NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF PHYSICS

COURSE PLAN – PART I			
Name of the programme and specialization	**M. Sc - II Semester & Physics**		
Course Title	INSTRUMENTATION		
Course Code	PH658	**No. of Credits**	3
Course Code of Pre-requisite subject(s)	NIL		
Session	January 2019	**Section (if, applicable)**	NA
Name of Faculty	Dr. Annapureddy V.	**Department**	Physics
Official Email	annp@nitt.edu	**Telephone No.**	+91-431-2503603
Name of Course Coordinator(s) (if, applicable)	Dr. M.C. Santhosh Kumar		
Official E-mail	santhoshmc@nitt.edu	**Telephone No.**	**0431-250-3611**
Course Type (please tick appropriately)	✓ **Core course** ☐ **Elective course**		

Syllabus (approved in BoS)

Generalized Characteristics of Instruments: Static characteristics: accuracy, precision, repeatability, reproducibility, resolution, sensitivity, linearity, drift, span, range. Dynamic characteristics: transferfunction, zero order instruments, first order instruments – step, ramp, frequency responses– secondorder instruments –step-ramp response – dead timeelements. Types of Errors: gross, systematic, random.

Vacuum Systems: Principle and operation of various pumps: rotary, diffiusion, sorption, turbomolecular ionisation and cryopumping. Gauges: McLeod, diaphragm, thermocouple, pirani, penning, ionisation and hot and cold cathodes – design of high vacuum systems – high pressure cells – measurements at high pressures.

Thermal Systems: Temperature scales – liquefaction of gases, achieving low temperature – design of cryostats. High temperature furnaces: resistance, induction and arc furnaces – high temperature measurements – pyrometers – total and selective radiation pyrometers –optical pyrometer.

Detectors and Spectroscopy: Detectors- pyroelectric, thermoelectric, photoconducting, photoelectric, photomultiplier, scintillation types of detectors, photon counters.Spectroscopy: principles of atomic absorption spectroscopy – instrumentation – single and double beam spectrometers –theory and components of nuclear quadrupole resonance technique –applications.

Signal Conditioning and Error Analysis: Signal conditioning- Impedance matching, filtering, clipping and clamping, attenuators and its types, amplitude modulation and demodulation, lock-in detector, box-car integrator. Error analysis: Linear and nonlinear curve fitting, chi-square test.

COURSE OBJECTIVES

1. Students will study the major characteristics ofmeasurement systems and errors involved in them.
2. Students will gain an understanding related to production and measurement of low temperatures and high pressure.
3. Student will read various spectroscopic techniques and detectors.

MAPPING OF COs with POs

Course Outcomes	**Programme Outcomes (PO)** (Enter Numbers only)
1. To fully appreciate the various techniques involved in production of vacuum and low temperatures, which will benefit the students to handle various instruments in a better way.	
2. To really understand the characteristics of instruments and analysis of errors will help them in interpreting the obtained data more efficiently.	

COURSE PLAN – PART II

COURSE OVERVIEW

- The PH658 – INSTRUMENTATION course is offered in the second semester to M.Sc Physics students.
- The subject has 3 credit theory weightage.

COURSE TEACHING AND LEARNING ACTIVITIES (Add more rows)

S.No.	Week/Contact Hours	Topic*	Mode of Delivery
1	2nd week of Jan.	**Generalized Characteristics of Instruments Static characteristics:** accuracy, precision, repeatability, reproducibility, resolution, sensitivity, linearity, drift, span, range.	Chalk and talk (C&T), power point presentation(PPT) & class room discussions (CRD)
2	3rd week of Jan.	Dynamic characteristics: transfer function, zero order instruments, first order instruments	C&T, PPT, CRD
3	4th week of Jan.	first order instruments – step, ramp, frequency responses – second order instruments – step response	C&T, PPT, CRD

4	5th week of Jan.	second order instruments –ramp response dead time elements. Types of Errors: gross, systematic, random.	C&T, PPT, CRD
5	2nd week of Feb.	**Vacuum Systems:** Principle and operation of various pumps: rotary, diffiusion, sorption, turbomolecular ionisation and cryopumping	C&T, PPT, CRD
6	3rd week of Feb.	Gauges: McLeod, diaphragm, thermocouple, pirani, penning, ionisation and hot and cold cathodes	C&T, PPT, CRD
7	4th week of Feb.	design of high vacuum systems – high pressure cells – measurements at high pressures.	C&T, PPT
8	5th week of Feb.	**Thermal Systems:** Temperature scales – liquefaction of gases, achieving low temperature – design of cryostats.	C&T, PPT
9	2nd week of March	High temperature furnaces: resistance, induction and arc furnaces	C&T, PPT
10	3rd week of March	high temperature measurements – pyrometers – total and selective radiation pyrometers –optical pyrometer.	C&T, PPT, CRD
11	4th week of March	**Detectors and Spectroscopy:** Detectors- pyroelectric, thermoelectric, photoconducting, photoelectric, photomultiplier,	C&T, PPT, CRD
12	5th week of March	scintillation types of detectors, photon counters. Spectroscopy: principles of atomic absorption spectroscopy – instrumentation	C&T, PPT, CRD
13	1st week of April	single and double beam spectrometers – theory and components of nuclear quadrupole resonance technique – applications.	C&T, PPT, CRD
14	2nd week of April	**Signal Conditioning and Error Analysis:** Signal conditioning- Impedance matching, filtering, clipping and clamping, attenuators and its types	C&T, PPT, CRD
15	3rd week of April	amplitude modulation and demodulation, lock-in detector, box-car integrator. Error analysis: Linear and nonlinear curve fitting, chi-square test.	C&T, PPT, CRD

Text Books: 1. A.K. Sawhney and Puneet Sawhney, A Course in Mechanical Measurement and Instrumentation, Dhanpat Rai & Sons, New Delhi 2000.

2. Dennis Roddy and John Coolen, Electronic communication, 4thedition, PHI private Ltd., (1999).

3. C.S. Rangan, G.R. Sharma and V.S.V. Mani, Instrumentation Devices and Systems, Tata McGraw-Hill (1983).

4. H.H. Willard, L.L. Merrit and John A. Dean, Instrumental Methods of Analysis, 6th edition, CBS Publishers & Distributors (1986).

Reference Books: 1. D.V.S. Murty, Transducers and Instrumentation, Prentice – Hall of India(P) Ltd., New Delhi (1995).

2. Ernest O. Doebelin, Measurement System Applications and Design,McGraw Hill International Book Company, Singapore (1983).

COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assessment –I (objective type, short answer questions and problems)	3rd week of Feb.	90 min.	20%
2	Assessment –II (Assignment/quiz/presentation)	3rd week of March	NA	10%
3	Assessment – III (objective type, short answer questions and problems)	2nd week of April	90 min.	20%
CPA	Compensation Assessment*	3rd week of April	90 min.	20%
5	Final Assessment (short and long descriptive questions, problems)	As per NITT time table	180 min.	50%

COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)

- ✓ Performance in the assessment methods
- ✓ Questionnaire about the effectiveness of the delivery method, topics and the knowledge gained.

COURSE POLICY (including compensation assessment to be specified)

MODE OF CORRESPONDENCE (email/phone, etc.)

The lecture materials such as power point presentation, problems and handouts shall be available with the faculty members. Faculty can be contacted through office phone or in person for further discussions and clarifications on a mutually convenient time.

COMPENSATION ASSESSMENT

Those who are absent for any of the assessment I and III on genuine grounds shall be given an opportunity only once for the compensation assessment with the prior permission of the faculty member (s). The test would be descriptive, problems and short answer questions.

ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed)

- At least 75% attendance in each course is mandatory.
- A maximum of 10% shall be allowed under On Duty (OD) category.
- Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' grade.

ACADEMIC DISHONESTY & PLAGIARISM

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.
- The above policy against academic dishonesty shall be applicable for all the programmes.

ADDITIONAL INFORMATION, IF ANY

- Cell Phones should be turned-off in classroom. During the lecture using mobile phones will be treated as punishable dishonesty.
- The teacher can be contacted through phone or in person for clarifications by the student on a mutually convenient time or through e-mail: annp@nitt.edu
- Any misbehavior, indiscipline in the classroom/exam hall will be dealt with seriously. In the worst case, the institute disciplinary committee is empowered to take action.

FOR APPROVAL

Course Faculty _____ **CC- Chairperson** _____ **HOD** _____