According to New Revised Credit System Syllabus

SPPU

Third Year Degree Course In

ELECTRONICS & TELECOMMUNICATION ENGG. (Sem - I)

MECHATRONICS

Includes

- Model Question Papers For Practice
  (In Sem-30 Marks & End Sem- 70 Marks)

Dr. R. C. JAISWAL

Dr. Y. S. ANGAL

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ADVANCEMENT OF KNOWLEDGE

A TEXT BOOK OF

MECHATRONICS

FOR

SEMESTER – I

THIRD YEAR DEGREE COURSE IN ELECTRONICS & TELECOMMUNICATION ENGINEERING

Strictly According to New Revised Credit System Syllabus of Savitribai Phule Pune University

(w.e.f. June 2017)

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Dedicated to

Shri Sant Sadguru Gajanan Maharaj,

Shegaon

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Constructive criticisms for improvement of this book are welcome.

3 July 2017

Pune **Authors**

PREFACE

It gives us great pleasure to present the book **'Mechatronics'** for the students of Third Year Degree Course in Electronics & Telecommunication Engineering of the Savitribai Phule Pune University. This book is strictly as per the new revised syllabus 2015 Pattern with effect from the Academic Year (2017-18).

As per New Revised Examination Scheme which has been implemented from this academic year, In-semester assessment carries 30 marks over first three units and End Semester Examination carries 70 marks over entire syllabus out of which first three units will carry 20 marks and units 4, 5, 6 will carry 50 marks. The theory course will have 4 credits.

The book is written such that all the basic concepts are explained in simplified manner. It is presented in a more conceptual manner rather than mathematical, as required by the new examination system. It is our objective to keep the presentation systematic, consistent, intensive and clear through explanatory notes and figures. Main feature of this book is, **Complete Coverage** of the New Credit System Syllabus with large number of Worked Solved Examples, Exercises, **Model Question Papers of In Sem.** and **End Sem. Exams.**

Mechatronics is a concept of Japanese origin was first introduced during early 1960's to qualify the dual alliance of electronics and computer technology to practical applications in mechanical systems. The Japanese were quick to exploit the advantages of this integrated technology through their consumer products while other are yet adopting this concept to realize its benefits.

Mechatronics aims at lending better value to products and systems. The combination of mechanical, electronics and information engineering is optimized to take full advantage of ability of microelectronics to reduce the demand on mechanical systems of product.

The integration of various theories, principles techniques, methodolics and standards to cater to the pressing needs have long been emerging as new disciplines.

In future, the subject **Mechatronics** is likely to find a place in the curriculum of many engineering disciplines.

This book consists of 6 Units and each unit includes Learning Objectives and Exercises in detail.

The topics of each unit then divided into labeled sections containing explaination, illustrations examples and, where appropriate, practical applications are also given. A wide variety of problems with step by step solutions are also included. Each unit ends with subjective type of questions and exercises.

Unit I : The broad knowledge accommodating the Principle of Mechatronics has been described logistically, so that the readers can grasp the essence of the topics. Real Life Examples are also discussed with a Case Study in brief. This unit gives significance / importance of the subject.

Unit II : It deals with Basic Transduction Principle of Transducers. Selection Criterion of Transducers / Sensors are discussed. This unit also deals with Characteristics and Applications of Various Transducers like Pressure, Flow, Motion, Temperature etc. Introduction to Smart Sensors and MEM'S is also given in this Unit.

Unit III : It is concerned with principles of Fluid Power Systems comprising especially Hydraulic Systems / Hydraulic Fluid Power Systems.

Unit IV : Gives introduction to Pneumatic Systems with Pneumatic Actuator Physical Components of Pneumatic Circuits are discussed in this Unit. At the end Case Study with Robotic Pick and Place Robot is explained.

Unit V : Selection and Specifications of Stepper Motors is explained in this unit. Electrical Actuators like Solenoid Valves, Electromechanical Relays.

Unit VI : Gives Role of Mechatronics in Automobile Industry. It also presents design approach and a collection of Case Studies of Mechatronics. Examples of Auto Pilot System, Car Parking System Engine Management System, High Speed Tilting Train, Anti Locks Brake Systems (ABS), CNC Machines are discussed here.

The books is written in a very user friendly language. We are confident that this book will be appreciated by the students and they will secure great success in this subject.

We are sure that this book will cater to all needs of students for this subject.

However, we will be highly obliged if the students and teachers, criticize or to bring to our notice any misprints, corrections, additions etc. necessary for improvement in this book.

Pune **Authors**

SYLLABUS

Unit I : Introduction to Mechatronics (6 Hrs)

Basics of Mechatronics Systems : Definition of Mechatronics, Key elements of Mechatronics Systems, Levels of mechatronics systems, Measurement Characteristics, Examples of Mechatronics systems in daily life as, Washing Machines, Digital Cameras, CD Players, camcorders, Mechatronics design process, phases of mechatronics design process, integrated design approach.

Mechanical Components and Servo Mechanism : Mechanical System and Motion, Mass Inertia and Dashpot, Gears, types of Gears, Servomechanism(Concepts and Theory, Problems). Case study Mechatronics Design of Coin Counter/Coin Separator

Unit II : Overview of Sensors, Transducers and their Characteristics Specifications (8 Hrs)

Specifications related to selection criterion for force, pressure, temperature and motion (Rotary and Linear). Classification and selection of transducers:

Force: Load Cell, Cantilever Beam (Design aspect example).

Pressure: Strain Gauge, Piezoelectric.

Motion: Rotary and Linear motions, Proximity sensors Inductive, Capacitive and Magnetic, sources detectors in optical proximity sensors. Comparison of Various proximity sensors.

Temperature: Optical Fibre and its use in temperature measurement, Fibre Optic Temperature sensors, Ultrasonic Transducers for applications as position, level, flow measurement. Gas sensors, Wind sensors: Gyroscope, Accelerometer, Magnetometer (As used in smart phones)

Smart Sensors: Concept, Radiation Sensors - Smart Sensors - Film sensor, IR- temperature sensors Introduction to MEMS & Nano Sensors . Rotary Optical Encoder

Unit III : Hydraulic Systems (6 Hrs)

Introduction to Hydraulic Actuators, Fluid Power Systems: Concept of Actuators, Classification of Actuators: Pneumatic, Hydraulic and Electrical Actuators, Fluid Power systems

Hydraulic Systems: Physical Components of a Hydraulic systems, Hydraulic Pumps (e.g. Gear Pumps, Vane Pumps, Piston Pumps and Axial Piston Pumps), Filters and Pressure Regulation, Relief Valve, Accumulator.

Unit IV : Pneumatic Systems (6 hrs)

Introduction to Pneumatic a Actuators Physical Components of a Pneumatic Systems, Pneumatic Cylinders, Pneumatic Actuators (e.g. Spring Actuator and Spring Actuator with positioner), Air compressor, Air Receiver, Air Dryer Air Service Treatment: Air Filter, air regulator and Gauge, Air Lubricator and Pressure regulation Intake and Air Filter. Case study of Robotic Pick and Place robot

Unit V : Electrical Actuators, Electron-Mechanical Actuators (6 Hrs)

Electrical-Actuation System: Selection criteria and specifications of stepper motors, solenoid valves, relays (Solid State relays and Electromechanical relays). Selection Criterion of control valve, Single acting and Double acting Cylinders. Electro-Pneumatic: Pneumatic Motors, Valves: Electro Hydraulic: 3/2 Valves, 4/2 Valves, 5/3 Valves Cables: Power cable and Signal cables

Unit VI : Mechatronics Systems in Automobile (6 Hrs)

(Treatment with Block Diagram Approach) Boat Autopilot, High Speed tilting trains, Automatic car parking systems, Engine Management systems, Antilock Brake systems (ABS), CNC Machines(Only Block Diagram and explanation)

CONTENTS

Mechatronics

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