GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: ANALYTICAL AND OPTICAL INSTRUMENTATION
(Code: 3340305)

Diploma Programmes in which this course is offered	Semester in which offered
Biomedical engineering	4th Semester

1. RATIONALE

Instruments used for analysis of different body fluids etc. constitute the largest number of instruments in use today. Optical instruments are used for internal inspection of body parts. Now days use of analytical and optical instruments has become routine in hospitals and pathological laboratories. It has therefore become necessary for students to acquire knowledge and skills to operate and maintain these instruments. This course tries to build these qualities in students.

2. COMPETENCY

The course content should be taught and curriculum should be implemented with the aim to develop required skills in students so that they are able to acquire following competency:

- **Operate and maintain various analytical and optical instruments**

3. COURSE OUTCOMES (COs)

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

i. Identify various elements of analytical instruments.
ii. Maintain different types of absorption instruments, colorimeter and Spectrophotometer.
iii. Maintain different types of flame photometers.
iv. Maintain different types of blood cell counters.
v. Identify various types of chromatography techniques.

4. Teaching and Examination Scheme

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	150
4	0	2	06	70	30	20	30	

Legends: L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit **ESE** - End Semester Examination; **PA** - Progressive Assessment.

5. COURSE DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Introduction	1.a. Define analytical Instrumentation. 1.b. Describe performance Requirements of Analytical Instruments. 1c. State the functional parameters of Intelligent analytical Instrumentation system	1.1Elements of analytical Instrument. 1.2Performance requirements of analytical instruments such as errors in chemical analysis, Accuracy and precision, SNR. 1.3 Intelligent analytical Instrumentation system.
Unit– II **Colorimeters and Spectrophotometers**	2.a. Describe Electromagnetic spectrum with Necessary diagram. 2.b.Explain beer Lambert's law 2. c. Draw and explain block diagram of absorption Instrument. 2.d. List components of absorption instrument and state application of Each. 2.e. Draw and explain basic components of single beam filter Photometer. 2.f. Describe application Of spectrophotometer. 2.g. Draw and explain block diagram of Spectrophotometer.	2.1 Electromagnetic radiation: EM spectrum, interaction of Radiation with matter. 2.2 Laws related to absorption of Radiation: beer-Lambert's law. 2.3 Absorption instruments: radiation source, different optical filters, monochromators, photosensitive detectors, slit Width, sample holders. 2.4 Colorimeters: single beam filter photometer and double Beam colorimeter. 2.5 Spectrophotometer: optical System of spectrophotometer.
Unit – III **Flame Photometer**	3.a. Describe principle of Flame photometry. 3.b. Draw and explain block diagram of Flame photometer. 3.c. List different types of flame Photometer. 3.d. State principle of clinical flame Photometer.	3.1 Flame photometry 3.2 Constructional details: emission system, optical system, photosensitive detectors, recording system 3.3 Types of flame photometers: single beam, double beam and recording type flame photometers, Clinical flame Photometer.
Unit – IV **Blood Gas Analyzers** **and Blood Cell Counters**	4.a. Define PH 4.b. Describe principle of PH measurement 4.c.List the types of pH electrodes 4c1. Describe principle of pH electrode with neat Sketch. 4.d. Describe principle of pCO2 and pCO2 electrodes 4.e. List measurement techniques blood cell counter 4e1. Explain working principle of	4.1 PH measurement 4.2 Acid base balance 4.3 blood pH measurement: syringe electrode, Microelectrode. 4.4 Measurement of blood pCO2 4.5 Measurement of blood pO2 4.4 blood cell counters: measurement techniques such as microscopic method, optical method, electrical conductivity method, coulter

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	electrical Conductivity method. 4.f. Explain working principle of optical method 4.g. Draw and explain block diagram of coulter counter	Counter method.
Unit – V Chromatography and Sterilizer Equipment	5.a. Describe principle of Chromatography. 5a1. List the types of chromatograph 5.b. Explain the principle of Gas chromatograph drawing block diagram and state function of each Component . 5b1. List the detectors used in it 5b2. List the recorders used in it 5.c. Describe principle of different liquid chromatography. 5.d. Explain principle of autoclave with its specific feature of application	5.1 Chromatography: chromatography basics and Its techniques. 5.2 Gas chromatograph: parts of gas chromatograph such as carrier gas, detection and recording system 5.3 Liquid chromatographs: types of liquid chromatography such as thin layer, column and paper partition chromatography 5.4 autoclave

6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction	08	04	04	00	08
II	Colorimeters and Spectrophotometers	12	02	08	06	16
III	Flame Photometer	08	04	04	02	10
IV	Ph Meter ,Blood Gas Analyzers And Blood Cell Counters	14	08	06	04	18
V	Chromatography and Sterilizer Equipment	14	08	06	04	18
	Total	**56**	**26**	**28**	**16**	**70**

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's Revised taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

7. SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills **(outcomes in psychomotor and affective domain)** so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

***Note**: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes (**as given in a common list at the beginning of curriculum document for this programme) would be assured.*

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit No.	Practical Exercises (Outcomes' in Psychomotor Domain)	Approx Hrs. Required
1	I	Demonstrate the working principle of single beam photometer	02
2	III	Measure the colometric value of given bio sample with double beam colorimeter	02
3	III	Measure the colometric value of given bio sample with spectrophotometer	02
4	III	Measure the %age of dissolved content value of given bio sample with flame photometer	02
5	III	Measure the %age of dissolved content value of given bio sample with double beam flame photometer	02
6	III	Measure the %age of dissolved content value of given bio sample with clinical flame photometer	02
7	III	Measure the pH value of given bio sample with pH meter	02
8	III	Measure the %age of content value of given bio sample with gas chromatograph	02
9	IV	Measure the %age of dissolved content value of given bio sample with liquid chromatograph	02
10	IV	Autoclave the given hospital clothes , OT content using the Autoclave	02
11	All	Calibrate any two instruments for their precision or dismantle and again assemble any two instruments.	08
Total			**28**

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities such as :

i. Student should perform various experiments in laboratory.

ii. Student should visit Hospital and pathology laboratories in nearby locations.

iii. Explore internet and visit websites of reputed manufacturers of analytical and optical instruments to collect specifications and details of their products and prepare a comparative report of instruments of different makes.

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

i. Show video/animation films of working and maintenance of analytical and optical instruments.

ii. Arrange visits to hospitals and pathology laboratories.

10. SUGGESTED LEARNING RESOURCES

A. List of Books

S. No.	Title of Book	Author	Publication
1.	Handbook of Analytical Instruments,	R. S. Khandpur,	Tata McGraw–Hill Publications, 3rd edition
2.	Instrumental Methods of Analysis	Willard, Merritt, Dean, Settle,	CBS Publishers & Distributors, New Delhi, Seventh edition.
3.	Principles of Instrumental Analysis	Skoog, Holler, Nieman	Thomson books-cole publications, 5th edition.
4.	Instrumental Methods of Chemical Analysis	Galen W. Ewing,	McGraw-Hill Book Company, Fifth edition
5.	Introduction to Instrumental Analysis	Robert D. Braun	McGraw-Hill Book Company

B. List of Major Equipment/ Instrument with Broad Specifications

i.Spectrophotometer
ii.Flame photometer
iii.Chromatograph
iv.Blood cell counter
v.Autoclave
vi.pH meter
vii.Colorimeter

C. List of Software/Learning Websites

http://www.mywbut.com

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. A. K. Bula**, Lecturer ,Dept. of Instrumentation engineering, G.P.Gandhinagar
- **Prof. S. S. Malkan**, Lecturer ,Dept. of Biomedical engineering, G.G.P.Ahmedabad
- **Prof. N. D. Makwana**, Lecturer ,Dept. of Biomedical engineering, G.P.Gandhinagar
- **Prof. M. H. Dave**, Lecturer, Dept. of Biomedical engineering, G. P. Gandhinagar

Coordinator and Faculty Members from NITTTR Bhopal

- **Prof. S. S. Mathew**, Associate Professor, Department of Electrical and Electronics Engineering
- **Dr S. K. Gupta**, Professor and Coordinator for state of Gujarat.