

# SAURASHTRA UNIVERSITY, RAJKOT

## B.E. V SEMESTER

### [BIOMEDICAL & INSTRUMENTATION ENGINEERING]

Code	Subject	Teaching Scheme		Exam Scheme				
		Lect.	Pra	Theory Hrs	Paper Marks	Prac/ Oral	Term Work	Total Marks
501	Linear Control Theory	4	2	3	100	-	-	100
502	Control System Components	4	2	3	100	25	25	150
503	Integrated Circuits & Applications	4	2	3	100	25	25	150
504	Analytical & Optical Diagnostic Techniques & Equipments	4	2	3	100	25	25	150
505	Medical Diagnostic Techniques & Equipments	4	2	3	100	25	25	150
506	Electronics Circuit Design Practice*	-	2	-	-	50*	-	50
<b>TOTAL</b>		<b>20</b>	<b>10</b>	<b>-</b>	<b>500</b>	<b>150</b>	<b>100</b>	<b>750</b>

\* College level Examination

**SAURASHTRA UNIVERSITY, RAJKOT**  
**B.E. SEM V (BIO-MEDICAL & INSTRUMENTATION ENGINEERING)**

**BM - 501: LINEAR CONTROL THEORY**

TEACHING SCHEME		EXAMINATION SCHEME				
THEORY HOURS	PRACTICAL HOURS	THEORY MARKS	PAPER HOURS	PRACTICAL/ORAL MARKS	TERMWORK MARKS	TOTAL MARKS
4	-	100	03	-	-	100

**1. INTRODUCTION:**

Open loop & Closed loop control systems. Servomechanism. Historical development of control systems. Application in non-engineering field.

**2. MATHEMATICAL MODEL OF PHYSICAL SYSTEM:**

Introduction. Differential equation of physical system. Transfer functions. Block diagram algebra & reduction techniques. Signal flow graph. Problems on Electrical, Mechanical, Electromechanical & Thermal systems.

**3. EFFECT OF FEEDBACK ON CONTROL SYSTEM CHARACTERISTICS:**

Types of Feed-back: Positive & Negative. Comparison between the Feedback & Non-feedback system. Variation or Effect of Feedback on System parameters such as Gain, Speed of response and Sensitivity.

**4. TIME DOMAIN ANALYSIS:**

Introduction. Standard test signals. Transient response of 1st & 2nd order systems. Steady state error constants.

**5. CONCEPT OF STABILITY & ALGEBRAIC CRITERION:**

The concept of stability. Necessary conditions for stability. Routh-Hurwitz's stability criterion. Relative stability analysis.

**6. ROOT - LOCUS TECHNIQUES:**

Introduction. Rules of construction of root loci. Stability analysis and effect of adding poles and zeroes.

**7. FREQUENCY DOMAIN ANALYSIS:**

Frequency Domain specifications. Correlation between time and frequency domain specification. Bode plot. Polar plot, Gain margin, and Phase margin.

**8. STABILITY ANALYSIS IN FREQUENCY DOMAIN:**

Bode plot. Nyquist stability criterion. Relative stability analysis. Sensitivity analysis in frequency domain.

**BOOKS RECOMMENDED:**

Control System Engineering	- Nagrath & Gopal
Automatic Control System	- B. C. Kuo
Modern Control Engineering	- K. Ogata

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**BM - 502: CONTROL SYSTEM COMPONENTS**

<b>TEACHING SCHEME</b>		<b>EXAMINATION SCHEME</b>				
THEORY HOURS	PRACTICAL HOURS	THEORY MARKS	PAPER HOURS	PRACTICAL/ORAL MARKS	TERMWORK MARKS	TOTAL MARKS
04	02	03	100	25	25	150

1. **Control Valves:** Types, Application and Selection, Capacity testing, Characteristics, Noise calculation and reduction.
2. **Components of Hydraulic and Pneumatic system:** Hydraulic Power Pack. Vane pump, ball pump, Valves and their types such as flow control, direction control, pressure control. Flapper valves, nozzle valves, pressure regulating devices, pressure switches.
3. **Gears and gear trains:** Worm, helical. Contact ration in gear, pitch of gear, design matching, backlash, and differential gear and application of gear as control component.
4. **Gyroscope:** Theory of operation of gyroscope, equation of motion. Transfer function, application of gyro to inertial navigation, restrained & rate-gyro- construction, vertical gyro, gyro characteristics and design consideration, gyroscope shift.
5. **Electromechanical Relays:** AC - DC type relay, Solid - state relay, Reed relay, Relay construction, characteristics. Stepper switches - construction, circuitry, and applications. Stepper motors- types, characteristics, applications, drive circuits.
6. **Solenoids:** Construction, operation, types, specifications, and applications.
7. **Servomotor:** AC - DC servomotors, their transfer functions, armature controlled, field controlled dc motors etc. and their applications
8. **Synchros:** Introduction, operation, construction, static and dynamic errors, residual voltages, and phase shift, zeroing techniques, applications.
9. **Tachometer:** Mechanical & Electrical types & type's applications.

**BOOKS RECOMMENDED:**

Control system component	- Gibson & Tutor
Electromechanical system components	- Charkey
Applied instrumentation in process Ind. Vol. II	- Andrews
Automatic control system	- Eckman

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**B.E. SEM V (BIO-MEDICAL & INSTRUMENTATION ENGINEERING)**

**BM - 503: INTEGRATED CIRCUITS & APPLICATIONS**

TEACHING SCHEME		EXAMINATION SCHEME				
THEORY HOURS	PRACTICAL HOURS	THEORY MARKS	PAPER HOURS	PRACTICAL/ORAL MARKS	TERMWORK MARKS	TOTAL MARKS
04	02	100	03	25	25	150

**1. INTEGRATED CIRCUITS FUNDAMENTALS:**

Classification of IC's based on scale of integration. Manufacturing techniques and applications i.e. analog or digital. Fabrication techniques, advantages over discrete components.

**2. BASIC OPERATIONAL AMPLIFIER :**

Various configurations and analysis of differential amplifier. Constant current source, current mirror circuits. IC operational amplifier and its characteristics, Specifications, parameters. Frequency response of Operational amplifier likes 741, 308, 356 etc. Applications of Operational amplifier such as DC/AC amplifier, voltage to current and current to voltage converter, Differentiator, Integrator, Bridge amplifier, Instrumentation amplifier, analog simulation for solution of differential equation. Voltage Regulators.

**3. SIGNAL GENERATORS USING IC:**

Phase shift oscillator, Wein bridge oscillator. Multivibrators. Schmitt trigger circuit. Timer using IC 555.

**4. NON-LINEAR APPLICATIONS:**

Precision rectifier. Comparator. Zero crossing detector. V/F & F/V converter. Clipper/Clamper. Sample and Hold circuit. Window Comparator.

**5. PHASE LOCKED LOOP:**

Introduction to PLL. Study of IC 565. Lock & capture range. Applications of PLL.

**6. ACTIVE FILTERS:**

Introduction. Comparison & design of Butterworth & chebychev filters.

**7. DIGITAL ICs:**

TTL series, low power schottky devices. TTL parameters. CMOS series. Advantages & Types, Parameters, Characteristics. TTL to CMOS Interfacing & vice versa.

**BOOKS RECOMMENDED:**

- |                                     |                     |
|-------------------------------------|---------------------|
| Integrated Circuits                 | - K. R. Botkar      |
| Op-Amp & Linear Integrated Circuits | - Ramakant Gayakwad |
| Digital Principles & Applications   | - Malvino & Leach   |

**SAURASHTRA UNIVERSITY, RAJKOT**

## B.E. SEM V (BIO-MEDICAL & INSTRUMENTATION ENGINEERING)

### BM - 504: ANALYTICAL & OPTICAL DIAGNOSTIC TECHNIQUES & EQUIPMENTS

TEACHING SCHEME		EXAMINATION SCHEME				
THEORY HOURS	PRACTICAL HOURS	THEORY MARKS	PAPER HOURS	PRACTICAL/ORAL MARKS	TERMWORK MARKS	TOTAL MARKS
04	02	100	03	25	25	150

#### SECTION:A ANALYTICAL & OPTICAL DIAGNOSTIC TECHNIQUES

1. Principle involved in Biochemical, Pathological & Microbiological laboratory techniques in clinical diagnosis.
2. Instrumental techniques.
  - Use of general instruments like Incubators, Autoclaves, Centrifuges, Hot air ovens, Balances, Auto pipettes.
  - Microtomes, Processing like automatic tissue processing (Histokinette).
  - Laboratory counters, anaerobic apparatus, Laminar flow tables, Culture techniques, Blood banking procedure & Instruments.
3. Analytical techniques like Spectrophotometry, Colorimetry, Auto analysis, Semi auto analysis, Gas & Electrolytes analysis & Flame photometry, Chromatography, Electrophoresis, Glucometry, Measurement of pH, RIA units, PCR units, ELISA reader, Dispenser & Washer, Pulse-oxymetry, Capnography, Arterial blood analysis etc and their significance in different diagnosis and prognosis of various clinical disorders.
4. Microscopy - simple, compound, binocular, trinocular, dark ground microscopy, phase contrast microscopy, electron microscopy, CCTV, Microphotography & Projection, etc. and their importance in clinical diagnosis.
5. Special microscopy like endoscopy, use of fiber optics.

## **SECTION: B ANALYTICAL & OPTICAL DIAGNOSTIC EQUIPMENTS**

Study of principle of operation, Block-diagram, Circuit diagram, Control panel, Specifications, Design aspects & Applications of the following Equipments.

- Incubators, Autoclaves, Centrifuges, Hot air ovens, Balances, Auto pipettes, Microtomes, Processing like automatic tissue processing ( Histokinette ), Laboratory counters, Anaerobic apparatus, Laminar flow tables, Spectrophotometer, Colorimeter, Autoanalyser, Semiautoanalyser, Flame photometer, Glucometer, pH meter, RIA units, PCR units, ELISA reader, Dispenser & Washer, Pulse - oxymeter, Arterial blood analysis.
- Endoscopes.
- Microscopes of various types including electron microscope.
- Chromatograph.
- Electrophoresis apparatus.

### **BOOKS RECOMMENDED:**

- |    |  |                                   |
|----|--|-----------------------------------|
| 1. | Medical laboratory technology (Methods & Interpretation) | Ramnik sood                       |
| 2. | Wildmann's: Clinical interpretation of laboratory tests  | Sacher                            |
| 3. | Interpretation of common investigations                  | Gupta & Gupta                     |
| 4. | The text book of Blood bank and transfusion medicine     | Satish Gupta                      |
| 5. | Principle clinical Biochemistry                          | Chavda R.                         |
| 6. | Clinical diagnosis and management by laboratory methods  | Henry                             |
| 7. | Bio-medical Instrumentals & Measurements                 | Cromwell                          |
| 8. | Bio-medical Instrumentals                                | R. S. Khandpur                    |
| 9. | Medical and clinical engineering                         | Bertil Jacobson<br>& John Webster |

**SAURASHTRA UNIVERSITY, RAJKOT**  
**B.E. SEM V (BIO-MEDICAL & INSTRUMENTATION ENGINEERING)**

**BM - 505: MEDICAL DIAGNOSTIC TECHNIQUES & EQUIPMENTS**

TEACHING SCHEME		EXAMINATION SCHEME				
THEORY HOURS	PRACTICAL HOURS	THEORY MARKS	PAPER HOURS	PRACTICAL/ORAL MARKS	TERMWORK MARKS	TOTAL MARKS
04	02	100	03	25	25	150

**SECTION: A      MEDICAL DIAGNOSTIC TECHNIQUES:**

1. **Cardiovascular diseases and their diagnosis:** ECG, Phonocardiography, Blood pressure & Heart rate measurements, Blood flow measurements, Dopplers.
2. **Respiratory disorders and their diagnosis:** X-rays, Volumes & capacity (Spirometry), Bronchoscopy, Laryngoscopy etc.
3. **G. I. Tract disorders and their diagnosis:** Laparoscopy, Cystoscopy, Upper G. I. Endoscopy, Colonoscopy, Sigmoidoscopy, Proctoscopy.
4. **Metabolic disorders and their diagnosis:** Thermometry, Oxygen & Carbon - dioxide content and pressure, various enzyme assays.
5. **Diseases related to Kidney & Urinary system and their diagnosis.**
6. **Nervous system disorders and their diagnosis:** EEG, SER, EMG, Scanning Techniques etc.
7. **Ocular disorders and their diagnosis:** Perimetry, Refractometry, Tonometry, Ophthalmoscopy, Ultrasound, VER, ERG, EOG, ENG etc.
8. **Auditory disorders and diagnosis:** AER, Audiometry etc.
9. **Obstetric & Gynecological problems and their diagnosis:** USG & Endoscopy.
10. **Biotelemetry and their clinical significance.**

## **SECTION : B MEDICAL DIAGNOSTIC EQUIPMENTS**

1. **Electrocardiograph:** The ECG waveform, Block-diagram, Front panel, Controls, ECG Pre-amplifier, ECG recorders.
2. **Electroencephalograph:** EEG waveform (Frequency range & Amplitude), Multichannel recording system & control panel details, Block-diagram, Pre-amplifier & filter circuits.
3. **Instruments for measurement of Physiological parameters:** Electronic manometer, Electro-sphygmomanometer, Electronic stethoscope, Blood flow meter, Thermometer, Tonometer, Auto- refractrometer, Spirometer, Audiometer.
4. **Diagnostic X-ray machine:** Generation, Fluoroscopy and Image Intensifier, Fundamentals only.
5. **Diagnostic Ultrasound:** Principle of measurements, Ultrasound imaging, Foetal monitor, Echocardiograph, Echoencephalograph.

## **BOOKS RECOMMENDED:**

- |     |  |                                 |
|-----|--|---------------------------------|
| 1.  | Diagnosis procedures in Cardiology                             | Warren & Lewis                  |
| 2.  | ECG made easy  | Atul Lutre                      |
| 3.  | Practical Echocardiography                                     | Setu Raman                      |
| 4.  | The sagar manual-Fundamentals of Laproscopy<br>G. I. Endoscopy | Karole                          |
| 5.  | Advanced Ophthalmic diagnosis & therapeutics                   | McKinney                        |
| 6.  | Prenatal Diagnosis and therapy                                 | A. Chakraborty                  |
| 7.  | Neurological differential diagnosis                            | Pattern                         |
| 8.  | Bio-medical Instruments & Measurements                         | Cromwell                        |
| 9.  | Bio-medical Instrumentation                                    | R. S. Khandpur                  |
| 10. | Medicine and clinical engineering                              | Bertil Jacobson<br>&JohnWebster |

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**BM - 506: ELECTRONIC CIRCUIT DESIGN PRACTICE**

TEACHING SCHEME		EXAMINATION SCHEME				
THEORY HOURS	PRACTICAL HOURS	THEORY MARKS	PAPER HOURS	PRACTICAL/ORAL MARKS	TERMWORK MARKS	TOTAL MARKS
-	02	-	-	-	50	50

• **Design, Fabrication and testing of the following Electronics circuits:**

1. D.C. power supply along with series regulated for 15V, 1 Amp.
2. D.C. regulator using IC.
3. SMPS using PWM techniques.
4. Voltage amplifier as per specifications.
5. Power amplifier as per specifications.
6. Window comparator.
7. Wave form generators using IC (e.g. sine wave, Square wave, ramp wave etc.)
8. Instrumentation amplifier.
9. Temperature controller.
10. Revolution counter.
11. A. C. Power controller using Thyristors.
12. Solid state over voltage / over current protection.
13. Alarm annunciator.
14. D to A converter.
15. A to D converter.

Student will have to submit a journal containing design procedure and test results of any ten problems from the above list & they will be examined in the subject by the college & marks will be submitted to the University.

**BOOKS RECOMMENDED:**

Microelectronics	- Sedra & Smith
TTL & CMOS Data Books	- Reference Books
Linear IC Data Books	- Reference Books
Semiconductor Data Books	- Reference Books
Application Notes.	