Gondwana University, Gadchiroli

Faculty of Engineering and Technology

B.E. (MECHANICAL ENGINEERING): SIXTH SEMESTER

ME601: CONTROL SYSTEM ENGINEERING (Theory)

CREDITS: 04

Teaching Scheme
Lectures: 3 Hours/Week
Tutorial: 1 Hour/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

UNIT – I **[9 Hrs.]**

Mathematical modeling of Physical Systems and Concept of Transfer Function.. (Mechanical, Mechanical System (Linear displacement with Two masses, Electrical and Operational amplifiers only). System representation through Block Diagram and Signal Flow Graph. Transfer function through Block Diagram Simplification and Masons Gain Formula.

UNIT – II **[9 Hrs.]**

Time Domain Response Analysis under transient inputs, Steady state error analysis and error constants. PID controller and its application, Routh-Herwitz criterion of absolute stability and Range stability.

UNIT – III **[9 Hrs.]**

Frequency Domain Analysis, Polar Plot, Bode plot, gain Margin and phase margin, Transportation lag, System Identification from Bode plot.

UNIT – IV **[9 Hrs.]**

Nyquist Stability criterion, Nyquist plot for Type zero and Type – L system, Root – Locus, it's significance, construction techniques and plotting of Root Locus.

UNIT – V **[9 Hrs.]**

Introduction to control system design, lag lead compensation, Feed Back compensation and Pole – Zero placement.

State variable approach and state equations, Transfer function from state models. state transition matrix and solution of state equations, controllability and observability test through test model.

BOOKS RECOMMENDED:

1. Modern Control Engineering by Ogata [PHI]
2. Control system Engineering by Nise [Willey]
3. Control Systems by Nagrath & Gopal [TMH]
4. Modern Control Systems by Dorf [Addision Wesley]
5. Digital Control and State Variable Methods by Gopal [TMH]
6. Control System Engineering - Raven

ME602: INDUSTRIAL ELECTRONICS (Theory)

CREDITS: 03

Teaching Scheme
Lectures: 3 Hours/Week
Tutorial: 1 Hour/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

Objectives:

1. To learn industrial electronics in applied manner with perspective of mechanical Engineering.
2. To introduce the design philosophy for mechanical processes control based on digital electronics, microcontroller and PLC.

Outcomes: Learner should be able to ….

1. Demonstrate the knowledge of basic functioning of digital circuits and microcontroller.
2. Understand input/output system and communication interfaces required for modern mechanical process.
3. Know the PLC. Programming with PLC and its application for the industrial automation.

UNIT – I: Digital Circuit [11 Hrs.]

Number system, Complements of binary number system, De-Morgan's theorem, Types of logic equations: SOP & POS, Karnaugh's map(upto 4 variables), Binary codes, Combinational logic: Code convertors, Introduction to multiplexer/demultiplexer, Introduction to decoder/encoder, Arithmetic circuits: Adder/Subtractor, Flip-flops

UNIT – II: Microcontroller 8051 [10 Hrs.]

Overview of Generic microprocessor and microcontroller, Architecture and functional block diagram of microcontroller 8051, Special function registers, Addressing modes, Types of instructions, Simple assembly language programs

UNIT – III: I/O Ports, Timers, Interrupts and Serial Communication [10 Hrs.]

I/O ports of 8051, Basics of serial communication, 8051 connection to RS232, Timers of 8051, Different modes of timers, Interrupts of 8051, Interfacing of 8051 with 8255 PPI, Interfacing of 8051 with external RAM and ROM

UNIT – IV: Industrial Automation [8 Hrs.]

Introduction to programmable logic controller, Block schematic, I/O processing, Programming with PLC, Ladder diagram representation, Watchdog timers, Selection of PLC, Applications

UNIT – V: Mechatronics [9 Hrs.]

Introduction to mechatronics, Systems, Measurement systems, Control systems, Microprocessor based controllers, Response of systems, Design processes in mechatronic systems, Case studies of mechatronic systems

BOOKS RECOMMENDED:

1. W. Bolton, "Mechatronics", Pearson Education, 3rd edition
2. R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill, 3rd edition
3. Kenneth J. Ayala, "The 8051 Microcontroller", Thomson Delmar Learning, 3rd edition

ME603: OPERATIONS RESEARCH (Theory)

CREDITS: 04

Teaching Scheme
Lectures: 3 Hours/Week
Tutorial: 1 Hour/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
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UNIT – I **[9 Hrs.]**

Introduction to O.R., Development , Definitions , Characteristics, Limitations, Phases of O.R. and applications. Types of Mathematical Models. Linear programming, Formulation of problem., Graphical Method , Simplex Method., Formulation of dual of LPP.

UNIT – II **[9 Hrs.]**

Assignment Model: Introduction , Problem on minimization and maximization. Travelling salesman problem by Branch and Bound Method. Transportation Model ; Introduction , Methods of finding initial solution , Test of optimality, Transportation problem , Transshipment problem.

UNIT – III **[9 Hrs.]**

Network Models: Introduction to PERT/CPM and its importance in project management. Concept and construction of network diagrams. Probability of completion of project , Cost analysis of project.

UNIT – IV **[9 Hrs.]**

Replacement Models: Introduction, Concept of equivalence, Replacement of items that Deteriorate , Replacement of items that fail suddenly.

Inventory Control Models: Introduction , Meaning of Inventory control , Advantages of Inventory control.

Deterministic Inventory control Models, economic lot size with instantaneous replenishment with and without storage costs, economic lot size with finite replenishment with and without shortage. Selective Inventory Management Technique.

UNIT – V **[9 Hrs.]**

Queuing Model: Introduction, (M/M/1): (FCFS/∞/∞), Single channel Poison arrivals with exponential service times, infinite population.(No Derivation Expected)

Simulation: Concepts and its application in Queuing Model, Inventory and Network. Monte Carlo Simulation Method.

BOOKS RECOMMENDED:

1) Operations Research - P.K. Gupta and D.S. Hira
2) Operations Research - J. K. Sharma
3) Operations Research - Dave and Patel
4) Quantitative Techniques - N.D. Vora

ME604: THERMAL ENGINEERING (Theory)

CREDITS: 04

Teaching Scheme
Lectures: 3 Hours/Week
Tutorial: 1 Hour/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

UNIT – I **[9 Hrs.]**

Principles of steam generation, classification of steam generators, fire tube and water tube steam generators, high pressure steam generators, advantages, Boiler mountings and accessories.

Fluidized Bed Boilers: bubbling fluidized bed boilers, Circulating fluidized bed boilers (elementary treatment expected).

Draught and its classification, Chimney height, diameter, efficiency, condition for maximum discharge.

Performance of steam generators, evaporation capacity, equivalent evaporation, boiler efficiency.

UNIT – II **[9 Hrs.]**

Steam Nozzles: Flow of steam through nozzle, Adiabatic expansion in nozzles, maximum discharge, critical pressure ratio and effects of friction, calculation of throat and exist area, supersaturated flow, Wilson line.

Introduction to steam engines, Steam turbines : Principles of working of steam turbines, classification of steam turbines, Impulse and reaction turbine and its comparison, compounding of steam turbines.

UNIT – III **[9 hrs.]**

Flow of steam through turbine blades, Ideal and actual reheat factors, velocity diagrams, graphical and analytical methods, work done, thrust and power, dimensions and proportioning of blades, steam turbine efficiencies, condition for maximum efficiencies, reheat and regenerative cycles, governing of steam turbines, energy losses in steam turbine.

UNIT – IV **[9 hrs.]**

Steam condensers : Types of condensers, classification of condensers, quantity of cooling water required, design calculations for surface condensers, Dalton's law of pressures, sources of air leakages and air removal,. air ejectors.

Cooling towers: Wet cooling towers, Dry cooling towers, cooling ponds.

UNIT- V **[9 hrs.]**

Positive Displacement Compressors: Reciprocating compressors – parts and operations, work done during isothermal, polytropic & adiabatic compression process. P-V diagram, isothermal efficiency, effect of clearance, volumetric efficiency mechanical efficiency, multistage compressor, condition for minimum work input, capacity control.

BOOKS RECOMMENDED:

1. Power Plant engineering – V. M. Domkundwar.
2. Thermal Engineering – P. L. Ballaney.
3. Thermal Engineering – Mathur & Mehta
4. Thermal Engineering – Vasandani & Kumar

ME605: DYNAMICS OF MACHINES (Theory)

CREDITS: 03

Teaching Scheme
Lectures: 3 Hours/Week
Tutorial: 1 Hour/Week

Examination Scheme
Duration of Paper: 03 Hours
University Assessment: 80 Marks
College Assessment: 20 Marks

UNIT - I **[9 Hhs.]**

Concepts of machine element dynamics: - Dynamic Stresses in machine elements, Various approaches for dynamic analysis- D`Alembert principle, Euler`s equation of motion. Simple precession & gyroscopic couple. Gyroscopic effect on airplane, Ship, vehicles and grinding wheels.

UNIT- II **[9 Hhs.]**

Static force analysis: - Free body diagram, condition of equilibrium. Analysis of all links of given linkages, cam, gear mechanism and their combinations without friction.

Dynamic force analysis of planar linkages such as four bar chain & reciprocating mechanism by graphical method, Cam dynamics and jump-off phenomenon. Problems on Cam Dynamics with flat face follower.

UNIT - III **[9 Hhs.]**

Balancing in reciprocating mechanism.

Static & Dynamic balancing in rotating machines. Balancing machines & field balancing by vector diagram.

UNIT- IV **[9 Hhs.]**

Turning moment vs. crank angle diagram for single - cylinder & multiple cylinder engines, punching machines etc. Flywheel selection.

Speed governors, centrifugal & inertia type, Watt, Portal, Proell, Hartnell governors, Operating characteristics of governors.

UNIT- V **[9 Hhs.]**

Derivation of equation of motion for vibratory system. Free vibration of single-degree-of-freedom system with & without damping. Logarithmic decrement & damping estimation. Forced vibration of single-degree-of-freedom & vibration isolation, whirling of shaft & critical speed of rotors.

Equation of motion for two-degree-of freedom system. Natural frequencies and mode shapes, vibration absorber.

Torsional oscillation of two-disc and three-disc rotors.

TEXT BOOKS:

1. Theory of machines & Mechanisms - Shigley
2. Theory of Machines & Mechanisms - Ghosh & Mallik
3. Theory of Mechanisms - S. S. Rattan
4. Mechanism and Machine Theory - Rao & Dukipatti
5. Theory of Vibrations - W. T. Thomson

REFERENCE BOOKS:

1. Theory of Machine - Thomas Bevan
2. Theory of Machines - Sandor & Erdman
3. Mechanical Vibrations - Grover

ME606: INDUSTRIAL ELECTRONICS (Laboratory)

CREDITS: 02

Teaching Scheme	**Examination Scheme**
Practical**:** 3 Hours/Week	University Assessment: 25 Marks
	College Assessment: 25 Marks

LIST OF PRACTICALS:

Minimum Eight out of following shall be performed.

1. To study basic logic gates.
2. To study adders and subtractors.
3. To study and verify Demorgan's theorem and Laws of Boolean algebra.
4. To study the operation multiplexer and demultiplexer.
5. To study the operation of a) decoder b) seven segment decoder.
6. Write an ALP to add two a) 8-bit nos. b) 16-bit nos.
7. Write an ALP to subtract two a) 8-bit nos. b) 16-bit nos.
8. Write an ALP to find largest no. in given array.
9. Write an ALP to separate even and odd nos. from given array.

A Journal/Report on practicals conducted shall be submitted by each student. University Practical examination shall be on viva-voce of 10 marks and practical performance or objective test of 15 marks.

ME607: DYNAMICS OF MACHINE (Laboratory)

CREDITS: 02

Teaching Scheme	**Examination Scheme**
Practical**:** 3 Hours/Week	University Assessment: 25 Marks
	College Assessment: 25 Marks

LIST OF PRACTICALS:

Minimum Eight out of following shall be performed.

1. Performance characteristics of Gyroscope.
2. Performance characteristics of Governor
3. Determination of critical speed of shaft
4. Determination of natural frequency of single rotor system
5. Determination of natural frequency of double rotor system.
6. Determination of natural frequency of un-damped system
7. Determination of natural frequency of damped system
8. Determination of Jump-off speed of cam follower system
9. Dynamic balancing of rotor
10. Balancing of Reciprocating mechanism
11. Natural frequency determination of cantilever beam

A Journal/Report on practicals conducted shall be submitted by each student. University Practical examination shall be on viva-voce of 10 marks and practical performance or objective test of 15 marks.

ME608: GEOMETRIC MODELLING (Laboratory)

CREDITS: 03

Teaching Scheme	**Examination Scheme**
Practical**:** 2 Hours/Week	University Assessment: 50 Marks
Tutorial: 1 Hour/Week	College Assessment: 50 Marks

Course Objectives and Outcomes: Computer Aided Drawing and modeling has become indispensable in the current engineering designs. All undergraduate Mechanical Engineering Students are expected to be well versed with these modern drawing techniques. Further the practice of this knowledge shall enhance the special intelligence and imaginations of the student. The Institute/colleges are expected to perform the practicals using any of the standard geometric modeling software based on the following syllabi. The students are expected to get introduced to the use & application of Geometric modeling software.

1) Introduction
Strengths and weaknesses of conventional 2D drawing. Types of geometric modeling, wire frame modeling, surface modeling, solid modeling (CSG & B-rep) advantages, disadvantages and application. File Formats and Data exchange.

2) Sketching
Sketching, line, circle, arc, spline. Filleting, trimming. Dimensioning linear, angular, diameter, radius, modifying dimension. Constraints parallel, perpendicular, co-incident, vertical, horizontal, tangent, symmetric.

3) Solid Modeling Sketch based features extrude, revolve, sweep, variable section sweep, loft. Add, subtract, intersection,
Modifying commands fillet, chamfer, array, copy, mirror etc. Design tables.

4) Surface modeling techniques
Tabulated surface, revolved surface, swept surface, lofted surface, edge defined surface. Multi section sweep & Variable section sweep

5) Assembly
Assembly: Top down and bottom up approach, constraints, mate, align, Joints

6) Drafting & Detailing of 3-D Models
Detailing generating views, sectional views, Orthographic views, isometric Dimensioning views, adding dimensional and geometric tolerances, surface finish. Creating BOM.

LIST OF PRACTICAL'S:

At least six to eight practicals based on of above syllabus, demonstrating application on sketching, surface modeling, part modeling, Assembly and detailing of assembly shall be performed using commercial software/s (like CATIA , PRO-E, SOLIDWORKS, etc.) or relevant freewares.

University practical examination shall be based on viva voce of 20 marks and practical performance of 30 marks.

BOOKS RECOMMENDED:

1. CAD / CAM , Theory & Practice - Ibrahim Zeid
2. User / Command / Tutorial manuals of relevant software/s

ME609: INDUSTRIAL TRAINING OR CASE STUDY

CREDITS: 01

Teaching Scheme	**Examination Scheme**
Practical: 2 Hours/Week	College Assessment: 50 Marks

Students are expected to fulfill any one of the following (A or B).

(A) Students are expected to undergo the training during the vacations before commencement of fifth/sixth semester in Industry or organization of minimum two weeks duration in total. Student should submit training report with certificate from concerned industry/organization. Student is expected to give presentation based on the training report.

(B) Students not undergoing industrial training will have the option of Case Study in lieu of Industrial Training and shall be completed during Sixth semester only. Case study should be based on the study of some specific case/issue/problem related to any industrial/business establishment. The case study can be also based on the study of report prepared by any industry/organization related to issues/problems. Group of students (Max 09) can be considered for this study. A report should be submitted. The report should include problem/issue identified, methodology of data collection, data collected, method of analysis, results and conclusion. Student is expected to give presentation based on this report.

Evaluation Guidelines for A and B are as follows:

Industrial Training **or** Case Study Report	-	25 Marks (Maximum).
Presentation	-	15 Marks (Maximum).
Viva – Voce	-	10 Marks (Maximum).