NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN

COURSE OUTLINE			
Course Title	**Analytical Instrumentation**		
Course Code	IC405	**No. of Credits**	3
Department	ICE	**Faculty**	1. Mr. Goldin Rajeshwar Bennet 2. Mr. Barath Kanna
Pre-requisites Course Code	None		
Course Coordinator	Mr. Goldin Rajeshwar Bennet		
Other Course Teacher			
E-mail	bennet@nitt.edu	**Telephone No.**	----
Course Type	[X] **Core course**	[ ] **Elective course**	

COURSE OVERVIEW
Analytical instrumentation is used in manufacturing, scientific research, and quality control. It is one of the core instrumentation courses taught to instrumentation engineers and analytical chemists.
COURSE OBJECTIVES
This course teaches the student about the analysis of materials which is an important requirement of process control and quality control in industry. The objective of this course is to make the student understand the basic principles used in various analytical methods. The student is then exposed to the various instruments used in the analysis of materials.

COURSE OUTCOMES (CO)	
Course Outcomes	**Aligned Programme Outcomes (PO)**
After studying this course: 1. The student learns the relevance of material sampling and analysis in process control and quality control in industry. 2. The student knows the various physical principles behind the various widely used analytical methods in the industry. 3. The student becomes familiar with the various analytical instruments used widely in the industry.	 1, 3 1, 5, 6 1, 6, 7, 8,12

COURSE TEACHING AND LEARNING ACTIVITIES			
S.No.	**Week**	**Topic**	**Mode of Delivery**
1	1 and 2 (6 contact hours)	Electromagnetic radiation and its interaction with matter – Beer's law – Spectral methods of analysis – Absorption spectroscopy – Radiation sources – Monochromators – Filters – Prisms – Diffraction gratings – Detectors – Choice of solvents. UV-Visible spectrometers – single-beam and double-beam instruments.	Lecture and video clips
2	3 (2 contact hours)	Infrared spectrophotometer – IR sources – Cells – detectors – sample preparation. Analysis using Attenuated Total Reflectance (ATR).	Lecture and video clips
3	3 (one contact hour)	***Quiz-1***	
4	4 (2 contact hours)	Atomic absorption spectrometry (AAS) – Wavelength choice –Sources – Cells – Detectors.	Lecture and video clips

5	4 (one contact hour)	Flame emission spectrometry. Atomic fluorescence spectrometry.	Lecture and video clips
6	5 (3 contact hours)	Radioactive measurement – Units of radioactivity – Application of radio-nuclides in analysis – Radioactivity detectors.	Lecture and video clips
7	6 (3 contact hours)	X-ray spectroscopy – X-ray absorption methods – X-ray fluorescence methods – X-ray diffraction.	Lecture and video clips
8	7 (3 contact hours)	Nuclear magnetic Resonance (NMR) spectroscopy – Basic principles – Continuous-wave NMR spectrometer – Pulsed Fourier Transform NMR spectrometer – NMR applications.	Lecture and video clips
9	8 (one contact hour)	***Written Exam-1***	
10	8 (2 contact hours)	pH measurement – Basic principles –Ion selective electrodes – Glass and reference electrodes – pH meter and its calibration.	Lecture and video clips
11	9 (3 contact hours)	Electrical conductivity measurement – Measuring circuit – Water and steam purity measurement using electrical conductivity.	Lecture and video clips
12	10 (2 contact hours)	Oxygen measurement – Paramagnetic oxygen analyzers – Ceramic electrode for high temperature oxygen measurement – Dissolved oxygen measurement.	Lecture and video clips
13	10 (1 contact hours)	***Quiz-2***	
14	11 (one contact hour)	Sampling – Sample collection for gas, liquid, and solid analysis.	Lecture and video clips

15	11 (one contact hour)	Flue gas analysis for pollution control – Measurement of CO, carbon di-oxide, NOX and SOX, dust and smoke measurement.	Lecture and video clips
16	11 (one contact hour)	Chromatography – Basic principles of liquid and gas chromatography	Lecture and video clips
17	12 (3 contact hours)	Column details – Detectors for chromatography – Thermal conductivity detector – Flame ionization detector – Flame photometric detector – Electron capture detector – Effect of temperature programming – High pressure liquid chromatography (HPLC).	Lecture and video clips
18	13 (one contact hour)	Visit to instrumentation facilities	Facility visit
19	13 (one contact hour)	***Quiz-3 on instruments seen during the visits to various instrumentation facilities.***	
20	14 (3 contact hours)	***Written Exam-2***	

COURSE ASSESSMENT METHODS

Students are expected to pass each individual written exam. **The pass/fail cut-off for each written exam is (mean of the class)/2. The quizzes have no pass/fail condition.**

Students who fail in any written exam or are absent in any written exam, even for valid reasons (other than leave on-duty), will have to appear for the supplementary exam and pass it before the semester grades are assigned. Those who are absent due to any valid leave on-duty, will get an z-score for that assessment which is an average of all z-scores they get for the other assessments. There will not be any retests during the course of the semester.

The supplementary exam will be conducted after the written exam-2 papers are evaluated. This exam will be for three hours and will cover the entire syllabus.
If they pass this special exam, those students who have not passed only one written exam earlier, will have their marks reset to the pass mark in that exam and the grades will be calculated normally.

Those students who failed in both the written exams will get an 'E' grade if they pass this supplementary exam.Those who fail in the supplementary exam also, will have to pass this course by registering for Formative Assessment only.

Students who do not pass the course before the semester grades are assigned, will be awarded 'F' grade only. Those who are awarded 'F' grade will have to apply for formative assessment only after that.

S.No.	Mode of Assessment	Week	Duration	% Weightage (On normalized z-scores)
1	Quiz-1	Week-3	One hour	10%
2	Written exam -1	Week-8	One hour	25%
3	Quiz-2	Week-10	One hour	10%
4	Quiz-3	Week-13	One hour	15%
5	Written exam – 2	Week-14	Three hours	40%
6	Supplementary Exam			

ESSENTIAL READINGS

Textbooks:

1. Braun, Robert D., Introduction to Instrumental Analysis, Pharma Book Syndicate, Hyderabad. 2006.
2. Ewing, G.W., Instrumental Methods of Analysis, 5 th Edition, McGraw Hill, Singapore, 1992.
3. Jain, R.K., Mechanical and Industrial Measurements, Khanna Publishers, Delhi,1999

Reference Books:

1. Liptak, B.G. Process Measurement and Analysis, 4 th Edition, CRC Press, Washington, 2003.
2. Considine, D.M. Process/Industrial Instruments and Controls Handbook, 4 th Edition, McGraw Hill, Singapore, 1993.
3. Sherman, R.E. and Rhodes L.J., Analytical Instrumentation, ISA Press, New York, 1996.

Intranet Course Site: http://10.0.0.27/~bennet

COURSE EXIT SURVEY

1. Anonymous feedback through questionnaire.
2. Feedback from the students during the class committee meetings.

COURSE POLICY

Academic dishonesty

All students are expected to do their own work and expected to put their best effort in the tests and assessments. The taking of information by means of copying homework assignments, or looking or attempting to look at another student's paper during an examination is considered dishonest. The tendering of information, such as giving your work to another student to be used or copied is also considered dishonest. Preventing or hampering other students from pursuing their academic activities is considered as academic dishonesty.

Colluding to reduce the pass/fail threshold for any exam is also considered to be academic dishonesty. If a large number of students perform badly in any exam, the faculty member reserves the right to set a higher pass/fail cut-off threshold than the (class mean)/2 threshold to preserve the integrity of the assessment process.

Any evidence of such academic dishonesty will result in the loss of all marks on that assignment or exam. Additionally, the names of those students so penalized will be reported to the Office of Dean (Students) and the Office of Dean (Academic) for the records.

1. Students opting for plagiarism during exams will be summarily sent out and awarded zero marks for that exam.
2. Students honestly producing original work will be rewarded with better marks.

Attendance requirement

Since it is the final year, there will be relaxed attendance requirement for the

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course. But the students have to attend at least 50% of the classes. Students who fail to attend even 50% of the classes without any valid reason will be awarded an 'F' grade and they have to pass the course through formative assessment only.

Exam hall code

Students must abide by the exam hall code given in the course website.

ADDITIONAL COURSE INFORMATION

Students may fix appointments for detailed discussions by sending email to *bennet@nitt.edu* two days prior to the desired appointment date with the topic to be discussed. The students must come prepared for the discussion with thorough background preparation.

Minor doubts will be clarified after the contact hours without any prior appointment.

FOR SENATE'S CONSIDERATION

Course Faculty ① Goldin R. Bennet 11.7.2016 ② C. B 11/7/16

CC-Chairperson 12.7.2016

HOD 12/7/16

DEPARTMENT OF INSTRUMENTATION AND CONTROL ENGINEERING ★ National Institute of Technology Tiruchirappalli-15