B.E Semester: 7 Mechanical Engineering
Subject Name: Control Engineering (ME703-N-C) [Dept. Elect.-3]

A. Course Objective:

- To present a problem oriented in depth knowledge of Control Engineering.
- To address the underlying concepts and methods behind Control Engineering.

B. Teaching / Examination Scheme:

Teaching Scheme				Total Credit	Evaluation Scheme					
L	T	P	Total		Theory		Mid Sem Exam	CIA	Pract.	Total
Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	Marks
3	0	2	5	4	3	70	30	20	30	150

C. Detailed Syllabus:

Unit No.	Details
1	**Introduction:** Types and classification of control systems, applications to engineering industries. **Basic control system:** Mathematical modelling and its importance, System differential equation of electrical, Mechanical, Thermal, Hydraulic and Electromechanical network, analogy.
2	**Theory of Automatic Control:** Concept of feedback referred to linear control systems in general, e.g. displacement and speed control, process control, definition and terminology. Open loop and closed loop systems and advantage. Block diagrams and signal flow graph representation of physical systems. Block diagram algebra, transfer function from block diagram. Applications of Laplace transform methods, Basic control actions and controllers – on – off, proportional, derivative and integral and PID controllers, steady – state analysis. Transient response of first order and second order systems to step, ramp and sinusoidal input, steady state errors. Routh's stability criteria and root locus methods, improving system performance.
3	**Hydraulic system:** Characteristic of hydraulic components control valves, source of hydraulic power, hydraulic motors, Pistons and transmission. Elements of circuit design. Accumulation control circuits such as position control and speed control circuit. Hydraulic control machine tools. **Pneumatic systems:** Pneumatic power supply, amplifiers with different controlling actions, Pneumatic valves and cylinders. Three, four way pilot valves, Pneumatic control of machine tools.
4	**Electrical systems:** Speed control of D.C. motors, Remote control positional servo -mechanism (including effect of gearing between motor and load). **Microprocessor based digital control:** State space analysis optional and adaptive control systems – Industrial logic control system - programmable logic controller and its applications.
5	**Fuzzy Logic:** Concept of fuggy logic, basic notions, linguistic variables of fuggy control comparison of design methodology, examples and case study
6	**Control Systems applications:** Mechanical engineering systems like thermal power plants, boiler, refrigeration plants, central air-conditioning plants and automobiles.

Total hours (Theory):48
Total hours (Practical):32
Total hours:80

D. Lesson Planning:

Sr. No.	Date/Week	Unit	Weight age	Topic No
1	1^{st} ,2^{nd} ,3^{rd}	Unit 1	20%	1
2	4^{th} .5^{th} ,6^{th}	Unit 2	20%	2
3	7^{th} , 8^{th} ,9^{th}	Unit 3	20%	3
4	10^{th} .11^{th} . 12^{th}	Unit 4	20%	4
5	13^{th} , 14^{th} ,$15^{th,}$,16^{th}	Unit 5	20%	5,6

E. Instructional Method & Pedagogy

1	At the start of course, the course delivery pattern , prerequisite of the subject will be discussed
2	Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal Weight age should be given to all topics while teaching and conduction of all examinations.
3	Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation.
4	One/Two internal exams may be conducted and total/average/best of the same may be converted to equivalent of 30 marks as a part of internal theory evaluation.
5	Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.
6	Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.
7	The course includes a laboratory, where students have an opportunity to build an appreciation for the concept being taught in lectures. Suggested list of experiment is given below

F. List of Practical:

1	Study of different types of control systems & their application
2	To prepare mathematical model and derive a transfer function of a physical system
3	Determine of transfer function using, 1) Block diagram reduction 2) Mason's gain formula
4	Study of hydraulic circuit and its components.
5	To understand a working of pneumatic control components and different circuits using pneumatic trainer.
6	Study of transient response analysis of first order & second order system
7	To study the concept of stability using Routh's stability criteria
8	Study of various control action & their effect on performance of control systems.
9	Study of programmable logic controller logic controller (PLC) & their application.

G. Students Learning Outcomes:

1	The student can identify different areas and applications of control engineering.

H. Text Books & Reference Books:

1	Modern Control Engineering – by Ogata
2	Control Systems Engineering – by Nagrath & Gopal.
3	Automatic Control Engineering – by Revan 2nd edition.
4	A course in Control Engineering – by Tandon Rao etc.
5	Automatic Control System – by Kuo.
6	Automatic Control Systems – by Verma
7	Control system engineering by S. K. Bhattacharya
8	Basic Pneumatic Systems, Principle and Maintenance by S R Majumdar, McGraw-Hill
9	Design of Control Systems by George Desouza