BACHELOR OF ENGINEERING (FOUR YEARS DEGREE COURSE)
FACULTY OF SCIENCE & TECHNOLOGY
TEACHING AND EXAMINATION SCHEME WITH CHOICE BASED CREDIT SYSTEM

Course and Examination Scheme of Bachelor of Engineering (Mechanical Engineering) V Semester B.E. (Mechanical Engineering)

Course Code	Course Title	Teaching Scheme				Examination Scheme									
		Hours per week			No. of Credits	Theory						Practical			
		L	T	P		Duration of Paper (Hrs.)	Max. Marks	Max. Marks Sessional		Total	Min. Passing Marks	Max. Marks	Max. Marks	Total	Min. Passing Marks
							ESE	MSE	IE			TW	POE		
ME501	Design of Machine Elements	3	1	-	4	3	80	10	10	100	40	-	-	-	-
ME502	Metrology & Quality Control	3	1	-	3	3	80	10	10	100	40	-	-	-	-
ME503	Mechanical Measurement	3	1	-	3	3	80	10	10	100	40	-	-	-	-
ME504	Heat Transfer	3	1	-	3	3	80	10	10	100	40	-	-	-	-
ME505	Program Elective-I	3	1	-	3	3	80	10	10	100	40				
ME506	Heat Transfer	-	-	2	2	-	-	-	-	-	-	25	25	50	25
ME507	Mechanical Measurement& Metrology	-	-	2	2	-	-	-	-	-	-	25	25	50	25
ME508	Computer Application – I	-	1	2	3	-	-	-	-	-	-	50	50	100	50
ME509	Mini Project	-	-	2	1							50	-	50	25
		15	6	8	24	-									
		29			24	-	400	50	50	500	-	100	100	250	125
						750									

Note: Students shall opt one Core Program Elective-I from Table- 1

Table-I
i) ME5051:- Industrial economics and Entrepreneurship Development
ii) ME5052:- Product design and Development
III) ME5053:- Industrial Robotics

BACHELOR OF ENGINEERING (FOUR YEARS DEGREE COURSE)
FACULTY OF SCIENCE & TECHNOLOGY
TEACHING AND EXAMINATION SCHEME WITH CHOICE BASED CREDIT SYSTEM

Course and Examination Scheme of Bachelor of Engineering (Mechanical Engineering) VI Semester B.E. (Mechanical Engineering)

Course Code	Course Title	Teaching Scheme				Examination Scheme									
		Hours per week			No. of Credits	Theory						Practical			
						Duration of Paper (Hrs.)	Max. Marks	Max. Marks		Total	Min. Passing Marks	Max. Marks	Max. Marks	Total	Min. Passing Marks
								Sessional							
		L	T	P			ESE	MSE	IE			TW	POE		
ME601	Control System Engineering	3	1	-	4	3	80	10	10	100	40	-	-	-	-
ME602	Program Elective-II	3	1	-	3	3	80	10	10	100	40	-	-	-	-
ME603	Thermal Engineering	3	1	-	3	3	80	10	10	100	40	-	-	-	-
ME604	Theory of Machines II	3	1	-	3	3	80	10	10	100	40	-	-	-	-
ME605	Industrial Electronics	3	1	-	3	3	80	10	10	100	40				
ME606	Theory of Machines II	-	-	2	2	-	-	-	-	-	-	25	25	50	25
ME607	Computer Applications – II	-	1	2	3	-	-	-	-	-	-	25	25	50	25
ME608	Industrial Electronics lab	-	-	2	2	-	-	-	-	-	-	25	25	50	25
ME609	Industrial Training or Case Study	-	-	2	1	-	-	-	-	-	-	50	-	50	25
		15	6	8	24	-									
		29			24	-	400	50	50	500	-	125	75	200	100
						700									

Note: Student shall opt one Professional Elective II. Refer Table-II

Table II
1) ME 6021 - Operations Research Techniques
2) ME 6022 - Hydraulics and Pneumatics
3) ME 6023 - Material Handling systems

Gondwana University, Gadchiroli

Faculty of Engineering and Technology

B.E. (MECHANICAL ENGINEERING): FIFTH SEMESTER

ME501: DESIGN OF MACHINE ELEMENTS (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

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UNIT – I **[12 Hrs.]**

Definition of design, types of design, design process, (i.e, various phases in design) feasibility, preliminary design alternatives, General consideration in Machine Design. Manufacturing considerations in design.
Mechanical properties, Applications and designations as per ISI and their equivalence with other standards of engineering materials, selection of material.
Factor of safety, Statistical methods in determining factor of safety. Theories of failure, modes of failure, compound stresses, eccentric axial loading, variable stresses in machine parts, stress concentration & stress raisers, notch sensitivity, stress concentration factor, methods for reducing stress concentration factor. Goodmans criteria, Soderberg criteria, Gerber`s criteria, fatigue design for finite & infinite life of the parts subjected to variable loads.
Design of Cotter Joint & Knuckle Joint.

UNIT – II **[12 Hrs.]**

Design of Riveted joint for Boiler shell, Design of Lozenge joint (Uniform Straight joint), eccentrically loaded riveted joint.
Welded Joint: Design of single transverse, double transverse, parallel fillet, combination fillet, butt joint, eccentrically loaded welded joints.
Bolted joint: Design of bolted fasteners, bolts of uniform strength, bolted joints under eccentric loading.

.**UNIT – III** **[12 Hrs.]**

Design of power screw: Derivation of Expression for deflection and shear stress in helical spring, design of helical spring, design of leaf spring.
Design of lever: Hand lever, Foot lever, and Bell crank lever

UNIT – IV **[12 Hrs.]**

Classification of thin & thick cylindrical pressure vessels, Stresses in thin & thick cylindrical pressure vessels when it is subjected to internal pressure, expression for circumferential & longitudinal stresses, design of pressure vessel, heads & cover plate.
Design of transmission shafts on the basis of strength, rigidity & critical speed.
ASME code for shaft design. Design of Stepped shaft, Axle, Splined shaft, Keys.
Design of Shrink & Press Fit Joints

BOOKS RECOMMENDED:

1. Design of Machine Element – V. B. Bhandari.
2. Machine Design – Sharma and grawal
3. Mechanical Engineering Design – J. E. Shigley.
4. Machine Design – Khurmi & Gupta
5. Design Data for Machine Elements – B. D. Shiwalkar

ME502: METROLOGY & QUALITY CONTROL (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 Hrs.]**

Classification of operations – Basic qualifying process, critical product, critical secondary, auxiliary, supporting operations.

Tolerance analysis of limit & fits. Types of fits, shaft basis system, hole basis system, Selective assembly, allowances, IS specifications. Design of Limit gauges.

UNIT – II **[9 Hrs.]**

Metrology :- Standards of measurements, simple gauging instruments for linear and angular measurement, comparators – Mechanical, Electrical, Pneumatic, Optical, Measurement of straightness and flatness. Measurement of thread, measurement of gear tooth profile.

UNIT – III **[9 Hrs.]**

Quality Control :- Definition, function, objectives, characteristics. Quality, Quality of design, quality of conformance, process control charts and process capability. Statistical quality control.

UNIT – IV **[9 Hrs.]**

Acceptance sampling techniques, O. C. Curves, sampling plans, Inspection :- Types and objectives.(No analytical treatment)

Introduction to ISO 9000, BIS 14000 series, TQM concepts, Quality assurance, Quality audit, Quality circles.

UNIT – V **[9 Hrs.]**

Jigs and Fixtures : Introduction, Difference between jigs and fixtures, uses, principles of jigs and fixtures design. Materials, principles of location, methods of location. Clamping requirements, types of clamps, jig bushes, drilling jigs, milling fixtures, classification of fixtures.

BOOKS RECOMMENDED:

1. Metrology – R. K. Jain.
2. Metrology – I. C. Gupta.
3. Quality Control Handbook – Juran
4. Statistical Quality Control – Grant.
5. Total Quality Management – Zaire
6. Production Engineering – P. C.Sharma.
7. Statistical Quality Control – Mahajan.

ME503: MECHANICAL MEASUREMENT (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 Hrs.]**

Purpose, structure and elements of measuring system. Static characteristics of measurement system elements including systematic, statistical characteristic, generalized model of system element and calibration . Measurement error, error probability density function, error reduction.

UNIT – II **[9 Hrs.]**

Dynamic Characteristics of Measurement System, First and Second Order Instruments, Transfer Function G(S), Step, Ramp And Frequency Response, Dynamic Errors. Signals and Noise in Measurement System including Deterministic and Random Signals, Noise, Interference, Noise Sources and Couplings, Reduction of Noise.

UNIT – III **[9 Hrs.]**

Introduction to Transducers Elements, Classification, Principle, Sensing Elements, Signal Conditioning Elements, Construction, Range & Working of Instruments for Measurement of Linear & Angular Displacement and Speed.

UNIT – IV **[9 Hrs.]**

Classification, Principle, Sensing Elements, Signal Conditioning Elements, Construction, Range & Working of Instruments for Measurement of Strain, Weight, Force, Torque, Power, Pressure, Vacuum, Sound.

UNIT – V **[9 Hrs.]**

Classification, Principle, Sensing Elements, Signal Conditioning Elements, Construction, Range and Working Instruments for Measurement of Temperature, Level & Flow.

BOOKS RECOMMENDED:

1. Principles of Measurement System - John P. Bentley, Pearson Education Asia.
2. Principles of Measurement Systems - Nakra Chaudhary
3. Principles of Measurement Systems - Beckwith Buck
4. Mechanical Measurement and Industrial Instrumentation - A. K. Sawhney
5. Mechanical Measurement and Industrial Instrumentation - D. S. Kumar
6. Mechanical Measurement and Industrial Instrumentation - R. K. Rajput

ME504: HEAT TRANSFER (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 Hrs.]**

Introduction, basic modes of heat transfer, conduction, convection and radiation. Laws of heat transfer and conservation of energy requirement. General heat conduction equation in Cartesian, cylindrical & spherical co-ordinates. Thermal conductivity and diffusivity. One dimensional steady state conduction equation for the plane wall, cylinder and sphere. Thermal resistance of composite structures, contact resistance, overall heat transfer coefficient, critical thickness of insulation.

UNIT – II **[9 Hrs.]**

Conduction with internal heat generation for plane wall, cylinder and sphere. Extended surfaces, Types of Fins. Fins of uniform cross sectional area, Temperature distribution and heat transfer rate, fin efficiency and effectiveness. Error in temperature measurement. Steady state heat transfer, lumped heat capacity analysis, Heisler charts. Biot Number, Fourier Number and their significance.

UNIT – III **[9 Hrs.]**

Forced convection, Physical significance of non-dimensional parameters. Concept of velocity & thermal boundary layer thickness, Local and average heat transfer coefficients. Empirical co-relations for external, internal flow, laminar & turbulent flow through conduits.

Free or natural convection. Grashoff number, Rayleigh number. Horizontal and vertical plate. Empirical co-relations for cylinders and spheres. Heat transfer with phase change, pool boiling curve & regimes of pool boiling. Film & Drop wise condensation, Laminar film condensation on vertical surface, Film condensation on horizontal tubes, Introduction to heat pipe.

UNIT – IV **[9 Hrs.]**

Radiation, nature of thermal radiation, black body radiation, radiation intensity, laws of radiation– Kirchhoff's, Planks, Weins displacement, Stefan Boltzmann & Lamberts Co-sine law. Emissivity, Absorbtivity, Transmissivity, Reflectivity, Radiosity, Emissive power, irradiation. Radiation network, radiation exchange between surfaces, idea of shape factor & reciprocity theorem, radiation between parallel plates, cylinder & spheres. Radiation shields, effect of radiation on temperature measurement.

UNIT – V **[9 Hrs.]**

Heat Exchanger :- Classification, Overall heat transfer coefficient, Fouling factor, LMTD method of heat exchange analysis for parallel, counter & cross flow arrangement. Effectiveness NTU method, heat exchanger analysis by NTU method, design aspects of heat exchangers. Introduction to compact heat exchanger.

BOOKS RECOMMENDED:

1. Introduction to heat Transfer – Incropera & Dewitt J. Wiley

2. Elements of Heat Transfer – M. N. Ozisik

3. Heat Transfer – S. P. Sukhatme

4. Heat and Mass Transfer – Domkundwar, Dhanpat Rai

5. Heat Transfer – Dr. D.S.Kumar

ME 505: PROGRAM ELECTIVE -1

ME 5051:- INDUSTRIAL ECONOMICS & ENTREPRENEURSHIP DEVELOPMENT (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 Hrs.]**

Industrial Economics : Basic concepts, demand analysis, types of demand, determinants of demand, methods of demand forecasting, supply, law of diminishing marginal utility, elasticity of demand.

UNIT – II **[9 Hrs.]**

Factors of production, production function, firm and industry, laws of return, cost concepts, fix variable, average, marginal and total cost, break even analysis, depreciation cost, taxation system, types of taxes.

UNIT – III **[9 Hrs.]**

Optimum size of unit, optimum firm, industrial combinations, causes for the growth of combinations, forms of combinations in India, Various competitive situations, perfect, monopoly, monopolistic, oligopoly. Price determination under these situations, Impact of globalization on Indian economy.

UNIT – IV **[9 Hrs.]**

Concept of entrepreneurship, definition, competencies of entrepreneurs, entrepreneurial functions, achievement, motivation, types of enterprises. Procedure to set up small scale industrial unit, advantages and limitation of SSI. Market survey and factors governing product selection. Project report preparation, technical, financial & marketing analysis of project.

UNIT – V **[9 Hrs.]**

Factors governing the selection of site, plant and machinery. Role of consultancy organizations, role of District Industries Center, State Industrial Development Corporations, Banks and Financial Institutions, latest SSI intensive schemes (To be confirmed from DIC time to time). Determination of working capital requirement.

BOOKS RECOMMENDED:

1.	Managerial Economics	–	V. N. Gupta.
2.	Managerial Economics	–	G. S. Gupta.
3.	Indian Industrial Economy	–	K. V. Sivaya, V. B. M. Das.
4.	Entrepreneurship Development	–	Khanka.
5.	Dynamics of Entrepreneurial Development	–	Vasant Desai

ME 505: PROGRAM ELECTIVE – I

ME 5052: PRODUCT DESIGN AND DEVELOPMENT (Theory)

CREDITS: 03

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

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

UNIT – I [9 Hrs.]

Introduction Product Design. Trigger for Product/Process/System, Problem solving approach for Product Design, Disassembling existing product(s) and understanding relationship of components with each other, Sketching of components, identifying materials and their processing for final product, fitting of components, understanding manufacturing as scale of the components, Reverse engineering concept, case studies of products in markets, (or in each discipline), underlying principles, Case studies of product failures, Revival of failed products, Public/Society's perception of products, and its input into product design.

UNIT – II [9 Hrs.]

Ideation, Generation of ideas, Funneling of ideas, Short-listing of ideas for product(s) as an individual or group of individuals, Sketching of products, Market research for need, competitions, Scale and cost, Initial specifications of products
Modern product development process. Innovative thinking. Morphology of design.

UNIT – III [9 Hrs.]

Conceptualisation.
Designing of components, Drawing of parts and synthesis of a product from its component parts, Rendering the designs for 3-D visualization, Parametric modelling of product, 3-D visualization of mechanical Products, Detail engineering drawings of components.
Industrial design: process, need. Robust Design: Taguchi Designs & DOE. Design Optimization

UNIT – IV [9 Hrs.]

Design for Manufacturing & Assembly: Methods of designing for Manufacturing & Assembly. Designs for Maintainability. Designs for Environment. Product costing. Legal factors and social issues. Engg ethics and issues of society related to design of products. Managing assembling, product specifications – data sheet, Simple mechanical designs, Workshop safety and health issues, Create documents for the knowledge sharing.

UNIT – V [9 Hrs.]

Ergonomics /Aesthetics: Gross human autonomy. Anthropometry. Man- Machine interaction. Concepts of size and texture colour. Comfort criteria. Psychological & Physiological considerations. Creativity Techniques: Creative thinking, conceptualization, brain storming, primary design, drawing, simulation, detail design.

Reference Books:

1. Model Curriculum for "Product Design Engineer – Mechanical", NASSCOM (Ref. ID: SSC/Q4201, Version 1.0, NSQF Level: 7)
2. Eppinger, S., & Ulrich, K.(2015). Product design and development. McGraw - Hill Higher Education.
3. Green, W., & Jordan, P. W. (Eds.).(1999).Human factors in product design: current practice and future trends. CRC Press.
4. Sanders, M. S., & McCormick, E. J. (1993). Human factors in engineering and design. McGRAW – HILL book company.
5. Roozenburg, N. F., &Eekels, J. (1995). Product design: fundamentals and methods (Vol. 2). John Wiley & Sons Inc.

ME 505: PROGRAM ELECTIVE – I

ME 5053: INDUSTRIAL ROBOTICS (Theory)

CREDITS: 03

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

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

UNIT – I [9 Hrs.]

Automation and Robotics, Robot anatomy, configuration of robots, joint notation schemes, work volume, introduction to manipulator kinematics, position representation, forward and reverse transformations of a 2- DOF arm, a 3- DOF arm in two dimension , a 4 – DOF arm in three dimension, homogeneous transformations in robot kinematics, D-H notations, solving kinematics equations, introduction to robot arm dynamics.

UNIT – II [9 Hrs.]

Basic control system models, slew motion, joint –interpolated motion and straight line motion, controllers like on/off, proportional, integral, proportional plus integral, proportional plus derivative, proportional plus integral plus derivative.

UNIT – III [9 Hrs.]

Robot actuation and feedback components position and velocity sensors, actuators and power transmission devices, mechanical grippers , vacuum cups, magnetic grippers, pneumatic, electric , hydraulic and mechanical methods of power and control signals to end effectors.

UNIT – IV [9 Hrs.]

General considerations in robot material handling, material transfer applications, pick and place operations, palletizing and related operations, machine loading and unloading, die casting, plastic molding, forging, machining operations, stamping press operations using robots. Application of robot in spot welding continuous are welding, spray coatings, Robots in Assembly Operations.

UNIT – V [9 Hrs.]

Robot cell layouts, multiple robots and machine interface, other considerations in work cell design, work cell control, interlocks, error detection and recovery, work cell controller, robot cycle time analysis.

TEXT BOOK:

1. Industrial Robotics, -- M. P. Groover, M. Weiss , R.N. Nagel, N.G. Odrey, McGraw Hill International, Koren Robotics, 1986

2. Robotic Technology & -- S.R.Deb, McGraw Hill International, 994 Flexible Automation,

REFERENCE S BOOKS:

1. Robptic Engineering - An Integrated Approach , Richard D. Klafter, Thomas A.Chmielewski, M. Negin, PHI Publication

2. Robotics, K .S.Fu , R. C. Gonzales , C.S.G.Lee, Tata Mc Graw Hills, International Edition, 1987

3. Introduction to Robotics – Analysis, System, Application, Saeed B. Niku, Pearson Education.

ME506: HEAT TRANSFER (Laboratory)

CREDITS: 02

Teaching Scheme
Practical: 3 Hours/Week

Examination Scheme
University Assessment: 25 Marks

College Assessment: 25 Marks

LIST OF PRACTICALS

Minimum Eight experiments out of following should be performed

1. Study of different methods of temperature measurements with special emphasis on thermocouples.
2. Study of different thermal properties of matter with special Emphasis on thermal conductivity of various materials.
3. Determination of thermal conductivity of metal bar
4. Determination of thermal conductivity of insulating material in the powder form.
5. Determination of thermal conductivity of liquids.
6. Determination of thermal conductivity by guarded plate heater method.
7. Determination of temperature distribution and heat transfer plate from a fin under (A) Free convection & (B) Forced convection condition.
8. Determination of forced convection heat transfer coefficient for fluid flow through a closed conduit.
9. Determination of forced convection heat transfer coefficient for air fluid flow over a vertical surface.
10. Determination of critical heat flux in saturated pool boiling.
11. Determination of condensation heat transfer in film wise & drop wise modes.
12. Study of various types of heat exchangers.
13. Determination of emissivity of non black surfaces.
14. Determination of Stefan-Boltzmann constant.
15. Study of heat pipes.

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.

ME507: MECHANICAL MEASUREMENT AND METROLOGY (Laboratory)

CREDITS: 02

Teaching Scheme
Practical: 3 Hours/Week

Examination Scheme
University Assessment: 25 Marks
College Assessment: 25 Marks

LIST OF PRACTICALS:

Minimum Eight experiments out of following should be performed.

1 Study of first order and second order instruments.
2 Study of displacement measurement using LVDT
3 Study of Load measurement using load Cell
4 Study of torque measurement using torque Cell
5 Study of Strain measurement using strain gauges and digital strain indicator.
6 Study of speed measurement using
   a) Photo electric pick up b) Magnetic pick up c) Stroboscope
7 Calibration of pressure gauge by
   a) Dead weight pressure tester b) Pressure cell
8 Study temperature measurement using thermocouple, thermisters and RTD
9 Study of comparators (mechanical type, electric type, electronic type)
10 Study of surface roughness indicators
11 Study of straightness and flatness by Autocollimeter, Profile projector and monochromatic light interference method.
12 Study linear measuring instruments (precision and non precision types)
13 Study of limits, fits and tolerances
14 Study of machine selection and process planning

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.

ME508: COMPUTER APPLICATIONS (Laboratory)

CREDITS: 03

Teaching Scheme	**Examination Scheme**
Practical: 3 Hours/Week	University Assessment: 50 Marks
	College Assessment: 50 Marks

Course Objectives and Outcomes:

Use of Computers for solving complex numerical problems requires the knowledge of programming learnt in the previous course. Engineering problems are quite complex and it may not be possible to find their analytical solutions. Hence it is required to resort to computer oriented numerical methods for solving them. The objective is to use programming knowledge for development of application programs for solution of various numerical methods & also in area of Mechanical engineering. This course is expected to provide some practical hands-on experience of programming for numerical methods, problems in Mechanical engineering & also exposure to Mathematical Software/s.

Review of Computer Programming: Variables, Data types, Declarations, Operators, Expressions, Input Output Operations, Formatted I/O, Hierarchy of

Operations, Decision Making the While, The For, The Do While Loops, Nesting of loops, Switch, Functions, Arrays.

Review of Numerical Methods for solution of Linear Equations, Interpolation, differentiation, Integration and differential equations.

Exposure to software's like MATLAB / MATHCAD / SCI LAB / MATHEMATICA or any other relevant commercial softwares/ freewares

LIST OF PRACTICAL

Minimum Eight to Ten practical from the following groups A, B & C covering each group.

A) Development of Programmes in C / C++ for following.

1. Factorial of a number using functions
2. Sorting of Vectors
3. Addition of Matrices
4. Transpose of Matrix
5. Multiplication of Matrices
6. Gauss Elimination method
7. Iterative Methods -Gauss Jacobi Iterative Method\
8. The Gauss-Seidel Iteration Method
9. Euler Method

10. Predictor Corrector Method
11. Runge Kutta Method
12. Taylor's Series
13. Regula Falsi Method
14. Newton Raphson's Method
15. Least Square Fit Method

B) Development of programmes in C / C++ to solve the problems in Mechanics, Fluid Mechanics, Kinematics of Machines, Engineering Thermodynamics, Hydraulic Machines, Mechanics of Materials, Design of Machine Elements, Heat Transfer or in other areas of Mechanical Engineering.

C) Application of Mathematical Software/s for solution of problems for the above mentioned groups.

A Journal/Report on practicals conducted shall be submitted by each student. University Practical examination shall be on viva-voce of 20 marks and practical performance of 30 marks.

BOOKS RECOMMENDED:

1. E. Balaguruswami - Programming in ANSI - Tata Mcgraw Hill Publishing Co. Ltd
2. Kerningham and Ritchie – The C Programming Language – Prentice -Hall
3. Y.P. Kanetkar - Let Us C - Jones & Bartlett Learning;
4. B. S. Grewal – Higher Engineering Mathematics : Khanna Publishers
5. User's/Command/Tutorial Guide of Relevant Mathematical Software

ME509: MINI PROJECT

CREDITS: 01

Teaching Scheme
Lectures: 2 Hours/Week

Examination Scheme
College Assessment: 50 Marks

A group of students (not more than 10 students in a group) should fabricate a working model of any mechanical or electro-mechanical system. Computer / mathematical model or simulation is not acceptable. A brief report and a photograph of the model shall be submitted by the students.

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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

ME 603: 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

ME604: THEORY OF MACHINES – II (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

ME605: Program Elective – I

ME6051 :- 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
College Assessment: 20 Marks

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

ME605 : Program Elective – II

ME6052 :- HYDRAULICS AND PNEUMATICS (Theory)

CREDITS: 03

Teaching Scheme	Examination Scheme
Lectures: 3 Hours/Week	Duration of Paper: 03 Hours
Tutorial: 1 Hour/Week	University Assessment: 80 Marks
	College Assessment: 20 Marks

UNIT - I [9 Hrs.]

FLUID POWER SYSTEMS AND FUNDAMENTALS :

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydra ulic fluids - General types of fluids -Fluid power symbols. Basics of Hydraulics-Applications of Pascals Law- Laminar and Turbulent flow - Reynold's number - Darcy's equation - Losses in pipe, valves and fittings.

UNIT II [9 Hrs.]

HYDRAULIC SYSTEM & COMPONENTS:

Sources of Hydraulic Power: Pumping theory - Pump classification - Gear pump, Vane Pump, piston pump, construction and working of pumps - pump performance – variable displacement pumps. Fluid Power Actuators: Linear hydraulic actuators - Types of hydraulic cylinders - Single acting, Double acting special cylinders like tandem, Rodless, Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary actuators - Fluid motors, Gear, Vane and Piston motors.

UNIT III [9 Hrs.]

DESIGN OF HYDRAULIC CIRCUITS:

Construction of Control Components : Directional control valve - 3/2 way valve - 4/2 way valve - Shuttle valve - check valve - pressure control valve - pressure reducing valve, sequence valve, Flow control valve - Fixed and adjustable, electrical control solenoid valves, Relays, ladder diagram. Accumulators and Intensifies: Types of accumulators - Accumulators circuits, sizing of accumulators, intensifier - Applications of Intensifier - Intensifier circuit.

UNIT IV [9 Hrs.]

PNEUMATIC SYSTEMS AND COMPONENTS:

Pneumatic Components: Properties of air - Compressors - Filter, Regulator, Lubricator
Unit - Air control valves, Quick exhaust valves, pneumatic actuators. Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Pneumo hydraulic circuit, Sequential circuit design for simple applications using cascade method.

UNIT V [9 Hrs.]

DESIGN OF. PNEUMATIC CIRCUITS:

Servo systems - Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics - Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic

Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting.

TEXT BOOKS:

1. Hydrantion and Pnumation by Dr. H.D.Ranchandra, Sudha Publication, Bangalore
2. Anthony Esposito, "Fluid Power with Applications", Pearson Education, 2005.
3. Majumdar S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw-Hill, 2001.
4. Hydraulics & Pneumatics by Andrew Parr, Jaico Publishing House
5. Pneumatic Systems by S.R. Mujumdar, TMH
6. Srinivasan.R, "Hydraulic and Pneumatic controls", Vijay Nicole, 2006.

REFERENCE BOOKS:

1. Shanmugasundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2006.
2. Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice Hall, 1989.
3. Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 1987.

ME605 : Program Elective – II

ME6053 :- MATERIAL HANDLING SYSTEM (Theory)

CREDITS: 03

Teaching Scheme	Examination Scheme
Lectures: 3 Hours/Week	Duration of Paper: 03 Hours
Tutorial: 1 Hour/Week	University Assessment: 80 Marks
	College Assessment: 20 Marks

UNIT – I [9 Hrs.]

Types of interplant transporting facility, principal groups of material handling equipments, choice of material handling equipment, hoisting equipment, screw type, hydraulic and pneumatic conveyors, general characteristics of hoisting machines, surface and overhead equipments, general characteristics of surface and overhead equipments and their applications. Introduction to control of hoisting equipments. Flexible hoisting appliances like ropes and chains, welded load chains, roller chains, selection of chains, hemp rope and steel wire rope, selection of ropes, fastening of chains and ropes , different types of load suspension appliances , fixed and movable pulleys, different types of pulley systems, multiple pulley systems . Chain and rope sheaves and sprockets.

UNIT – II [9 Hrs.]

Load handling attachments, standard forged hook, hook weights, hook bearings, cross piece and casing of hook, crane grab for unit and piece loads, carrier beams and clamps, load platforms and side dump buckets, electric lifting magnets, grabbing attachments for loose materials, crane attachments for handling liquid materials.

UNIT – III [9 Hrs.]

Arresting gear, ratchet type arresting gear, roller ratchet, shoe brakes and its different types like electromagnetic, double shoe type, thruster operated, controller brakes, shoe brakes, thermal calculations of shoe brakes and life of linings, safety handles, load operated constant force and variable force brakes general theory of band brakes, its types and construction.

UNIT – IV [9 Hrs.]

Different drives of hosting gears like individual and common motor drive for several mechanisms, traveling gear, traveling mechanisms for moving trolleys and cranes on runway rails, mechanisms for trackless, rubber-tyred and crawler cranes motor propelled trolley hoists and trolleys, rails and traveling wheels , slewing, jib and luffing gears. Operation of hoisting gear during transient motion, selecting the motor rating and determining braking torque for hoisting mechanisms, drive efficiency calculations, selecting the motor rating and determining braking torque for traveling mechanisms,slewing mechanisms, jib and luffing mechanisms. (Elementary treatment is expected).

UNIT – V [9 Hrs.]

Cranes with rotary pillar, cranes with a fixed post, jib cranes with trolley, cranes with luffing boom cantilever cranes, cage elevators safety devices of elevators belt and chain conveyors and their power calculations, vibrating and oscillating conveyors pneumatic and hydraulic conveyors, screw

conveyors hoppers, gates and feeders. Introduction to AGV s as new material handling device, use of robot form material handling.

BOOKS RECOMMENDED:

1. Materials Handling Equipment – N. Rudenko , Envee Publishers , New Delhi
2. Materials Handling Equipment – M.P. Alexandrov. Mir publications, Moscow
3. Introduction to Material Handling – Siddharth Ray, New Age International

ME606: THEORY OF MACHINE - II (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.

ME607: GEOMETRIC MODELLING (Laboratory)

CREDITS: 03

Teaching Scheme
Practical**:** 2 Hours/Week
Tutorial: 1 Hour/Week

Examination Scheme
University Assessment: 50 Marks
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 PRACTICALS:

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

ME608: INDUSTRIAL ELECTRONICS LAB (Laboratory)

CREDITS: 02

Teaching Scheme	**Examination Scheme**
Practical**:** 2 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.

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).