of hydrologic data, rainfall, evaporation measurement, stream gauging, use of remote sensing in data collection.

**Water Requirement for Various Uses**

10 L

**Irrigation Water**

Consumptive use of water for crops, determination of irrigation requirements, comparative performance of irrigation methods.

**Domestic and Industrial Water supply Needs**

Per capita water demands, water needs of major industries.

Water requirement for non-consumptive uses such as power generation and inland navigation.

**PAPER - 3(b): WATER RESOURCE MANAGEMENT - II**

**Management of Water Availability**

12 L

Surface water development, ground water development, weather modification, water conservation, inter basin transfer of water, waste water reuse, desalination, other approaches.

Management of extremes such as floods-structural and non-structural approach, droughts.



Collection, Conveyance and Distribution Systems, Water Losses	10 L
Location and boring of tube wells, maintenance of tube wells and related machinery.	
Micro Water Shed Management	8 L
Costal Water Management	
<b>PAPER - 4(a): WATER QUALITY MANAGEMENT - I</b>	
Water Quality Requirements and Standards for Various Uses	3 L
Quality of Water in Different Sources	2 L
Water Quality Monitoring	6 L
Sampling methods for wastewater, stream and lake water and sediment; sampling equipment.	
Water Treatment Processes	20 L
Conventional Water Treatment Process	
Coagulation and flocculation, sedimentation, filtration, disinfection, water softening.	
Specific Water Treatment Process	
Removal of iron and manganese, defluoridation, desalination.	
<b>PAPER - 4(b): WATER QUALITY MANAGEMENT - II</b>	
Wastewater Treatment Processes	18 L
Quality and characteristics of domestic wastewater	
Primary treatment, secondary treatment (conventional and low cost), advanced wastewater treatment including nitrogen and phosphorus removal.	
Treatment and disposal of sludge.	
Characteristics and Treatment of a Few Typical Industrial Wastewater	6 L
Maintenance of effluent treatment plants.	
Performance studies of a few typical treatment plants.	
Wastewater Disposal and Reuse	3 L
Water Quality Protection for Open Wells and Ponds	2 L

**B.Sc. Part - III**

**PAPER - 5(a): ENVIRONMENTAL MANAGEMENT - I**

**Air Pollution Abatement**

**30 L**

**Air Pollution and Meteorology**

Meteorological parameters, vertical motion of air and atmospheric stability, wind rose diagram and wind direction frequency, lapse rates, temperature inversions, maximum mixing depth.

**Atmospheric Dispersion**

Plumes and plume rise, dispersion of pollutants

**Ambient air quality monitoring**

**Stack gas emissions and their measurement**

**Ambient air and stack gas quality standards, threshold limit values.**

**Air Pollution Control**

Control of stationary source emissions-particulate emissions control, gaseous emissions control.

Control of mobile source emissions.

**Role of plants and trees in air pollution abatement.**

**Disposal of hazardous waters.**

**Management of Land Surface**

**4 L**

Soil conservation practices for restoration of eroded soils, recovery of chemically degraded land, biological reclamation techniques.

**PAPER - 5(b): ENVIRONMENTAL MANAGEMENT - II**

**Global Atmospheric Change**

**7 L**

**Introduction**

Global temperatures, simple global temperature models, the green house effect and its enhancement.

**Carbon dioxide, chlorofluorocarbons and other green house gases**

**Their sources and effects**

Regional effects of temperature change	
Ozone layer and destruction of stratospheric ozone	
Alternative models for global atmospheric change	
Sustainable Development	4 L
Concept	
Environmental friendly products and technologies, non-polluting energy sources.	
Environmental Impact Assessment for Creation of a Physical Facility	15 L
Objectives of an EIA study	
Components of EIA study	
Need for the proposed facility, the site and surroundings, the facility, environmental effects of construction of facility, environmental effects of operation of the facility, environmental monitoring programmes, remedial measures for negative impact.	
Assessment methodologies	
Industrial plant location and city planning	
Case studies	
Coal fired power plant, water resource development project.	
Economics and Benefits of Pollution Control	3 L
Concept of Environmental Audit	2 L
Environmental Acts and Legislation	2 L
Problems in implementation, role of public participation	

## **ENVIRONMENT AND WATER MANAGEMENT**

### **Laboratory/Project/Field Work**

#### **B.Sc. Part - I**

#### **PRACTICALS BASED ON PAPER I AND II**

##### **Hydraulics Laboratory**

###### **Flow visualization**

Measurement of discharge in an open laboratory channel by area-velocity method using a pilot tube.

Measurement of discharge in an open laboratory channel by area velocity method using a current meter.

Measurement of discharge in an open laboratory channel using flumes (Venturi/Parshal) and notches.

Measurement of discharge in a pipe using orifice meter, venture meters, water meter.

Determination of resistance coefficient in a uniform channel flow and in a pipe flow.

##### **Environmental Chemistry Laboratory**

Estimation of water quality parameters such as turbidity, colour, solids, alkalinity, acidity, pH, hardness, sulphates, chlorides, fluorides, iron and manganese.

Colourimetric measurement of some heavy metals in effluents (e.g. Cr(VI), Pb).

Estimation of wastewater characteristics of some typical wastewater as per pollution control, board requirements including DO, BOD, COD, Total Kjeldahl Nitrogen and Phosphates.

Measurement of total dust and dust fall rate.

**B.Sc. Part - II**

**PRACTICALS BASED ON PAPER III AND IV**

**Water Management**

Measurement of discharge and calculation of seepage loss in a canal reach

Lysimeter experiment on the same site

Measurement of pan evaporation and its comparison with Penman equation

Determination of infiltration rate from a controlled plot experiment.

**Environment Management**

Field ecology-Terrestrial and Aquatic Flora and Fauna

Experiments related to water quality management

Ambient air sampling and determination of criteria pollutants

Monitoring of stack emissions and automobile exhausts

Visits to water and wastewater treatment plants and industries employing air pollution control equipment.

**B.Sc. Part - III**

**PRACTICE ORIENTED COURSE/PROJECT/SEMINAR/PRACTICAL TRAINING**

~~Environmental Management~~

Determination of bacteriological pollution in water (total and fecal coliform count)

Visits to/training in a municipal waste disposal system/national laboratories dealing in pollution control.

Study of water/wastewater/industrial effluent treatment plant and air pollution control plants (15 days in each plant)

**Water Management**

Visit to /training in a water resources development centre

**Practice (for Honours Students Only)**

An EIA study of a Industrial/Water Resource Development Project

Training in water management and land management institute of State or Centre

Training in a mining area reclamation project.



**4**

**VOCATIONAL SUBJECT**

**IN**

**REFRIGERATION AND**

**AIR - CONDITIONING MAINTENANCE**

**REFRIGERATION AND AIR-CONDITIONING MAINTENANCE**

**SUMMARY CHART**

Sr.No.	Year/ Semester	Paper	L (Period/Week)	P
1.	I/I	Fundamentals of Refrigeration and Air-conditioning - I	3	-
2.	I/I	Refrigeration Cycles & Systems - I	3	-
3.	I/I	Refrigeration Equipment Laboratory	-	6
4.	I/II	Electrical Aspects of Refrigeration and Air-conditioning - II	3	-
5.	I/II	Air-conditioning Cycles & Systems - II	3	-
6.	I/II	Refrigeration System Laboratory	-	6
7.		On the Job Training - I	Summer	One Month
8.	II/I	Refrigeration Machines and Components - I	3	-
9.	II/I	Refrigeration Equipments - I	3	-
10.	II/I	Refrigeration Workshop Practice	-	6
11.	II/II	Refrigeration & Air-conditioning System Practice	3	-
12.	II/II	Air-conditioning Machines and Components	3	-
13.	II/II	Refrigeration Assembly & Testing Practice	-	6
14.		On the Job Training - II	Summer	One Month
15.	III/I	Maintenance, Servicing and Trouble Shooting - I	3	-
16.	III/I	Project Development	-	6
17.	III/I	Air-conditioning System Control Practice	-	6



Sr.No.	Year/ Semester	Paper	L (Period/Week)	P
18.	III/II	Air-conditioning in Automobiles and Railway Coaches	3	-
19.	III/II	Trouble Shooting & Maintenance Practice	-	6
20.	III/II	Project Work	-	6

## REFRIGERATION AND AIR-CONDITIONING MAINTENANCE

### PAPER - 1: FUNDAMENTALS OF REFRIGERATION ENGINEERING - I.

<b>Units and Dimensions :</b> Various types of units. F.P.S./M.K.S./S.I. Units.	2 L
<b>Introduction :</b> Basic concept and definitions.	5 L
Thermodynamic system, properties, state and process, cycle, definition of pressure, vacuum head, density, specific volume, how discharge for fluids.	
<b>Work and Heat</b>	8 L
Force, work, power and energy. Specific heat, sensible heat and latent heat of vaporisation and fusion, specific heat of gases, expansion and contraction, sublimation and expansion.	
<b>Laws of Thermodynamics</b>	5 L
First law and second law of thermodynamics, Boyle's Law, Charle's Law, definition of entropy, properties of gas and vapour.	
<b>Elementary Heat Transfer</b>	4 L
Conduction, convection, radiation, thermal conductivity.	
<b>Fundamentals of Electrical Engg.</b>	5 L
Fundamental concepts and principles, definition of voltage current, resistance, power and their units, Ohm's law.	
<b>Measuring Instruments</b>	5 L
Electrical measurement and measuring instruments e.g. multimeter and megger.	
<b>Application</b>	6 L
Electrical wiring, electrical circuit or a refrigerator, air conditioner and water coolers, earthing of electrical equipments.	

### PAPER - 2: FUNDAMENTALS OF REFRIGERATION ENGINEERING - II

#### Refrigeration

Introduction-basic terms and definitions, refrigeration or concept of "Ton" as applied to refrigeration, Refrigeration effect, coefficient of performance, work input, power required for compression.

#### Refrigerants

7 L

Introduction, classification of refrigerants, properties of refrigerants, important refrigerants, secondary refrigerants and brines, anti-freeze solutions, selection of refrigeration for required purposes.

## **Methods of Refrigeration**

6 L

Types of refrigeration system, air refrigeration, vapour compression and vapour absorption system of refrigerations.

## **Air Refrigeration Systems**

5 L

Introduction, reversed Carnot cycle, reversed Brayton cycle or Bell-Coleman cycle, advantages and disadvantages of air refrigeration system.

## **Basic Vapour Compression Cycles**

10 L

Introduction to simple vapour compression cycle on PV, TS and PH diagrams, simple calculations on work done, refrigeration effect, C.O.P. etc., factors affecting the performance of vapour compression system.

## **Compressor Calculations**

6 L

Mass of refrigerant handled during compression process, theoretical and actual volumetric displacement, volumetric efficiency, cylinder dimensions.

## **PAPER - 3 : METHODS OF REFRIGERATION**

### **Complex Vapour Compression System**

8 L

Introduction, methods of improving C.O.P. simple load systems, multiload systems with single compressor, dual compression systems and its applications.

### **Advantages and Application of Vapour Compression System**

8 L

Comparison of simple vapour compression cycle with reversed Carnot cycle, advantages and disadvantages of vapour compression over air compression refrigeration system, application of vapour compression systems.

## REFRIGERATION AND AIR-CONDITIONING

### PAPER - 1: FUNDAMENTALS OF REFRIGERATION AND AIR CONDITIONING

Introduction to Units ; Terminology of Refrigeration, Air-conditioning.  
Definition of 'Ton' as applied to refrigeration. 2 L  
Thermodynamic : laws of thermodynamics.  
Concept of work, energy, enthalpy, entropy, heat.  
Properties of fluids during phase change.  
Thermodynamic processes ( const.vol., const.press., const.enthalpy, isothermal, isentropic etc.).  
Thermodynamics of air-water vapour mixtures, Psychrometric charts. 21 L  
Elements of heat transfer : conduction, convection, radiation and phase change. 4 L  
Working fluids : Refrigerants, nomenclature(numbering) of inorganic and organic fluids. Environmental, thermal and economic considerations. 7 L

### PAPER - 2: ELECTRICAL ASPECTS OF REFRIGERATION & AIR CONDITIONING

Concept of volts, current, power, A.C. and D.C. operations, forces due to magnetic field, single and three phase operations. Code and practices for electrical wiring, field instruments for voltage, current and resistance measurements.  
Single phase motors : Capacitor start capacitor run, capacitor start induction run, starting, running and winding.  
Current, voltage and thermal relays.  
Solenoid valves, Motorized valves.  
Thermostat relays, concept of cut in- cut out, range, differential.

### PAPER -3 : REFRIGERATION CYCLES AND SYSTEMS

Methods of Refrigeration 6 L  
Types of refrigeration system, air refrigeration, vapour compression and vapour absorption system of refrigeration.

Air Cycle Refrigeration 5 L

Vapour compression refrigeration - T S, p - h diagrams, cycle description, C O P, sub cooling, superheating, multistage and cascading. Calculation of mass flow rate requirement, Non-idealities, effects of pressure drop and non-isentropic compression.  
Calculation of refrigerating effect, power, condenser requirements.

Vapour absorption refrigeration : Simple absorption cycles- analysis with Ammonia-water or water-Lithium bromide.  
C O P, use of charts, limits of operation- Electrolux system.  
Comparison with Vapour compression system.

## **PAPER - 4: AIR CONDITIONING CYCLE AND SYSTEMS**

Psychrometric processes - sensible cooling, heatmix, dehumidification/humidification etc.

Thermal comfort - standard conditions, choice of design of indoor and out door conditions, ventilation requirement, dilution.

Various types of Air-conditioning systems :

Direct expansion, chilled water, all air, air-water, all water.

Window air conditioning, package air conditioning, split units, features of central plants.

Components of Air conditioning : Chillers, coils, blowers, ducts, air distributors and pumps.

## **PAPER - 5: REFRIGERATION MACHINES AND COMPONENTS**

Refrigeration Hardware :

Compressors : Hermetic, semi-Hermetic, Open compressors, Centrifugal and Rotary compressors - constructional features, choice of drive motors, volumetric efficiencies, Isentropic efficiency, Multicylinder compression, capacity control, cylinder unloading.

Identification of sources of problems in operation - valve failure, leakage across rings, shaft seals, 3 way valves, cylinder to head gaskets ; compressor testing in field.

Constructional features of air cooled, water cooled, evaporative condensers, cooling towers. Multipass, multirow coils, shell and tube, shell and coil condensers/ chillers.

Fouling and descaling. Brine systems.

Expansion devices : capillary, constant pressure, thermostatic, electronic expansion devices. Sizing of capillaries, standard sizes, testing and adjustment of expansion devices.

High and low side float valve devices.

Refrigerant receivers, pump down.

Dryers, filters, flow measuring devices.

## **PAPER - 6: REFRIGERATION AND AIR-CONDITIONING SYSTEM PRACTICE**

Piping layout, selection of pipe material and size for various refrigerants. Methods of joining, flare connections, unions brazing, silver brazing, vibration damping, oil return.

Piping insulation, various piping arrangements (for multiple evaporators, multiple)

System evacuation, dehydration, charging, balancing, leak testing.

System safety, use of solenoid valves, pressure equalizers, bypasses.

## **PAPER 7 :REFRIGERATION EQUIPMENTS**

Construction and operational features of domestic refrigerators, defrost and controls.

Cold storages : construction, sealing, safety, insulation, multizone systems.

Refrigeration requirements for various food items.

Water coolers : storage, pressure type, filtering, constructional features, insulation.

Environmental test chambers : cooling and heating arrangements, devise of insulation, thermal bridge, vapour barriers.  
Bottle coolers, Ice creams, display cases.

#### **PAPER - 8: AIR CONDITIONING MACHINES AND COMPONENTS**

Air conditioning Hardware :

Types of cooling, dehumidification coils, heating coils.

Fans and blowers.

Filters and Dampers.

Duct construction : mitred/ radiused bends, T's, mixing and diverting splitters.

Water pumps : vertical and horizontal types.

Construction of plenums.

Clean rooms.

#### **PAPER - 9: MAINTENANCE, SERVICING AND TROUBLESHOOTING**

Measurement of T, p, Q in refrigeration and Air conditioning systems, Air balancing.

HP-LP cutouts, servicing setting, calibration.

Following of ladder/ logic diagrams.

Safety aspects.

Fire dampers.

Defrosting : hot gas, reverse cycle, electrical.

Filters : cleaning, evaluation of performance.

Electrical fault detection, grounding requirements.

Air conditioning : Special applications.

Transport air conditioning.

Hospital air conditioning.

#### **PAPER - 10: AIR-CONDITIONING IN AUTOMOBILES AND RAILWAY COACHES**

Air-conditioning of Automobiles and Railway Coaches

15

- Sources of heat load

- Power required to drive the compressor

- Air distribution and location of different components

- Installation, servicing and maintenance

Solar Energy

Introduction, solar collector, future of solar energy

Solar refrigeration

Solar refrigeration, solar dehumidifier.

## LIST OF EXPERIMENTS

### Ist Semester- Lab I :

1. To study the basic tools eg. spanners, cutting and threading tools, bending and twisting tools etc.
2. Cutting, flaring and joining of tubes.
3. Bending of tubes of different sizes and gauge.
4. Soldering, brazing and pinching of tubes.
5. Cutting and threading of G.I. and Copper pipes.
6. To make different types of joints with the help of Elbows, T's, Unions, Sockets etc.

### II nd Semester- Lab II :

1. To study different types of Compressors eg. open and sealed type.
2. To study different types of Condensers eg. Air cooled & Water cooled.
3. To study various types of expansion devices eg. Capillary tube, Expansion valves, Thermostatic expansion valve etc.
6. To study various types of fluid flow meters eg. watermeter, rotameter
7. To study various pressure and temperature measuring instruments.

### III rd Semester- Lab III :

1. To study various control devices eg. thermostats, relays, dryers etc.
2. To study a vapour compression system.
3. To study an Electrolux refrigerator.
4. To study window and split type air conditioners.
5. To study ammonia-water Ice plant.
6. To study a cooling tower.
7. To study a desert cooler and pumps used for this type of cooler.

### IV th Semester- Lab IV :

1. Gas charging in a refrigerating system and testing for leakages.
2. To find the coefficient of performance of a vapour compression Test-Rig.
3. To find the C.O.P. of an absorption test-rig.
4. To find the C.O.P. of an Ammonia Ice plant.
5. To find the C.O.P. of a water cooler.
6. To test and check the capacitors, relays, automatic expansion valve, solenoid valve, high and low pressure cut-off etc.
7. To assemble and operate a small vapour compression refrigeration system.

### V th Semester Lab-V :

1. To find the Horse power of the compressor and Tonnage and C.O.P. of an Air conditioner.
2. To test the motor of an air conditioner for high voltage.
3. To find the humidity of surrounding air using Dry and Wet bulb thermometer and compare it with Sling Psychrometer.

4. To set and repair Low pressure and High pressure cut-outs.
5. To determine the pressure losses in the ducts.
6. To find the Range and Approach of a Cooling Tower.
7. To visit a Cold Storage/ Air-conditioning Plant and submit a detailed report.

**VI th Semester Project Work :**

A project report to be prepared based upon the following :-

1. Air Conditioning of Buildings, Automobiles, Railway coaches etc.
2. A detailed design of a refrigeration system.
3. A project in collaboration with refrigeration and air-conditioning industry.

**List of Reference Books**

S.No	Title	Author	Publisher
1.	A course in Refrigeration & Air conditioning	S.C.Arora	Dhanpat Rai
2.	Refrigeration & Air Conditioning	P.L.Ballaney	Khanna Publ.
3.	Refrigeration & Air Conditioning	S.Domkundwar	Dhanpat Rai
4.	Refrigeration & Air Conditioning Data Book	Manohar Prasad	Wiley Eastern
5.	Combustion & Mass Transfer	Spaldings	Pergamon Press
6.	Refrigeration & Air Conditioning	W.F.Stoecker	McGraw Hill
7.	Thermal Environmental Engineering	J.L.Threlkeld	Prentice Hall
8.	-----do-----	R.C.Jordan & G.B.Priester	Prentice Hall of India
9.	Heating and Ventilation	Jakob	
10.	Audels Refrigeration & Air-Conditioning Guide	E.P.Anderson	D.B.Tarapore-wala & Sons.
11.	Refrigeration Servicing	S.K.Jain	Dehata Pustak Bhandar
12.	Refrigeration Guide	Narendranath	-----do-----
13.	Refrigeration, Air Conditioning and Over servicing	B.R.Scharff	McGraw Hill

**List of Probable Employers**

1. KELVINATOR India Ltd., Faridabad.
2. VOLTAS Ltd, Bombay.
3. BLUE STAR Ltd., Bombay.
4. GODREJ Ltd., Bombay.
5. ALLWYN Ltd., Faridabad.
6. FRICK INDIA Ltd., Faridabad.
7. ARCO Ltd., Faridabad.
8. FEDDERS & LLOYDS Ltd., New Delhi.
9. HINDUSTAN REFRIGERATION, Daryaganj, Delhi.



**5**

**VOCATIONAL SUBJECT**

**IN**

**AUTOMOBILE MAINTENANCE**

AUTOMOBILE MAINTENANCE

SUMMARY CHART

Sr.No.	Year/ Semester.	Paper	L (Period/Week)	P
1.	I/I	Principles of Automobiles	3	-
2.	I/I	Ignition, Cooling & Lubrication Systems	3	-
3.	I/I	Engine Testing Laboratory - I	-	6
4.	I/II	Constructional Details and Working of I.C. Engine	3	-
5.	I/II	Suspension & Steering System	3	-
6.	I/II	Engine Testing Laboratory - II	-	6
7.		On the Job Training - I	Summer	One Month
8.	II/I	Transmission System	3	-
9.	II/I	Chassis and Body Design	3	-
10.	II/I	Transmission and Suspension System Practice	-	6
11.	II/II	Components of the Transmission System	3	-
12.	II/II	Electrical Systems, Accessories and Control	3	-
13.	II/II	Assembly Practice	-	6
14.		On the Job Training - II	Summer	One Month

Sr.No.	Year/ Semester	Paper	L (Period/Week)	P
15.	III/I	Automobile Maintenance and Service Stations	3	-
16.	III/I	Project Development	-	6
17.	III/I	Engine Overhauling Practice	-	6
18.	III/II	Motor Vehicles and Entrepreneurship	3	-
19.	III/II	Performance Testing & Practice	-	6
20.	III/II	Project Work	-	6

## **AUTOMOBILE MAINTENANCE**

### **PAPER - 1: PRINCIPLES OF AUTOMOBILES**

Thermodynamic Cycles	3 L
Otto, diesel and dual combustion cycles and their air standard efficiencies.	
Classification of Engines	6 L
SI and CI engines, two stroke and four stroke engines and their working principles.	
Engine Specifications	4 L
Bore, stroke-length, M.E.P., I.H.P., B.H.P., B.S.F.C., Mechanical and thermal efficiencies.	
Valve Timing Diagrams	6 L
For two stroke and four stroke engines	
Fuel used in I.C. Engines	4 L
Properties of petrol and diesel fuels, fuel additives, fuel rating (octane and cetane numbers).	
Combustion Processes in I.C. Engines	10 L
Auto ignition and chemical reactions, effect of knocking, calorific values of fuels, requirement of oxygen for complete combustion, excess air, pre-ignition, MAN and open combustion chambers.	

### **PAPER - 2: CONSTRUCTIONAL DETAILS AND WORKING OF I.C. ENGINE**

Layout of an Automobile	6 L
Main components and assemblies	
Constructional Features and Functions of Two & Four Wheelers	16 L
Cylinder block, crank case, cylinder head, oil sump, gasket, crank shaft, main bearings, vibration dampers, exhaust system, intake and exhaust manifolds, flywheels, piston, piston rings, piston pins, connecting rod, cams and camshaft, valve and valve mechanism.	
S.I. Engines	18 L
Combustion process, types of fuel feed system, various components of fuel system - fuel tank, fuel filters and screens, fuel losses, fuel gauges, fuel pumps, air cleaners, carburetor and its working, trouble shooting, service and adjustment.	

## C.I. Engines

Combustion and combustion chamber, fuel injection system fuel tanks, fuel feed pumps, fuel injection pumps, fuel injectors, nozzles and their types, details of nozzle and fuel injector unit.

### PAPER - 3: IGNITION, COOLING & LUBRICATION SYSTEM

Ignition System 14 L

Battery, electric and magneto ignition system

Cooling Systems 6 L

Importance of cooling systems, their types, various components and accessories.

Lubricating System 8 L

Importance of lubrication, lubricants, their properties and selection, types of engine lubricating system and their working, filters, lubrication in other parts of an automobile.

### PAPER - 4: SUSPENSION AND STEERING SYSTEM

Suspension 22 L

Objective and principle of a suspension system, types of suspension systems, components of suspension system (helical and leaf springs, torsion bars, rubber suspension, hydraulic suspension and air suspension), shock absorbers and dampers.

Steering System 18 L

Steering mechanism and layout, principle and operation of steering mechanism, Akerman's and Davies' steering mechanism, various linkages and components. Power steering.

### PAPER - 5: TRANSMISSION SYSTEM

Introduction 14 L

General principles of automobile transmission systems, its objectives and types, manual systems, semi-automatic, automatic and hydraulic transmission.

Gear and Gear Boxes 26 L

Resistance to motion of a vehicle, power required for propulsion, acceleration and hill climbing and necessity of gear box, function and type of gears, construction and operation of a synchro-mesh gear box, differential gear, free wheel drive, types of gear boxes used in Indian automobiles, gear lubrication.

## **PAPER - 6: COMPONENTS OF THE TRANSMISSION SYSTEM**

**Clutch System** 10 L

Clutch and its function, types of clutches, clutch linkage, clutch facing and friction material, common faults and their adjustments.

**Propeller Shaft** 10 L

Types of propeller shaft, fluid drive, Hotchkiss drive function and working of universal and slip joint, torque converters.

**Final Drive and Rear Axle** 10 L

Types of final drives, differential gears and its principles of operation, rear axle and its types.

**Front Axle** 10 L

Type of front axle and their components; swivelling mechanism, front fork of a motor cycle

## **PAPER - 7: CHASIS AND BODY DESIGN**

**Chassis, Frames and Body** 10 L

Chassis layout and its main components, design features, types of chassis and frames, materials and dimensions for auto body work, methods of manufacturing and space requirement.

**Brakes and Braking Systems** 20 L

Principles of brakes and braking mechanism, classification of automobile brakes-mechanical brakes, hydraulic brakes, disc and drum brakes, bleeding in hydraulic braking system, servo and power braking system, adjustments and servicing of brakes.

**Wheels and Tyres** 6 L

Types of tyres and their specifications, tubeless tyres and radial tyres, friction due to pavements and earth in relation to wear, care and maintenance of tyres and tubes, repair and retreading of tyres.

## **PAPER - 8: ELECTRICAL SYSTEMS, ACCESSORIES AND CONTROL**

**Electrical System** 10 L

Various electrical elements in an automobile, automobile batteries and its maintenance, generator and battery charging system, negative and positive earth return systems, voltage and current regulators, self starters and bendix drive, ignition system and its components, ignition timing, ignition advance, methods of ignition advance, setting of contact breaker gap, spark plugs, firing order checking.

Accessories and Controls	8 L
The horn and types, wind screens-wipers, direction indicators and flashing units, signalling systems, lamps and their types, starter switch, speedometer, antiburst door lock, anti theft devices, fuel gauges, oil pressure gauges, water temperature gauges etc, car radios.	
Lighting System	8 L
Wiring system and wiring diagram, colour coding, wiring diagram of few Indian automobiles.	
Important Features of Indian Automobiles	4 L
Types of automobiles used in India and technical data related to it (two wheelers and four wheelers).	
Tractor and Farm Equipment	10 L
Tractor and various attachments-two speed power take off, hydraulic lift system, three point linkages, linkage and draw bar, automatic depth and draft control, use of tractors in agriculture-maintenance and service.	
<b>PAPER - 9: AUTOMOBILE MAINTENANCE AND SERVICE STATIONS</b>	
Engine Servicing and Tuning	10 L
Basic requirements of automobile engine servicing, types and procedures.	
Garages and Service Stations	10 L
Location and layout, equipment required in a service station, types of service to be carried out, garage procedure.	
Servicing of Motor Vehicles	20 L
Significance of servicing and its types, engine tuning and various instruments used, decarbonizing of engine parts, servicing of batteries, servicing of different system-electrical system, fuel injection and ignition system, lubrication system, cooling system, braking system and other accessories.	
<b>PAPER - 10: MOTOR VEHICLES AND ENTREPRENEURSHIP</b>	
Motor Vehicles Troubleshooting - causes and remedies	10 L
Types of troubleshooting-engine troubles, clutch trouble, fuel system troubles, ignition system troubles, lubrication troubles, brakes and braking system troubles, steering control and tyre wear. electrical system, instrument and accessories troubles.	

Inspection and Testing of Motor Vehicles 10 L

Types of Inspection, inspection cards, inspection and repair, accident inspection, diagnosis of faults, laboratory and road testing of motor vehicles.

Entrepreneurship 18 L

Introduction to Entrepreneurship, project management, financing and marketing.

Motor Vehicles Act with special reference to pollution control 2 L  
and measures required for safe drive, etc.

### LIST OF EXPERIMENTS

#### I st Semester Lab-I :

1. To study the Engine components of a two stroke spark ignition engine.
2. To study the Engine components of a four stroke spark ignition engine.
3. To study the Engine components of a four stroke Diesel engine.
4. To study the Carburetor and Fuel pump of different types.
5. To study the fuel injection system of C.I. engines.
6. To study the different Ignition systems.
7. Testing, cleaning and setting of spark gap of a spark plug.

#### II nd Semester Lab-II :

1. To disassemble and assemble a carburetor and tuning it.
2. Setting of Firing order of a multicylinder 4-stroke S.I.Engine.
3. To disassemble and assemble a fuel injector of C.I.Engine.
4. To disassemble and assemble a fuel injection pump of a C.I.Engine.
5. To check and set the Self starter of an Engine in order.
6. To draw the valve timing diagram of a S.I. and 4-stroke C.I.Engine.
7. To draw the valve timing/port opening of a 2-stroke Engine.

#### III rd Semester Lab-III :

1. To disassemble and assemble a friction clutch for a 2-stroke Engine.
2. To disassemble and assemble a friction clutch for a four stroke Engine.
3. To disassemble and assemble a Gear Box.
4. To disassemble and assemble a Hotchkiss drive (Universal joint, Slip joint and Propellershaft).
5. To disassemble and assemble a Differential and checking of the Final Drive Ratio.
6. To disassemble and assemble Suspension systems (Rigid suspension including Shock Absorbers).
7. To check and set the cooling system of a Car/Bus (Four wheeler) for proper cooling).

#### IV th Semester Lab-IV :

1. To disassemble and assemble tyres of two wheelers and four Wheelers.
2. To set the vehicle for desired Castor, Camber, Toe-in, Toe-out and King pin inclination (Wheel alignment).



3. To service the Master cylinder and to adjust the linkages from the Brake pedal.
4. To disassemble and assemble a Brake shoe with emphasis on Brakeshoe lining adjustments.
5. To detect the Punctures and repairing them. (Cold or Hot).
6. To disassemble and assemble the Steering mechanism of a vehicle and its adjustments.
7. To check and set the Engine for proper Lubrication.

V th Semester Lab-V :

1. To disassemble the Engine.
2. To assemble the Engine components (Cylinder block, Crankshaft and Flywheel).
3. To assemble the Piston rings, Liners and Gudgeon pin.
4. Fitting of Journal Bearing and mounting of a Crank.
5. Assembly of Cylinder head and Valves.
6. Engine Tuning and Performance test with respect to Horse power and Fuel consumption.
7. To check the exhaust for the recommended pollution level (Smoke meter).

VI th Semester Project Work :

A project report taking into account the intensive training in Automobile Service Stations/ Garages/ Industry giving emphasis on the following aspects :-

- a) Engine servicing
- b) Engine Tuning
- c) Engine Performance
- d) Diagnosis of Engine trouble shooting and its remedies for Clutches, Gear box, Brakes, Steering and Suspension systems.

However in the absence of such a facility, a project report on Servicing and Tuning of Engines in the Laboratory can also be done.

**List of Reference Books**

S.N.	Title	Author	Publisher
1.	Automobile Mechanics	J.Heitner	East West Press
2.	Automotive Engines	W.H.Crouse	McGraw Hill
3.	Automobile Engineering	G.B.S.Narang	Khanna Publ.
4.	Automobile Maintenance	R.W.Bent	Pitman & Sons
5.	Automobile Fault Tracing	S.Abbey	Pitman & Sons
6.	Automobile Brakes and Brake Testing	Maurice Platt	-----do-----
7.	Automobile Engine Overhaul	A.W.Judge	-----do-----
8.	Automotive Chassis and Body	W.H.Crouse	McGraw Hill
9.	Automobile Electrical Maintenance	A.W.Judge	Pitman
10.	Automobile Chassis Maintenance & Overhaul	Abbey & Staton	-----do-----

- |  |              |              |
|--|--------------|--------------|
| 11. Automobile Transmission<br>Servicing & Overhaul        | -----do----- | -----do----- |
| 12. Automobile Steering Braking<br>and Suspension Overhaul | -----do----- | -----do----- |

**List of Probable Employers**

1. Maruti Udyog Ltd., Gurgaon.
2. Hindustan Motors, Calcutta.
3. Premier Automobiles, Bombay.
4. TELCO, Jamshedpur and Pune.
5. Ashok Leylands, Madras.
6. Escorts Tractors Ltd., Faridabad.
7. Punjab Tractors Ltd., Chandigarh.
8. Eicher Tractors Ltd., Faridabad.
9. International Tractors Ltd., Pune.
10. Auto Tractors Ltd., Pratapgarh.
11. Bajaj Auto Ltd., Pune.
12. LML Vespa Ltd., Kanpur.
13. HMT Tractors Division, Pinjore

**6**

**VOCATIONAL SUBJECT**

**IN**

**MANUFACTURING PROCESSES**

**MANUFACTURING PROCESS**

**SUMMARY CHART**

Sr.No.	Year/ Semester	Paper	L (Period/Week)	P
1.	I/I	Engineering Materials	3	-
2.	I/I	Workshop Technology	3	-
3.	I/I	Engineering Drawing and Metal Work Laboratory	-	6
4.	I/II	Safety Measures and Tools	3	-
5.	I/II	Treatment & Testing of Materials	3	-
6.	I/II	Pattern Making and Heat Treatment Lab.	-	6
7.		On the Job Training - I	Summer	One Month
8.	II/I	Manufacturing Processes - I	3	-
9.	II/I	Metrology	3	-
10.	II/I	Machine Shop Practice (Lathe)-I	-	6
11.	II/II	Manufacturing Processes - II	3	-
12.	II/II	Manufacturing Processes - III	3	-
13.	II/II	Metrology and Material Testing Practice	-	6
14.		On the Job Training - II	Summer	One Month
15.	III/I	Manufacturing Processes - IV	3	-
16.	III/I	Project Development	-	6
17.	III/I	Foundry and Welding Practice	-	6
18.	III/II	Industrial Management and Quality Control	3	-
19.	III/II	Machine Shop Practice (Shaper & Milling Machine)	-	6
20.	III/II	Project Work	-	6

## WORKSHOP TECHNOLOGY

### PAPER - 1: ENGINEERING MATERIALS

Engineering Materials 8 L

Metals and non-metals (Plastics, P V C, Teflon & Ceramics)  
Classification, properties and uses.

Mechanical Properties 18 L

Mechanical fundamentals, simple stress and strain, Hooke's Law, strength, elasticity, stiffness, resilience, plasticity, ductility, malleability, toughness, hardness, hardenability & brittleness. Creep, fatigue and fracture.

### PAPER - 2: SAFETY MEASURES AND TOOLS

General Tools 12 L

Description and specifications of screwdrivers, spanners, vices hacksaw, chisels, files, hammers, mallets, taps & dies, insulated pliers, phase tester and test lamps.

Power Tools 8 L

Portable electric drill, bench type drill and grinder.

Measuring & Marking Tools 5 L

Marking gauge, inside and outside callipers, haerophrodite dividers, combination sets, try squares, micrometer and Vernier callipers, Bevel protractor, surface plate and V-blocks.

Safety Measures 15 L

Aprons, face shields, face pad, hand gloves, safety shoes, insulated tools and appliances, safety from fires, fire extinguishers, use of lifting toggles / pulley / blocks, operation of levers, trolleys and first aid materials.

### PAPER - 3: WORKSHOP TECHNOLOGY

Carpentry 10 L

Types of wood, its texture, their defects, seasoning and preservation, equipments and types of joint. Wood working machines.

Smithy and Forging

10 L

Tools and equipments; Anvil, hearth & furnaces, sledge hammer and hand hammers, leg vice, swage block, hot & cold chisel, tongs, swages, fullers, flatters, punches and drifts. Upsetting, drawing, swaging & punching, rivetting, forge welding. Forging dies. Power hammers.

Fitting:

10 L

Types of chisels: Hand, Gouge, Diamond etc.

Types of hammers : ball pean, straight pean & cross pean.

Files : Classification; flat ( rectangular, square etc.), round. half round and triangular files. Single and double cut; jeweller's file. Scrapers.

Sheet Metal Working

4 L

Tools and equipments, development of surface and types of joints.

Electroplating

6 L

Equipment, electrolytes and electroplating compounds, electroplating processes. Metalizing and Powder coating.

#### **PAPER - 4: TREATMENT AND TESTING OF MATERIALS**

Heat Treatment

25 L

Iron-Carbon diagram and Phase diagrams. Purpose and methods of heat treatment, annealing-process, full annealing, isothermal annealing, spheroidizing, homogenizing and patenting annealing, normalizing, hardening, requirement for hardening, water oil and liquid Nitrogen -quenching, hardenability, factors affecting hardenability and its determination, tempering, tempering processes (low, medium and high temp.), case hardening, carburizing, cyaniding, nitriding, surface hardening, flame hardening, induction hardening and hardening using electrolytic bath, diffusion coatings-calorizing, chromizing, etc.

Heat Treatment Equipments

5 L

Coal, oil and gas fired furnaces. Induction furnaces.

Testing of Materials

10 L

Tensile test of ductile and brittle materials, -measure of elasticity, strength and ductility; use of extensometers, compression test, hardness test (Brinell, Rockwell, Vicker's etc.), impact test, fatigue test, bending, shear and torsion test.

**PAPER - 5: MANUFACTURING PROCESSES - I**

Machinability 6 L

Criteria for machinability, variables affecting Machinability and evaluation of machineability.

Heat Generation in Metal Cutting and Calorimetry 2 L

Machine Tools 8 L

Classification and general requirements of machine tools, specification of machine tools, machine tool drives, structures, guide ways, tools and work holding devices, maintenance of machine tools.

Introduction to metal machining process 2 L

Metal Cutting Process 20 L

Construction and operations on a Centre lathe: Centre lathe, specifications, attachments and accessories, turning, facing, threading, taper turning, hydrocopying, drilling and boring operations on a lathe. Shaper, planer, slotter, boring, drilling, broaching, milling, gear cutting and shaving and thread cutting machines.

**PAPER - 6: MANUFACTURING PROCESSES - II**

Abrasive Processes 12 L

Construction and operation of grinding, honning, lapping, super-finishing, burnishing and deburring machines.

Selection of Tool Materials 4 L

Requirement of tool materials, tool materials, tool wear, tool life and heat treatment of tools.

Selection of Cutting Speed 2 L

Feed and depth of cut for different processes and tool-work material combinations.

Cutting Fluids 4 L

Function of cutting fluids, abrasive action of cutting fluids, cooling action of cutting fluids, types, selection and application of cutting fluids for different metal cutting operations.

Cutting Tool Nomenclature 4 L

**Types of Chips**

8 L

Continuous, discontinuous, Built up edge (BUE) chips, shear plane angle, orthogonal and oblique cutting. Cutting forces. Merchant's diagram.

**Tool Life**

2 L

Taylor's Tool Life formula.

**Introduction to Modern Machining Process**

6 L

Electrochemical machining (ECM), Electric discharge machining (E.D.M) Ultrasonic machining, Hot machining etc.

Computerized Numerical Control machines (C N C) and Flexible Manufacturing Systems (F M S).

**PAPER - 7: METROLOGY**

**Introduction**

10 L

Standards of measurement viz. line and end standards, measurement of length, flatness, angles & threads, measurement of surface topography, tolerances limits and fits.

**Measuring Instruments / Gauges**

8 L

Classification and types. GO and NO GO gauges, plug and ring gauges.

**Interchangeability**

2 L

**Instrumentation**

15 L

Measuring instruments, slip gauges, comparators; mechanical, electrical, optical and pneumatic calibration, sensitivity, precision and reliability. Sources of error.

**Screw Thread and Gear Measurements**

5 L

Two and three wire method of screw measurement. Gear run out test.

**PAPER - 8: MANUFACTURING PROCESSES - III**

**Foundry Technology**

22 L

Materials for patterns, types of pattern, pattern allowances, pattern layout and design, sands and binders, sand preparation and testing, sand moulding processes, core making processes, equipment for moulding and core making, precision casting processes, principles, technology and scope of CO moulding, shell moulding, investment casting, permanent mould, pressure die-casting, centrifugal casting, casting design consideration, casting defects, inspection of castings, cleaning and conditioning of castings.



**Metal Joining Processes**

18 L

Welding processes, gas, arc, resistance, thermit, submerged arc, TIG & MIG welding and their applications, equipment. Weldability, welding of ferrous and non-ferrous metals and alloys, welding defects and remedies. Types of welded joints.

**PAPER - 9: MANUFACTURING PROCESSES - IV**

**Flame Cutting: Torches, equipment and processes** 1 L

**Brazing and Soldering:** 2 L

Processes, equipment, requirement of materials.

**Metal Forming Processes** 12 L

Hot and cold working processes: rolling, forging, piercing, drawing, deep drawing, wire drawing, spinning, extrusion, bending, squeezing and peening.

**Powder Metallurgy** 8 L

Powder production and properties, compact sintering and applications.

**Press Tools** 7 L

Classification of Presses. Constructional details of mechanical and hydraulic presses. classification of press working operations, design of punches and dies for shearing, bending and drawing operations, material selection, stock strip layout and economics.

**PAPER - 10: INDUSTRIAL MANAGEMENT AND QUALITY CONTROL**

**Jigs and Fixtures** 10 L

Economic considerations, types, principles of design, location and clamping, jig bushes, manufacturing of jigs and fixtures.

**Industrial Management** 6 L

Introduction, management concept and general consideration for plant location and layout.

**Work Analysis** 4 L

Time and motion study, work sampling, selection of labour and wage payment.

**Production, Planning and Control** 6 L

Methodology, aggregate planning, scheduling, materials requirement planning.

Quality Control: Acceptance sampling and control charts. 6 L

Material Management: Inventory, deterministic model. 4 L

### LIST OF EXPERIMENTS

#### I st Semester Lab-I :

##### Engineering Drawing :

Introduction. First and Third Angle Projections, Orthographic and Isometric Views.

Threads and Threaded fasteners. Nuts, Bolts and Locking devices.

Rivettted and Welded joints.

Constructional details of components and machines and their sectioned views.

##### Fitting :

To prepare a M.S.job involving chiseling and filing operations.

To make a threaded hole using drills and taps.

To prepare a job involving matching of two components.

##### Sheet Metal Working :

To make a Funnel out of tin sheet according to the given specifications involving cutting of sheets and finishing the joints.

To make a soap case from tin sheets involving application of Mechanical joints.

#### II nd Semester Lab-II :

##### Carpentry :

To prepare different joints namely Half Lap Cross Joint, Mortise and Tenon Joint and Dovetail Joint.

To make a Portal Frame.

To prepare a pattern for a Plummer Block.

To prepare a pattern for Flange Pipe and CoreBox.

##### Smithy Forging And Heat Treatment :

To make a Hexagonal Bolt.

To make a pair of Tongs.

To make an Eye Bolt.

To prepare a Chisel followed by Quenching and Tempering.

To Case Harden a given M.S.job by Carburising.

##### Electroplating :

To electroplate \ Chromeplate a job.

##### Material Testing :

To perform tensile test of M.S..

To perform compression test of C.I..

To perform Rockwell hardness test.

To perform impact test.

To perform torsion test.

### III Semester Lab-III :

#### Machine Shop :

To study the constructional details and working of different parts of a Centre Lathe.

Study of Power transmission mechanism of a lathe.

To study the lathe accessories and attachments viz. chucks, rests, job holding devices, tool holders, centers, taper turning and grinding attachments.

To make a job involving facing, turning, thread cutting, taper turning, parting, chamfering, drilling, boring and knurling on a lathe.

To machine a single point tool on a bench grinder.

### IV Semester Lab-IV :

#### Machine shop :

To study the constructional details of a Shaper.

To study the Quick Return Mechanism.

To machine M.S. block to specifications on a shaper.

To cut a Keyway on a shaft by shaper.

To study the constructional features of Universal Milling Machine.

To study different types of milling cutters and their use.

To study a Universal dividing head.

To machine a hexagonal headed bolt.

To make a spur gear using universal indexing.

To cut helical flutes on a shaft.

To perform alignment test on a milling machine

To perform Surface Grinding of a job.

### V th Semester Lab-V :

#### Metrology :

To study a set of Slip Gauges.

To study a Sine Bar.

To study a Clinometer.

To study Ring and Plug Gauges (GO and NO Go type)

Screw thread measurement by two and three wire method.

To study different types of comparators (mechanical, optical, pneumatic)

#### Foundry :

To prepare a sand mould of three jobs namely bearing cap, flange pipe (with core) and anvil.

To test the permeability of green sand sample.

To determine the compressive strength of green and baked sands.

To determine the grain fineness number (GFN) of the given Silica sand.

To determine the moisture and clay content in sand samples.

#### Welding :

##### Gas Welding :

To study different types of Torches and flames (Oxidizing, neutral and carburizing).

To prepare a Lap Joint by Gas Welding.

To prepare a Butt Joint by gas welding.

To prepare a Corner Joint by gas welding.

##### Arc Welding :

To study the welding power source and different tools.  
 To prepare a lap joint, butt joint and T-joint by arc welding.  
 To braze a given joint.

VI th Semester Project Work :

To fabricate a Machine including Pattern making, Foundry, Machining and Assembly and present a Project Report at the end.

#### List of Reference Books

S.N.	Title	Author	Publisher
1.	Workshop Technology Vol.I II III	W.A.J.Chapman	E L B S
2.	Workshop Technology Vol.I II	B.S.Raghuvanshi	Geeta Prakashan
3.	Manufacturing Processes	M.L.Begeman	Wiley
4.	Production Engineering	P.C.Pandey	Standard Publ.
5.	Engineering Metrology	R.K.Jain	Khanna Publ.
6.	Engineering Metrology	K.J.Hume	Kalyani Publs.
7.	Foundry Technology	Beeley	Eutterworths
8.	Welding Engineering	R.J.Sacks	
9.	Welding Technology	S.V.Nadkarni	
10.	Manufacturing Technology	Lindberg	

#### List of Probable Employers

1. Maruti Udyog Ltd., Gurgaon.
2. Hindustan Motors, Calcutta.
3. Premier Automobiles, Bombay.
4. TELCO, Jamshedpur and Pune.
5. Ashok Leylands, Madras.
6. Escorts Tractors Ltd., Faridabad.
7. Punjab Tractors Ltd., Chandigarh.
8. Eicher Tractors Ltd., Faridabad.
9. International Tractors Ltd., Pune.
10. Auto Tractors Ltd., Pratapgarh.
11. Bajaj Auto Ltd., Pune.
12. LML Vespa Ltd., Kanpur.
13. HMT, Bangalore, Hyderabad and Pinjore
14. TISCO, Jamshedpur.
15. D.L.W., Varanasi.
16. I.T.I., Bangalore, Rai Bareli and Mankapur.
17. BHEL, Hardwar, Hyderabad, Trichy, Bhopal and Varanasi.
18. E.I.L., New Delhi.
19. E.P.I., New Delhi.
20. BMEL, Bangalore.
21. L & T, Bombay.
22. HAL, Bangalore Hyderabad and Lucknow.

\* All plants and projects involving manufacture and fabrication viz. HSC NTPC, NHPC, Sugar industries, Cement plants and State Electricity Boards.

**7**

**VOCATIONAL SUBJECT**  
**IN**  
**ELECTRICAL EQUIPMENT**  
**MAINTENANCE**

## ELECTRICAL EQUIPMENT MAINTENANCE

SUMMARY CHART

Sr.No.	Year/ Semester	Paper	L (Period)	P (Week)
1.	I/I	Introduction to Power Apparatus and System - I	3	-
2.	I/I	Instrumentation and Control - I	3	-
3.	I/I	Electrical Devices and Circuits Lab.	-	6
4.	I/II	Introduction to Power Apparatus and System - II	3	-
5.	I/II	Instrumentation and Control - II	3	-
6.	I/II	Electrical Transformers and Machine Laboratory	-	6
7.		On the Job Training - I	Summer	One Month
8.	II/I	Utilisation of Electrical Energy - I	3	-
9.	II/I	Specifications and Estimation of Electrical System - I	3	-
10.	II/I	Testing and Maintenance Practice of Electrical Equipments	-	6
11.	II/II	Utilisation of Electrical Energy - II	3	-
12.	II/II	Specification and Estimation of Electrical System - II	3	-
13.	II/II	Testing and Repair Practice of Electrical Equipment	-	6

14.	On the Job Training - II	Summer	One Month
15.	III/I	Maintenance of Electrical Equipment and System - I	3 -
16.	III/I	Project Development	- 6
17.	III/I	Repair and Assembly Practice of Electrical Equipment	- 6
18.	III/II	Maintenance of Electrical Equipment and System - II	3 -
19.	III/II	Repair and Assembly Practice of Electrical Equipment	- 6
20.	III/II	Project Work	- 6

## ELECTRICAL EQUIPMENT MAINTENANCE

### PAPER - 1(a): INTRODUCTION TO POWER APPARATUS & SYSTEMS - I

#### Introduction

16 L

Review of basic laws-Ohm's, Kirchoff's, Ampere's, Biot-Savart's

Types of resistors, capacitors, inductor and its uses. Circuit concepts and components in electric circuits, sinusoidal excited circuits, concept of phasor, R.C.L. circuits under steady-state, mutual inductance, KVL & KCL applied to circuits, Network theorems.

Power in electric circuits.

Magnetic circuit-magnetic circuit calculations. Analogy with electric circuits.

3-phase balanced system, star and delta connections, inter-relationships and transformation, power in 3-phase circuit and power measurement.

#### Transformers

12 L

Constructional features, ideal two-winding transformer, transformation ratio, phasor diagram, approximate equivalent circuit, regulation, 3 phase transformer connections, losses, efficiency, all-day efficiency.

Auto-transformers.

Special types of transformers-instrument, radio-frequency, pulse, welding transformers.

#### General Considerations of Rotating Machines

8 L

Electro-mechanical energy converters, mechanical, electrical, magnetic and thermal circuits. Armature windings, distribution and coil-span factors, general e.m.f. equation, role of commutator.

### PAPER - 1(b): INTRODUCTION TO POWER APPARATUS & SYSTEMS - II

#### D.C. Machines

7 L

Constructional features, process of self-excitation, generator characteristics, commutation, armature reaction, commutating poles and compensating windings.

Operation as motor, motor characteristics, starting, speed control.

Losses, efficiency and testing.



<b>3-Phase Induction Motors</b>	<b>7 L</b>
Rotating magnetic field, constructional features, characteristics, starting, speed control, losses, testing.	
<b>Single-phase Induction Motors</b>	<b>4 L</b>
Conditions of starting torque, construction features-split-phase, shaded-pole motors, characteristics.	
<b>3-Phase Synchronous Machines</b>	<b>4 L</b>
Constructional features, operation as a generator, synchronous impedance, voltage regulation, phasor diagram, synchronising.	
Operation as a motor - V curves, starting.	
<b>Small Electric Machines</b>	<b>5 L</b>
Construction and principles of operation of: universal, FHP, stepper switched reluctance, permanent magnet and hysteresis motors.	
Applications of these motors.	
<b>Transmission and Distribution</b>	<b>5 L</b>
Layout of single-phase and three-phase transmission lines, transmission line parameters, performance of lines, efficiency and regulation, improvement of power-factor with capacitors.	
<b>Protective Relays</b>	<b>3 L</b>
Requirements of relaying, principle and working of different types of relays, electro-mechanical and static relays and their uses in protective schemes. Earth leakage relays.	
<b>Circuit Breakers</b>	<b>3 L</b>
Principles of arcing and arc-quenching, over voltages during ar interruptions, types, rating and maintenance of circuit breakers, MCB and Fuses.	

**PAPER - 2(a): INSTRUMENTATION & CONTROL - I**

Classification, construction and working principles of ammeters, voltmeters, wattmeters, energymeters, frequency meters, power factor meters. Testing and Calibration. Extension of instrument range. 15 L

Measurement of resistance, inductance, capacitance, dielectric loss, power factor, permittivity. High voltage measurement. 12 L

Electronic devices, Operational Amplifiers, other IC's commonly used in instrumentation, Power Supplies and U.P.S. 15 L

**PAPER - 2(b): INSTRUMENTATION & CONTROL - II**

Transducers. Measurement of nonelectrical quantities. Instrumentation amplifiers. A/D and D/A converters. Display devices, recorders, data loggers, digital multimeters, frequency counters, signal generators, oscilloscope. Microprocessor based instruments, isolation transformer, shielding and spike busters. 25 L

Basic principles of control systems, examples of open-loop and closed-loop control. Effect of feedback. Control system. Components - tachogenerators, synchros, error detectors and servomotors. 10 L

**PAPER - 3(a): UTILISATION OF ELECTRICAL ENERGY - I**

**Power Electronics** 18 L

Introduction to high-power solid-state devices: characteristics, ratings, commutation methods, series and parallel operation, protection schemes.

Converters and inverters: AC to DC, DC to AC, DC to DC, AC to AC with D.C. link, cyclo-converters.

Application to control of motors and U.P.S.

**Illumination** 8 L

Nature of light, relative sensitivity curve of human eye and effect of wavelength. Basic laws of illumination. Measurement of illumination and photometry.

**Light source and their characteristics:**

Incandescent and discharge lamps.

Different types of fittings for filament, mercury, sodium, fluorescent and neo lamps.

Design and control of lighting for residential and industrial buildings, auditorium, street-lighting and flood-lighting.

**Electric Heating** 4 L

Resistance, induction, dielectric and arc types of electric heating. Types of furnaces and their uses. Microwave heating.

**Electric Welding** 4 L

Arc and resistance types of electric welding, equipments for current and time control.

**PAPER - 3(b): UTILISATION OF ELECTRICAL ENERGY - II**

**Electrochemical Process** 18 L

Electrodeposition. Equipments and accessories for electroplating. Anodising and electrorefining.

Electroplating on non-conducting materials.

**Electrical home Appliances.**

Description of electrical circuits used in refrigerators, air conditioners, water coolers and other home appliances.

**Electric Drives** 12 L

Comparison of electric drives with other types. Review of characteristics of electric motors. Electric braking - plugging, rheostatic and regenerative.

Mechanical power transmission devices: belt, gear, chain, clutches and their dynamic characteristics.

Selection of drives for workshops, textile mills, paper mills, steel mills, rolling mills, printing press, cranes, lifts. flywheel and its use.

**Concept of Conservation and Methods for Conservation of Electrical Energy.** 4 L

**PAPER - 4(a): SPECIFICATIONS AND ESTIMATION OF ELECTRICAL SYSTEMS-I**

**Introduction to Engineering Specifications** 12 L

Different types of specifications: functional, environmental and performance specifications. Rating, duty cycle, heat generation and dissipation.

Electricity regulations, codes for electrical equipment and installation. Circuit symbols and diagrams. Standardisation, use of ISI specifications.

Properties and selection of different types of electrical engineering materials, conductors, insulators - oil, varnish, ceramic materials and SF6 gas, magnetic materials. Classes of insulations.

**Industrial and Domestic Wiring** 10 L

Internal wiring system, estimation of wiring installation for residential, commercial and industrial buildings, design of layout, load estimation, specification of materials and accessories.

**Estimation of Power Wiring** 10 L

Determination of size of cables, conductor, distribution boards, main switches, starters. Costing of equipment and accessories. Estimation and costing of material and work for motors, pumpsets, small workshops and sub-station.

Estimation and costing of service connection to domestic, commercial and industrial consumer.

**Cable Laying, Jointing and Fault Detection** 4 L

**PAPER - 4(b): SPECIFICATIONS AND ESTIMATION OF ELECTRICAL SYSTEMS-II**

**Design and Estimation** 10 L

Design of control circuits/panels for various types of electric generators, motors.

Estimation of materials required for a small Power Control Centre (PCC) and Motor Control Centre (MCC) 5 L

**Earthing** 5 L

Earthing conductors, electrodes, grid, earthing system for equipment, transmission lines, towers, buildings and sub-station. Earth

## **Quality Control**

Concept of quality control, ISO9000/BIS 1400 concepts, elements of quality control, quality control groups, basic principles of statistical quality control, quality assurance and reliability, MTBF and MTTR.

## **Electrical Energy Management**

8 L

Concept and classifications, general principles of energy conservation, efficiency and energy economics analysis, electrical energy consumption patterns.

Classical versus systems approach of electrical energy management.

## **PAPER - 5(a): MAINTENANCE OF ELECTRICAL EQUIPMENTS & SYSTEM - I**

### **Industrial Management**

Repair and Maintenance of Electronically controlled electrical equipments: 20 L

Testing, repair and maintenance principle of electronically controlled equipments, corrective preventive overhauling and servicing. Faculty diagnosis and remedies. Trouble shooting and safety.

Repair and Maintenance of Electromagnetic Devices and Electrical Equipment 16 L

Repair and maintenance and safe operation of electromagnetic devices - corrective, preventive, overhauling and servicing.

Fault diagnosis and remedies.

Trouble shooting, electrical accidents and safety.

Testing.

## **PAPER - 5(b): MAINTENANCE OF ELECTRICAL EQUIPMENTS & SYSTEM -II**

### **Maintenance of Domestic appliances**

Fan, pumps, inverters and UPS, heating appliances, Refrigerators, Airconditioners, coolers and electrical fittings.

Maintenance of 3 phase and single phase Industrial appliances and Electrical fittings, Power Control Centre (PCC) and Motor Control Centre (MCC). Battery and Battery Charger. 20 L

**PAPER - 5(c): CASE STUDIES-PROJECT REPORT PREPARATION**

**LIST OF EQUIPMENTS, METERS, COMPONENTS, CONSUMABLES AND CONTINGENCIES**

Laboratory equipments and instruments to be augmented in the beginning of introducing the vocation subjects "Electrical Technology" (assuming all the experiments are done under one roof. Otherwise the inputs will be higher).

**I. NON-RECURRING**

**A) Equipment**

- 2 Nos. Double-beam oscilloscopes
- 2 Nos. Signal generator
- 5 Nos. 1 ph. variacs
- 2 Nos. 3 ph. variacs
- 2 Nos. 250 VA D.C. Motor-generator sets
- 2 Nos. 500 VA 1 ph. transformers
- 2 Nos. 250 VA Ind. Motor/D.C. generator sets
- 1 No. 1 KW Synchronous motor/D.C. generator set
- 3 Nos. Electromechanical over current and differential relays
- 1 No. Solid-state controlled relays
- 2 Nos. Line models
- 1 No. Cable-fault detection bridge
- 1 No. Transformer oil-testing kit.

## B) Meters

- 15 Nos. Ammeters AC/DC 0-0.5-1A
- 15 Nos. Ammeters AC/DC 0-2.5-5A
- 15 Nos. Digital Multimeters
- 15 Nos. Voltmeters AC/DC 0-150-300-600V
- 5 Nos. Wattmeters (current rating 0-1-2A)
- 5 Nos. Wattmeters - do - 0-2.5-5A)
- 5 Nos. Wattmeters - do - 0-5-10A)
- 5 Nos. Hand held digital/analog tachometers
- 1 No. Time interval meter
- 1 No. Meggar, earth tester (500 V)
- 2 Nos. 1 ph. Energy meter
- 1 No. D.C. Galvanometer
- 1 No. A.C. Galvanometer
- 2 Nos. Frequency counter

## C) Components and Demonstration Boards

- 1+1 Servo Demonstration Board AC & DC
- 5 Nos. Transducers  
Assorted L-S electronic components
- 1 No. Kelvin's bridge
- 1 No. D.C. potentiometer
- 4 Nos. Electronic experimental boards
  - 1+1 Regulated power supply analog & digital
- 2 Nos. A/D & D/A and digital experimental boards
- 1 No. Lumen-meter
- 5 Nos. Rheostats (current 1A) 300 ohms.
- 5 Nos. Rheostats (current 1A) 1000 ohms.
- 10 Nos. Loading boxes
  - 2 ways keys, DPDT and TPDT switches

## RECURRING

### Consumables & Contingencies

Connecting wires

Tool kits - pliers, Screw drivers insulator splicers,  
soldering iron, etc.

### LIST OF EXPERIMENTS

#### B.Sc. Part - I - SEMESTER - I

#### A) Experiments on Circuits, Measurement and Control

- 1) Calibration of instruments
  - a) dc voltmeter and ammeter using potentiometer
  - b) ac voltmeter and ammeter using substandard instruments.
- 2) Measurement of low, medium and high resistances
- 3) Measurement of inductance and capacitance
- 4) Phasor diagram of RLC circuit and measurement of power and power factor.
- 5) Performance and testing of energy meter.
- 6) Measurement of power in three phase ac circuit.
- 7) Testing of voltage and current amplifier and study of wave forms.
- 8) Learning the use and adjustment of oscilloscope for common measurements like instantaneous amplitude, phase and frequency of voltage and current waveforms.
- 9) Performance and testing of common transducers for position and temperature control.
- 10) Performance and testing of Hall effect transducer.
- 11) Study of performance of ADC & DAC
- 12) Performance and testing of filters
- 13) Performance and testing of regulated power supply
- 14) Performance of position control system on servo demonstration unit.
- 15) Use and testing of signal generator with the help of multi-meter, oscilloscope and frequency counter.



- 16) Characteristics of servo-motors
- 17) Luminous efficiency measurement of a incandescent lamp and fluorescent tube.

#### **Experiments on Electrical Machines, Power Systems and Utilisation**

- 1) Polarity, turns ratio, efficiency and regulation of a 1-ph. two winding transformers.
- 2) Study of 3-point and 4-point starters. Determination on no-load magnetization characteristic of a d.c. shunt generator. conditions of self-excitation.
- 3) Starting of 3 phase and 1 phase induction motors
- 4) Earth resistance measurement
- 5) Load characteristics of d.c. generators and their comparison.
- 6) No-load and blocked rotor test on 3 ph induction motors. Determination of losses and efficiency.
- 7) Voltage regulation and load characteristics of a 3 phase alternator.
- 8) ABCD parameters of transmission line model regulation-efficiency.
- 9) Speed control of d.c. motors including solid state controllers.
- 10) Synchronising of an alternator to supply system and parallel operation.
- 11) Study and testing of over current and differential relays.
- 12) Load-test on d.c. motor. Comparison of efficiency by Swinburn's method.
- 13) 3 phase transformer connections. Measurement of phase-shift, line and phase values of voltages and currents.
- 14) V-curves of synchronous motors and starting of synchronous motors.
- 15) Speed control of induction motor.
  - i) by Rotor resistance
  - ii) by Solid state control
- 16) Modification of d.c. motor characteristic.

**SUGGESTED ITEMS FOR PRACTICE COURSE II YEAR COURSE**

(1 UNIT = 3 HR.)

		TURN
1.	Trouble shooting, testing and repair of small transformers	2
2.	Study of d.c. and a.c. motor starters	1
3.	Testing of insulation transformer oil, centrifuging of oil	1
4.	Methods of vacuum heating and impregnation	1
5.	Study of bearings, fitting of bearings and couplings on motor shafts end-covers.	1
6.	Testing and maintenance of voltage stabilizer, UPS, power conditioners.	1
7.	Maintenance of indicating and digital instruments (ammeters, voltmeters, multimeters).	1
8.	Maintenance of energy meters.	1
9.	Study of common machine parts-assembly, trouble shooting, brush placement.	2
10.	Study of induction machine parts-assembly, trouble shooting.	1
11.	Study of brushless excitation systems in standalone a.c. generators.	1
12.	Study of domestic fittings, switches, contractors, mini circuit breakers.	1
13.	Study of fuse systems and fuse holders. Methods of selecting fuses.	1
14.	Domestic wiring systems, layout, design, sectionalisation, stair-case lighting system, tube-light connection, switch boards.	2
15.	Industrial wiring - layout planning, selection of equipment, switch boards and switch-areas.	1
16.	Study of electrical welding equipment, methods of welding.	1
17.	Electroplating-selection of electrotypes, arrangements	1
18.	Illumination-layout design, amp selection, fittings and installation-direct and indirect lighting schemes.	2
19.	Study of FHP motors used in domestic appliances, circuit layout, thermostat setting, relays and protecting systems.	2

- |      |   |   |
|------|---|---|
| 20.  | Machine windings - design of formers, coils, actual winding practice interconnection, common connection, testing. | 2 |
| 21.  | Earthing and grounding systems - meggar testing, study of earthing arrangements.                                  | 1 |
| 22.  | Cable laying and jointing processes   | 1 |
| 23.  | Demonstration of small m/cs - step-motor, ac servo motors, p.m. motor, etc.                                       | 1 |
| *24. | Study of sub-station installation   | 2 |
| *25. | Visits to power generation installations  | 2 |

\*THROUGH SITE VISITS

Total Turns: 33

During summer vacation after II year a 6 week practical training should be organised.

Input required for Electric Repair Shop/Workshop

Augmentation = Rs.50,000.00

Recurring = Rs.10,000.00



**8**

**VOCATIONAL SUBJECT**

**IN**

**CONSTRUCTION MANAGEMENT**

**AND**

**TECHNOLOGY**

**CONSTRUCTION MANAGEMENT AND TECHNOLOGY**

**SUMMARY CHART**

Sr.No.	Year/ Semester	Paper	L (Period/Week)	P
1.	I/I	Introduction to Construction Materials and Technology - I	3	-
2.	I/I	Construction Methods, Plants and Equipments - I	3	-
3.	I/I	Laboratory	-	6
4.	I/II	Introduction to Construction Materials and Technology - II	3	-
5.	I/II	Construction Methods, Plants and Equipments - II	3	-
6.	I/II	Laboratory	-	6
7.		On the Job Training - I	Summer	One Month
8.	II/I	Integrated Planning and Design Consideration - I	3	-
9.	II/I	Socio-Economic Dimensions of Construction - I	3	-
10.	II/I	Work Practice	-	6
11.	II/II	Integrated Planning and Design Consideration - II	3	-
12.	II/II	Socio-Economic Dimensions of Construction - II	3	-
13.	II/II	Work Practice	-	6

14.		On the Job Training - II	Summer	One Month
15.	III/I	Construction Management - I	3	-
16.	III/I	Project Development	-	6
17.	III/I	Work Practice	-	6
18.	III/II	Construction Management - II	3	-
19.	III/II	Work Practice	-	6
20	III/II	Project Work	-	6

## CONSTRUCTION TECHNOLOGY

### PAPER - 1(a): INTRODUCTION TO CONSTRUCTION TECHNOLOGY - I

#### Definitions:

Science, Art, Engineering, Technology, Materials and Constructions, Need for Construction.

#### Classification of Constructions:

Roads, buildings, storage structures, Hyd. Structure, Dams, etc.

#### Construction Materials:

Desirable characteristics of construction materials.

Mud, bricks, tiles, stone, lime, timber, steel and other metals, cement concrete, plastics, bitumen, paints and varnishes.

#### Other Materials:

Ferrocement, fibre composites, AC & GI sheets, epoxy, polymer, timber based product and admixtures in concrete for specific requirements.

Refractory Materials and Eco-friendly Materials.

Need for Modular Materials

Need for Quality Assurance

Role of Bureau of Indian Standards

Standard Test Procedures, Destructive & Non-destructive Tests

Acceptance Criteria.

### PAPER - 1(b): INTRODUCTION TO CONSTRUCTION MATERIALS & TECHNOLOGY - II

#### Construction Technology:

Classification-appropriate, rural, intermediate good and bad construction practices.

Construction tools.

Temporary support structures-from work, centering, shuttering, scaffolding, shoring and underpinning.

Connections and joints: welding, bolting, nailing, etc.

Need for mechanisation in construction.



Operations involved in construction:  
Excavation, drilling, blasting, dressing, haulage, handling,  
fabrication and erection.

Need for prefabrication: Partial & full prefabrication.

Cost in hilly areas.

## PAPER - 2(a): CONSTRUCTION METHODS, PLANTS AND EQUIPMENT - I

Construction Methods:

Sub-surface, surface, under water and deep water constructions.

Sub-surface Constructions:

Tunnels, tube-wells and buried structures.

Surface Constructions: Jetties, etc.

Deep Water Structures: Off shore structures.

Rating Structures: Dams, retaining and breast walls.

Classification of Buildings:

Residential, commercial, educational, public, official, etc.

Brick Masonry: Bonds and mortars used, walls and slabs.

Stone Masonry: Random rubble, ashlar, course and roughened masonry.

Concrete Structures: Reinforced and prestressed concrete members.

Production of Concrete:

Hand and machine mixing, methods of transportation, compaction and curing.

Fabrication and layout of reinforcements.

Use of jump, slip and lift forms.

Massive Concrete Structures:

Retaining: wall, dams and embankments.

Need for construction joints.

**PAPER - 2(b): CONSTRUCTION, METHODS, PLANTS AND EQUIPMENTS - II**

**Prestressed Concrete:**

Methods of prestressing, internal and external, pretensioning and post tensioning, prestressing of railway sleepers, bridge super structure, building and roofing components.

**Prefabricated Construction:**

Fabrication of mould, accelerated curing, handling, stacking, transportation and erection, sealing of joints.

**Steel and Timber Structures:**

Different types of constructions, methods of fabrication and erection.

**Composite Constructions:**

Steel and timber, masonry and concrete, steel and concrete.

**Foundations:** Shallow and deep footings, rafts, piles and wells.

**Under Water Construction:**

Concreting through tremie and direct dumping.

**Road Construction:**

Types of road, flexible, semi-rigid and rigid pavements, precast pavement components.

**Ferro Cement Technology:**

Selection of materials, hand and machine fabrications, building and storage components.

Repair and rehabilitation of constructions, safety aspects, inspection, quality control and load testing, acceptance criteria.

**Plants:**

Premix and hot mix bitumen plants, batching plant for concrete, welding and fabricating plants.

**Equipments:**

Stone crushers, screening, weighing, batching, concrete mixers, compaction, excavating, earth moving, hauling, drilling, blasting, grouting, belt and truck conveyers, dewatering and concrete pumping, rolling equipments.

**PAPER - 3(a): INTEGRATED PLANNING AND DESIGN CONSIDERATIONS - I**

Definition of planning, analysis and design.

Planning for safety, economy, strength and aesthetics.

Integrated planning of habitats and industrial complexes.

Macro-level planning-house, bridge, silo, water tank, road, etc.

Macro-level planning-housing colony, industrial complex, etc.

Construction of housing system - structural, service, comfort, safety and durability aspects.

Structural details of - walls, columns, beams, roofs, foundations, chajjas, etc.

Service details - plumbing, sewerage, electric, overhead water tank, etc.

Comfort aspects - thermal, acoustics, orientation, ventilation, circulation.

Safety for loads, fire, natural hazards (earth quakes, winds, flood, cyclones, etc.

**PAPER - 3(b): INTEGRATED PLANNING AND DESIGN CONSIDERATIONS - II**

Durability and maintenance consideration.

Zero energy concepts.

Selection of sites for different constructions and sub-soil investigations.

Eco-friendly structures - use of locally available materials and products.

Elementary Analysis of simple beams for bending moment, shear and deflections.

Relevant I.S. specification for loads and materials stresses.

Physical behaviour of structures highlighting causes and effects.

Study of normal drawings of simple beam, columns, footings, roads, storage structures, pipe and slab, culverts, drains, retaining walls and embankments.

**PAPER - 4(a): SOCIO-ECONOMIC DIMENSIONS OF CONSTRUCTION - I**

Concepts: Ecology, city, community, urbanisation.

Historical development of society and its constructional needs: Housing and industrial-rural/urban.

Social Ecology: Locations, ecological patterns, adaptation of different types of constructions.

Size, density and spatial requirement of constructions.

Problems of composite living and its effect on construction:

- complexity and conflict
- separation v/s integration
- cultural and socio-economic aspects

**PAPER - 4(b): SOCIO-ECONOMIC DIMENSIONS OF CONSTRUCTION - II**

Organizational, administrative and finance rules governing society and constructions.

State/national policy and measures for constructional activities.

**ECONOMIC ASPECT:**

Financial statement and cost accounting, present worth, future worth and uniform annual series calculations, interest, inflation, depreciation and corporate tax.

Evaluation of capitalised cost, equivalent uniform annual cost, rate of return, benefit/cost ratio and service life, evaluation of multiple alternatives.

**PAPER - 5(a): CONSTRUCTION MANAGEMENT - I**

**Introduction:**

Need for scientific management, general concepts of management, traditional and modern methods of management.

**Personnel Management:**

Man power planning, recruitment placement, training, motivation, performance, industrial and public relations, welfare.

**Materials Management:**

Construction materials, stages of material management, storage and inventory control.

**Financial Management:**

Financial resources, control, accounts and audit.

**Project Management:**

Planning, scheduling, controlling and forecasting in respect of time, cost and resources, network techniques, CPM and PERT, bar charts and progress curves.

**PAPER - 5(b): CONSTRUCTION MANAGEMENT - II**

**Safety Management:** Safety and health codes, safety measures.

**Specifications:**

Purpose, types and drafting, detailed specifications of various components of constructions.

**Estimate:**

Approximate estimates and detailed estimates, measurement and quantity calculations, analysis of rates, cost estimation.

**Tendering and Contract:**

Organisational structure; different units and their function, types of tenders, tendering procedures, contracts, laws of contract, contract documents, conditions of contract, disputes and arbitration, accident claims and insurance.

**LABORATORY/PRACTICE**

1. Physical and chemical properties of cement
2. Physical and mechanical properties of aggregates
3. Bricks and tiles
4. Concrete-fresh and hardened state
5. Chemical analysis of mortar and concrete
6. Lime
7. Steel
8. Timber
9. Non-destructive tests.
10. Video graphic display of equipments, plants and projects in construction.
11. Visit to project site to see working of earth handling equipments

12. Comparative study of flexible, semi-rigid and rigid pavement
13. Visit to steel fabrication work shops
14. Visit to prefabricating components workshop
15. Visit to prestressed concrete fabricating shops.
16. Anatomy of an engineering drawing
17. Planning of a home (Micro-level)
18. Integrated planning of a colony (Micro-level)
19. Planning of building services
20. Study of buildings
21. Design of roads and pavements
22. Study of specifications
23. Quantity surveying and cost estimation of a typical structure such as (buildings, roads, culverts, bridges and dams, etc.).
24. Preparation of tenders-various types/management and monitorial aspects-personnel and material.
25. Work experience at a construction project site
26. Preparation of a project report

The students will conduct surveys of the communities/problems of the community. Make cost benefit analysis of any industry. May be placed in city organisation (municipality, corporation, etc.) to observe th functioning.

Visit to local construction sites (government/public sector/private) to study the report about the socio-economic aspects of constructions.

**VISITS:**

1. Survey of construction projects for materials and technology used.
2. Cement plant
3. Brick kiln
4. Aggregate production site etc.

**9**

**VOCATIONAL SUBJECT**

**IN**

**RURAL TECHNOLOGY**

**RURAL TECHNOLOGY**

**SUMMARY CHART**

Sr.No.	Year/ Semester	Paper	L (Period/Week)	P
1.	I/I	Rural Socio-Economic Structure and Organisation - I	3	-
2.	I/I	Rural Health, Sanitation and Water Supply - I	3	-
3.	I/I	Laboratory	-	6
4.	I/II	Rural Socio-Economic Structure and Organisation - II	3	-
5.	I/II	Rural Health, Sanitation and Water Supply - II	3	-
6.	I/II	Laboratory	-	6
7.		On the Job Training - I	Summer	One Month
8.	II/I	Rural Housing and Transportation-I	3	-
9.	II/I	Rural Energy, Resources and Management - I	3	-
10.	II/I	Work Practice	-	6
11.	II/II	Rural Housing & Transportation - II	3	-
12.	II/II	Rural Energy, Resources and Management - II	3	-
13.	II/II	Work Practice	-	6
14.		On the Job Training - II	Summer	One Month
15.	III/I	Agricultural Technology and Rural Industries - I	3	-
16.	III/I	Entrepreneurship	3	-
17.	III/I	Work Practice	-	6



## **RURAL TECHNOLOGY**

### **PAPER - 1(a): RURAL SOCIO-ECONOMIC STRUCTURE AND ORGANISATION - I**

#### **Rural Sociology:**

Meaning, nature and subject matter, concept of rural social structure and social organization, folk culture and little community.

Social Institutions: Family, marriage and kinship, caste.

#### **Research Techniques:**

Observation, questionnaire, schedule, interview, processing of data, interpretation of data, reporting.

#### **Social Processes:**

Social stratification, socialization, social control.

Social Change-factors responsible for change in rural communities.

#### **Rural Economics:**

Property, characteristics of rural economy, jajmani system, market economy.

#### **Rural Reconstruction:**

Community development programme, rural reconstruction and five year plan, IRDP, cooperative and housing policy, income and expenditure patterns, economic activities and impact on living habits.

### **PAPER - 1(b): RURAL SOCIO-ECONOMIC STRUCTURE AND ORGANISATION - II**

#### **Village Administration:**

Panchayat raj, village panchayat its organisation, functions and finances. Role of panchayats in rural development.

Details of various Govt. schemes for normal development

#### **Village Planning With Special Reference to Space:**

Types of villages, physical problems of Indian villages allocation of land use for dwellings, school, shops, cottage industries, places of public assembly, recreation and grazing grounds, principles of neighbourhood planning.

## Land-Spacing:

Factors affecting landscape of villages, characteristics of trees, plants, creepers in the design of landscape, selection, planting and protection of trees, landscape patterns suitable for road side, residential recreational and public areas.

Needs of the changing rural society.

## PAPER - 2(a): RURAL HEALTH, SANITATION AND WATER SUPPLY - I

Historical development of health services in Rural India:

- Pre-independence period
- Post-independence period (Bhore Committee Report).

Objectives and scope of present health service in India

Rural health infrastructure and their functions

Common health problems of rural community

Communicable Diseases:

Insect born, water born (typhoid, cholera etc.), air born and soil transmitted - symptoms and identification.

Nutritional Diseases:

Protein-energy malnutrition, vitamin A deficiency, anemia.

Problem of population growth and demography

Vital statistics and health indices, maternity and child care

Health Programme:

Medical care, including primary health care, national programmes, immunization, nutrition and population control, methods of family planning.

Sterilization of injection and surgical equipments.

First aid details to be given for normal accident cases in villages.

**PAPER - 2(b): RURAL HEALTH, SANITATION AND WATER SUPPLY - II**

**Sanitation and Water Supply:**

Problems in environmental sanitation-introduction to rural ecology and environment, housing and ventilation, smoke and air pollution, drinking water, disposal of human and animal waste water, water, functions and scope of agencies involved.

**Drinking Water:**

Source-surface, sub-surface (ground), percapita requirement of water, laboratory diagnosis of the quality of water, chemical parameter, bacteria logical parameter, methods of disinfection of water, rural water supply schemes and their implementation, various appropriate technologies for providing potable drinking water, storage and supply system from different sources (hand pump, water pumps, wells, tap water) and its maintenance including chlorination.

**Human Excreta Disposal:**

Hazards of open field defecation, construction of suitable type of latrine (hand flushed) its construction and maintenance.

**Refuse and Animal Excreta Disposal:**

Compost pit, biogas plant construction and maintenance

**Water & Storm Water Disposal:**

Soakage pit, drains, irrigation of kitchen garden.

Smoke Disposal by Smokeless Chhulahs

Plantation of trees.

## **PAPER - 3(a): RURAL HOUSING AND TRANSPORTATION - I**

**A rural house - definition and meaning**

**Types and pattern of rural houses**

**Socio-economic aspects of housing:**

**Habits, attitudes, mode of living, household size, economic status (classification of family).**

**Materials:**

- Locally available materials and their characteristics. Mud/soil, sundried bricks, brick, lime, sand, wood, aggregates, stones, cement, etc.
- Techniques for improving the characteristics of locally available materials.
- Characteristics and utility of newer & improved materials - stabilized soil, stabilized soil blocks, rice husk (cement), agrobased materials, fly ash, ferrocement, slag cement/pozzolana cement, light weight aggregate, comparative cost studies. Manufacturing details of these materials.
- Field and laboratory testing of materials.
- Planning and Design Aspects: Elements of a rural house (1) traditional (various components with their relative cost per centage) (2) modern (various components with their relative cost per centage).
- Classification of various types of rural houses.
- Essentials of a good house design, orientation with regard to sun, wind and other climatic conditions.
- Consideration of health, hygiene, environment, safety, liveability, convenience and comforts.
- Requirements of space for living, storage, cattle and fodder, etc.
- Special emphasis to cooking area: external/internal.
- Ventilation aspect in relation to spacing (between houses), height, size and location of doors and windows.
- Aspects of thermal comfort in relation to Sun's effect, shades, trees, etc.
- Elements of village planning in respect of housing - rural planning bye laws.

- Planning and design of community buildings - panchayat ghar, schools, market places, community centre, religious places, primary health centres, grain godowns, post-office, bank, cooperative stores, farm, building, buildings for housing tubewells, biogas plants, etc.
- Cost estimates of different design &
- Critical study of various types of design, analysis with regard to their utility, functionality.

#### Construction Details:

- Base concept and principles of surveying with eliminating methods
- Foundation - Principles underlying their design under various conditions, their protection against dampness, white ants. Special conditions like expansive soils, hilly terrain marine deposits and desert sands, etc.
- Walls in mud (compacted mud and adobe) - their thickness for load radiation and water penetration in mud, sundried bricks, pucca bricks with mud, lime/surkhi and cement sand mortar.
- Bamboo reinforced walls.
- Composite wall construction with pucca and kachcha sundried bricks.
- With stabilized soil blocks.
- Finishing of walls with mud plaster, cement plaster, lime plaster.
- Water proofing techniques for walls.
- Cost reduction techniques in walling - Prefabricated, cavity walls, composite wall, soil stabilised wall, wall panels.

#### Roofing:

Different types - Kachcha & Pucca: Thatch (treatment methods for improving the durability/fire retendent), Tile, Flat/Sloping, Wooden beam + stone slab, R.C. Slab.

Details of various types of low cost prefabricated roofings like - brick panel, doubly curved unit, channels, L-panels, RC Plank & Joist etc.

Doors, windows and other openings: Different types with complete details and cost ratios - wooden/RCC/Ferro cement etc.

Details of internal and external finishing - Mud plaster, pointing, plastering, etc.

Analysis of rates/estimation/costing/repair details, various construction methods, techniques for disaster mitigation.

A normal house design for hilly areas.

**PAPER - 3(b): RURAL HOUSING AND TRANSPORTATION - II**

**Roads & Transportation**

- Elementary survey principles - alignment concept, etc.
- Elements of a rural road.
- Planning of rural roads: Main road connection a village to urban and sub-urban, link roads, internal streets/roads.
- Principles of rural road design.
- Earthwork calculation, design.
- Stabilisation techniques.
- Construction materials for roads - local or otherwise.
- Construction methods - compacting, soiling, metalling, tar and bitumen surfacing.
- Road finishing and other requirements.
- Road side land scaping - planning, development, design.

**Introduction to rural transportation:**

- Various means of rural transportation.
- Conventional and improved design of rural transportation.
- Details of cost effective and efficient designs.

**Practicals/Practice:**

**Soil:**

1. Field density test
2. LL/PL
3. Standard compaction test (Preparation and testing of soil blocks)
4. Shrinkage limit
5. CBR test

Various tests on materials: Cement/concrete/aggregate/bricks, etc.

## **PAPER - 4(a): RURAL ENERGY RESOURCES AND MANAGEMENT - I**

### **Rural Energy Resources:**

Rural energy needs - different aspects, necessity of zero cost energy; energy resource classifications: Commercial-coal, oil and electricity; non-commercial-fuelwood, forest and agricultural wastes; animal and human power - cowdung; renewable - solar, wind, biogas and biomass, microhydel, geothermal, tidal, waves and ocean thermal.

### **Energy Technologies:**

Cooking stoves - existing rural cooking systems; improvement in cooking stoves; smokeless chulhas - fabrication, repair and maintenance, briquetted fuels.

### **Solar Thermal Applications:**

Solar cells, solar arrays and panels - power considerations, installations and maintenance, battery charging, solar electric lighting, photovoltaic pumps.

### **Wind Energy:**

Basic design, construction, working and maintenance of wind turbines, applications of wind mills, water lifting and battery charging.

## **PAPER - 4(b): RURAL ENERGY RESOURCES AND MANAGEMENT - II**

### **Bio-gas:**

Rural requirements of LPG; utilisation of cowdung, biogas conversion principle, design, construction and working, types, efficiency, improvements, biogas utilisation, accessories and appliance, community biogas plants, maintenance and repair.

### **Electrical safety and Earthing - Accidents**

### **Biomass:**

Biomass availability, assessment and production, bio crops and farming, biomass products and uses.

### **Social and Environmental Pollution?**

Causes and remedial measures, energy consciousness and awareness, human resource development, implementation of appropriate technology.

## **Rural Energy Management:**

Concept, issues, approaches, system description and energy inputs, rural energy consumption patterns, survey, audit and estimation of energy consumption, supply and demand projections, energy distribution model and energy planning parameters, energy conservations, future strategies and targets, integrated rural energy developments and use, alternative back up systems.

## **PAPER - 5(a): AGRICULTURE TECHNOLOGY AND RURAL INDUSTRIES - I**

Irrigation technology and water resource management for rural area.

### **Water Supply Process:**

Introduction to hydrological cycle; surface water - estimate, collection and conveyance; sub-surface water - aquifer system, geophysical explorations, safe yield, ground water collection systems.

Water losses - Evaporation, evapotranspiration and seepage losses.

### **Water Quality Management:**

Consumption use of water for crops, determination of irrigation water requirement. Various irrigation methods and their comparative performances - canal, tube well, tank, sprinkler and drip irrigation etc. Conjuncture use of surface and sub-surface water. Water budgeting for a pilot rural area and optimal use of different available irrigation water resources. Checking of water table and overdrafting of deep aquifer system.

Water-logging, its mitigation and prevention.

Soil conservation and prevention of erosion.

Rotation of crops, high yielding variety of seeds, dosing of fertilizers and pesticides.

Social forestry.



## **PAPER - 5(b): AGRICULTURE TECHNOLOGY AND RURAL INDUSTRIES - II**

Rural implements, tools and equipments: Agricultural implements; etc.; Agro-processing equipments; material handling and transport; water lifting devices, hydram, etc.;

Storage of food grain and their preservation.

Fishery and livestock management

Rural Industries: Marketing of agricultural produce/cottage and village industry products, special marketing strategies.

Techno-Economic Survey of the Area.

Identification of feasible cottage, village and service industries - oil extraction, soap manufacturing, crayons, chalk, garments and weaving, printing, metal and ceramic, carpentry, ferrocement, pickle and fruit juice, processing of wheat, rice, pulses to different stages, dairy industries and preservation of food and products, etc.

Implementation of appropriate technology.

Entrepreneurship financial organisations and government support available for cottage and village industries.

(Various agro-based industries (KVIC) Khadi Udyog).

Marketing of agriculture produce and cottage industries product.

### **LABORATORY/PRACTICE**

The students will be asked to prepare a tool for conducting the survey of a village for knowing their needs and evolve strategies for their improvement of socio-economic conditions of rural people.

Sterilization of minor surgical equipments. Techniques for giving injections and first aid and also developing primary health packages.

Estimation of water quality parameter: physical, chemical and bacteriological analysis.

Chlorine demand and chlorination technique.

Tests on closed conduct and open channel, pumping sets (well/tube well).

Measurement, estimation and distribution of rural water resource.

Climate temperature - humidity and rainfall measurement.

Study of various types of pumps.

Training of normal marketing system.

Practice: Study of water supply system, refuse and garbage disposal and other health related subject in the village, community and preparation of report.

Study of rural maps and drawings

Preparation of a complete project for redevelopment of a lab-village, basic maps, chart and diagrams.

Working diagram for remodeling of existing houses and new houses, roads and drain, etc.

Planning and estimation of a community building.

Actual construction through a demonstration house - unit - techniques of laying roads and drain etc.

Field Work: Physical survey

Socio-economic survey for housing of a lab-village.

Mobilisation of public opinion by means of group and personal contacts, discussion, meetings, lectures, filmshow and social work.

Design and fabrication of cook stoves

Design and layout drawing, estimation and costing of biogas plants:

(a) KVIC type, (b) Janata type, (c) Polythene gas holder types

Studies on actual fabrication, testing, maintenance and repair of biogas plants.

Study the characteristics of photovoltaic cells and load characteristics of (i) Photo voltaic pumps (ii) Solar electric lighting systems.

Studies on assembly and installation of solar arrays and panels.

Installation of electric wiring system and maintenance of common household electrical equipments.

Design, estimating and costing, fabrication and assembly, maintenance and testing of solar appliances: (i) Solar cookers (ii) Solar agro products dryer (iii) Solar cold storage.

Study on wind mills characteristics.

Design and layout diagrams, estimating and costing, testing, maintenance and repair of windmills.

Wind generators and their characteristics.

Simulation and calculation of rural energy, planning parameters.

Material selection, production studies of briquetted fuels.

Study of existing irrigation systems and methods and scope of improvement coming.

Study of food grain storage system and marketing.

Techno-economic survey of a rural area.

Study of existing cottage industries in a rural area and scope of improvement.

Feasibility study for starting a new cottage industry.

Study of governmental and other financing organisational support for Entrepreneurship.

Healthy agriculture and industrial extension services.

Project on integrated development of a village/cluster of villages and suggesting the ways and means to develop rural area through technology upgradation and preparation of project report.



**10**  
**LIST**  
**OF**  
**EXPERTS**

**COMPOSITION OF THE SUB-COMMITTEE TO DEVELOP TECHNICAL COURSES  
FOR VOCATIONAL EDUCATION AS APPROVED BY THE U.G.C.**

Professor S. Rame Gowda, Vice-Chancellor, Karnataka University

Professor G. Rajsekar, Deptt. of Electrical Engg., IT, Banaras  
Hindu University.

Dr. A.R. Patankar, Director, WRIC, Univ. of Bombay, Bombay

Professor S.K. David, Deptt. of Electronic Sciences, Univ. of Poona

Professor B.N. Roy, Deptt. of Civil Engg., IT, Banaras Hindu Univ.

Professor P.C. Pandey, Deptt. of Mech. Engg., Univ. of Roorkee

Professor Y.D. Upadhyay, Deptt. of Chem. Engg., IT, Banaras Hindu Univ.

Professor Justo, Civil Engg., Jana Bharti, Bangalore

Professor S.K. Chitle, School of Computer Science, Devi Ahilya  
Vishwavidalaya, Khandawa Road, Indore

Professor R.P. Wadhwa, D.I.T., Delhi

Dr. M.D. Tiwari, Joint Director, U.G.C., New Delhi.

Professor S.K. Srivastava, Deptt. of Electronics - Co-ordinator  
Engineering, IT, Banaras Hindu University

**LIST OF EXPERTS WHO HAVE CONTRIBUTED IN THE DEVELOPMENT  
OF CURRICULUM OF ENGINEERING AND TECHNOLOGY**

- |  |   |
|--|---|
| 1. S. Rame Gowda,<br>Vice-Chancellor,<br>Karnataka University  | 12. S.K. Srivastava,<br>Deptt. of Electronics Engineering,<br>IT, Banaras Hindu University.         |
| 2. G. Rajsekar,<br>Deptt. of Electrical Engg.,<br>IT, Banaras<br>Hindu University.                         | 13. M.M. Sharma,<br>Director, CSRMS,<br>Delhi.  |
| 3. A.R. Patankar,<br>Director, WRIC,<br>Univ. of Bombay,<br>Bombay   | 14. S.K. David,<br>Head, Deptt. of Electronic-Science<br>University of Poona,<br>Pune               |
| 4. N. Mukunda,<br>Dean,<br>Fac. of Science,<br>I.I.Sc.,<br>Bangalore                                       | 15. S.A. Gangal,<br>Reader,<br>University of Poona,<br>Pune   |
| 5. B.N. Roy,<br>Deptt. of Civil Engg.,<br>IT, Banaras Hindu Univ.  | 16. A.D. Shaligram,<br>Reader,<br>University of Poona,<br>Pune                                      |
| 6. P.C. Pandey,<br>Deptt. of Mech.Engg.,<br>Univ. of Roorkee   | 17. D.C. Gharpure,<br>Lecturer,<br>University of Poona,<br>Pune                                     |
| 7. Y.D. Upadhyay,<br>Deptt. of Chem.Engg.,<br>IT, Banaras Hindu Univ.                                      | 18. Surendra Shukla,<br>Software Professional Citicorp<br>Oversead,<br>Software Limited,<br>Bombay. |
| 8. Justo,<br>Civil Engg.,<br>Jana Bharti,<br>Bangalore   | 19. Sulakha Denskar,<br>Modern College,<br>Pune   |
| 9. S.K. Chittle,<br>School of Computer Science,<br>Devi Ahilya Vishwavidalaya,<br>Khandawa Road,<br>Indore | 20. M.G. Gaitwad,<br>K.T.H.M. College,<br>Nasik   |
| 10. R.P. Wadhwa,<br>D.I.T.,<br>Delhi   | 21. A.V. Patankar,<br>WRIC,<br>Bombay   |
| 11. M.D. Tiwari,<br>Joint Director,<br>U.G.C.,<br>New Delhi.   | 22. R.N. Karekar,<br>Pune University,<br>Pune   |

23. R.P. Wadhawa,  
D.I.T.,  
Delhi
24. R.P. Agrawal,  
Deptt. of Electronics &  
Computer Engg.  
Roorkee University,  
Roorkee
25. Ashok Chandra,  
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