Jabalpur Engineering College, Jabalpur

(Declared Autonomous by MP Govt., Affiliated to RGPV, Bhopal)

(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) III Semester (Mechatronics Engineering)

w.e.f. July 2023

S.No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
				Theory			Practical						
				End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work		L	T	P	
1	MA34	BSC	Mathematics-III	70	20	10	-	-	100	3	1	-	4
2	CH32	HSMC	Energy & Environmental Engineering	70	20	10	-	-	100	3	1	-	4
3	MT33	PCC	Digital Electronics	70	20	10	30	20	150	3	-	2	4
4	MT34	PCC	Strength of Materials	70	20	10	30	20	150	3	-	2	4
5	MT35	PCC	Electronic Instrumentation & Drives	70	20	10	30	20	150	3	-	2	4
6	MT36	ESC	Production Lab	-	-	-	30	20	50	-	-	4	2
			Total	**350**	**100**	**50**	**120**	**80**	**700**	**15**	2	**10**	**22**
7	MT37	DLC	Self-Learning Presentation (SWAYAM/NPTEL/MOOC)	-	-	-	-	-	-	-	-	-	8
8	MT38	MC	NSS/NCC/Swatchhata Abhiyan/Rural Outreach	Qualifier									
Additional Course for Honours or Minor Specialization				Permitted to opt for maximum two additional MOOC courses in subject code MT37 for the award of Honours (Minor Specialization).									

Note: MOOC/NPTEL subjects shall be taken with permission of HOD/Coordinator

1 hour lecture (L) = 1 credit	1 hour Tutorial (T) = 1 credit	2 hour Practical (P) = 1 credit

BSC: Basic Science Course, HSMC: Humanities & Social Sciences including Management Course, PCC: Professional Core Course, ESC: Engineering Science Course, MC: Mandatory Course, DLC: Distance Learning Course

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(AICTE Model Curriculum Based Scheme and Syllabus)

Bachelor of Technology (B.Tech.) III Semester, Branch (Mechatronics)

COURSE CONTENT **w.e.f. July 2023**

Subject Code	Subject Name	Maximum marks Allotted			Total marks	Hours/Week			Total Credit
MA34	MATHEMATICS-III	Theory			100	L	T	P	4
		End Sem	Mid-SemExam	Quiz/ Assignment		3	1	0	
		70	20	10					

Module 1: Numerical Methods-I (08 hours)

Finite differences, Relation betweendifference operators, interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae. Numerical differentiation, Numerical integration: Trapezoidal rule, Simpson's 1/3rd and 3/8 rules, Weddle's rule.

Module 2: Numerical Methods-II (08 hours)

Solution of polynomial and transcendental equations: Bisection method, Newton-Raphson method and Regula-Falsi method. Solution of simultaneous Linear Algebraic equations: Gauss's Elimination, Gauss's Jordan, Crout's methods, Jacobi's Method, Gauss-Seidal and Relaxation method.

Module 3: Transform Calculus-I (06 hours)

Fourier integrals, Fourier sine and cosine integrals, Fourier transform, Fourier sine and cosine transforms and their elementary properties, Convolution theorem, Application of Fourier transformations to solve the boundary value problems.

Module 4: Transform Calculus-II (10 hours)

Hankel Transforms, Mellin transforms and Wavelet transformswith their elementary properties, Application of Hankel and Mellin transformations to solve the boundary value problems, Z- transform and inverse Z-transform of elementary functions, Shifting theorems, convolution theorem, Initial and final value theorem, Application of Z- transform and inverse Z-transform to Radius/Circle of convergence.

Module 5: Probability Distributions and Statistics (08 hours)

Random variables, Probability Mass function, Probability Density function, Discrete Distributions (Binomial, Poisson Distribution);Continuous Distributions (Normal, Exponential Distribution),Introduction to curve fitting by the method of least squares and testing of hypothesis.

Books References:

1. S. Ross, A First Course in Probability, 6th Edition, Pearson Education India 2002.
2. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Edition, Wiley 1968. Statistics
3. B.S Grewal, Numerical methods in Engineering and Science, Khanna Publishers.
4. B.V. Ramana,Higher Engineering Mathematics TMH Publications.
5. PrasannaSahoo, Probability and Mathematical Statistics, Louisville KY 40292 USA.
6. E. Kreyszig, Advanced Engineering Mathematics, 10th edition, Willey 2015.

Course Outcomes:

At the end of the course the students will:

1. Use the finite difference operators and numerical methods for solving problems related to Numerical differentiation, Numerical integration and other engineering applications.
2. Apply mathematical tools for numerical solution of algebraic, Transcendental and simultaneous equations.
3. Employ the techniques of transform calculus to solve application based problems.
4. Make use of probability distribution and concept of statistics to solve engineering related problems.

H.O.D.
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Jabalpur Engineering College
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(AICTE Model Curriculum Based Scheme)
Bachelor of Technology (B.Tech.) III Semester
Branch- Common to (CE/EE/EC/CSE/IT/IP/AI&DS /MT)
COURSE CONTENTS

w.e.f. July 2023

Subject Code	Subject Name	Maximum Marks Allotted			Total Marks	Hours/Week			Total Credits
		Theory							
CH32	Energy & Environmental Engineering	End Sem	Mid-sem Exam	Quiz/ Assignment		L	T	P	4
		70	20	10	100	3	1	-	

Module 1:

A. **Introduction to Energy Science:**
World & Indian Energy Scenario, Overview to Energy Systems, Energy sustainability and Environment. Fossil Fuels. Alternatives for fossil fuels: biomass, wind, solar, nuclear, wave, tidal, hydrogen & geothermal energy.

B. **Batteries:**
Classification of Batteries, Important Applications, Lead-Acid battery, Ni-Cd battery & Li battery. Fuel Cell: Hydrogen-Oxygen Fuel cell.

Module2: Environmental Pollution A:

I. **Air Pollution**
Causes, Effects & Control Measures of Air Pollution: Primary and Secondary air pollutants and photo-chemical smog. Climate changes, Global warming, Ozone layer depletion. Pollution case studies: Bhopal gas Disaster and London smog Disaster.

II. **Water Pollution**
Definition, Causes, Effects and Control Measures (Primary & Secondary waste water treatment), Acid Rain and Marine pollution. Pollution case studies: Minamata Tragedy, Ganga Action Plan, Major oil spills of the 20^{th} & 21^{st} century. Water conservation, Rain water harvesting and Water Shed Management.

III. **Noise Pollution**
Causes, Effects & Control Measures.

Module3: Environmental Pollution B:

I. Sources, Adverse effects and Control measures of Soil Pollution, Thermal Pollution, Nuclear Pollution & Nuclear hazards. Major case studies.

II. Solid waste management: Municipal Solid Waste (MSW), Collection and disposal methods. Disaster Management.

III. Introduction to carbon footprint, ways to reduce carbon footprint, Carbon trading.

Module 4: Ecosystem & Biodiversity:

Concept of an ecosystem; Structure and function of an ecosystem; Producers, consumers and decomposers; Energy flow in the ecosystem; Ecological succession; Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of the following ecosystem (a.)Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Introduction ,Definition: genetic, species and ecosystem diversity; Bio-geographical classification of India; Value of biodiversity: Biodiversity at global & National levels; India as a mega-diversity nation; Hot-spots of biodiversity; Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; Endangered and Endemic species of India; Conservation of Biodiversity: In-situ and Ex-situ conservation of biodiversity. Environment Protection Act.

Module 5: Corrosion & its prevention:

Theories of Corrosion and Mechanism – Dry (Direct Chemical attack), Wet (Electro Chemical Theory) Atmospheric corrosion, Galvanic Series, Galvanic and Concentration Cell Corrosion, Corrosion by sea water. Factors Influencing and Control of Corrosion – Proper Design, Use of pure metal and metal alloys, passivity, cathodic protection – Sacrificial anode and Impressed Current. Modifying the environment, Use of inhibitors.

Protective coatings:

Hot dipping, Electroplating, Metal spraying metal cladding & cementation.

TEXT BOOKS

1. A text book of Engineering Chemistry by Jain & Jain, Dhanpat Rai Publishing Company, New Delhi
2. Chemistry of Engineering Materials by C.P. Murthy, C.V. Agarwal and A. Naidu BS Publication Hyd.
3. A text book of Environmental Chemistry and Pollution control by S.S. Dara & Dr. D. D. Mishra, S. Chand & Co, New Delhi
4. Energy,Environment Ecology and Society by Dr.Pushpendra,Vayu Education of India New Delhi
5. Energy, Environment Ethics and Society, by Dr.S.Deswal & Dr.A.Deswal Dhanpat Rai Publishing Company, New Delhi

REFERENCE BOOKS

1. J.C. Kuriakose and J. Rajaram, "Chemistry in Engineering and Technology", Vol.1 & 2, Tata Mcgraw Hill Publishing Company (P) Ltd., New Delhi
2. Mars G. Fontana, "Corrosion Engineering", Tata Mcgraw Hill Publishing Company (P) Ltd., New Delhi.
3. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
4. J.P.Gupta, A Text book of Energy, Environment Ethics & Society" Dhanpat Rai Publishing Company.

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COURSE OUTCOME: At the end of the course the student will be able to

CO1	Apply the concept of sustainability of renewable energy to overcome the shortcoming of energy from non-renewable sources. Understanding of Energy devices.
CO2	Develop an understanding related to Water, Air and Noise pollution.
CO3	Understand the importance of Soil, Thermal and Nuclear pollution. Illustrate municipal practices in solid waste management. Define carbon footprints.
CO4	Understand the interrelationship of different species in variety of ecosystems. Conservation of Biodiversity & awareness of Environmental protection Act.
CO5	Recognize the origin as well as types of corrosion and apply appropriate protection mechanism to control corrosion.

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
		Theory			Practical			L	T	P	
		End Sem	Mid Sem. Exam	Quiz/ Assignment	End Sem	Lab Work					
MT- 33	Digital Electronics	70	20	10	30	20	150	3	-	2	4

MODULE-I

Number Systems: Decimal, Binary, Octal and Hexadecimal systems, arithmetic operations of binary numbers, conversion from one base to another, Codes-BCD, Excess- 3, Gray codes, error correcting and error detecting codes- Hamming codes, ASCII, EBCDIC. Logic gates and binary operations- AND, OR, NOT, NAND, NOR, Exclusive–OR and Exclusive– NOR.

MODULE-II

Implementations of Logic Functions using gates, NAND–NOR implementations – Multi level gate implementations- Multi output gate implementations. Boolean postulates and laws – De-Morgan's Theorem - Principle of Duality, Boolean function, Canonical and standard forms, Minimization of Boolean functions, Minterm, Maxterm, Sum of Products (SOP), Product of Sums (POS), Karnaugh map Minimization, Don't care conditions, Quine - McCluskey method of minimization.

MODULE-III

Design and analysis of combinational circuits: Design and analysis of code convertor, half-adders, half subtractor, full adders, full subtractor circuits, Series & parallel adders and BCD adders. look-ahead carry generator and adders. Decoders, Encoders, Binary Multiplier – Binary Divider, multiplexers & demultiplexers, parity checker, parity generators, code converters, Magnitude Comparator. Designing of combinational circuits with ROM and PLA.

MODULE-IV

Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation Unit-4 Registers and Counters: Asynchronous Ripple or serial counter. Asynchronous Up/Down counter - Synchronous counters – Synchronous Up/ Down counters – Programmable counters

MODULE-V

Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices

Text & Reference Books:

1. W. H. Gothman, "Digital Electronics" (PHI) "
2. R.J. Tocci, "Digital Systern Principles & Application.
3. Z. Kohair (TMH), "Switching & Automata Theory"
4. M. Mano (PHI) "Digital Logic & Computer Design"
5. M. Mano (PHI) "Digital Design".

List of Experiments:

1. To study the operation & working of various types of logic gets with the help of electronic kit.
2. To study of Binary Adder.
3. Study of Binary subtractor.
4. To study of Encoder & Decoder.
5. To study of multiplexer and demultiplexer.
6. Experiment on Astable multivibrator.
7. Experiment on Bistable multivibrator.
8. Experiment on Monostable multivibrator.
9. Study of Analog to Digital convertor.
10. Study of Digital to Analog convertor.

Course Outcomes: Upon successful completion of course students will be able to:

CO1	Understand Binary Number System, Logic Gates.
CO2	Understand De-morgan's Theorem and K-Map to simplify Boolean expression.
CO3	Design and analysis of Combinational Circuits.
CO4	Design and Analysis of Sequential Circuits.
CO5	Describe semiconductor memories with PLA.

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
		Theory			Practical			L	T	P	
		End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
MT- 34	Strength of Materials	70	20	10	30	20	150	3	-	2	4

Module-I Stress and Strain: Stresses in members of a structure, Axial loading, normal stress, shear stress, analysis of simple structures, stepped rods, bars of varying section, stress-strain diagram, Hooke's law, stress due to temperature, Poisson's ratio, Bulk modulus, shear strain, relation among elastic constants, residual stress, strain energy under axial loads and stresses due to impact of falling weights. Transformation of stress and strain principal stresses, normal and shear stress, Mohr's circle and its application to two dimensional analyses.

Module-II Shear Force and Bending Moment: Shear force and Bending Moment diagram for cantilever, beam supported at ends, beams with overhangs. Point of contra flexure.
Stresses in beams: Pure bending, Theory of simple bending, Neutral layer- neutral axis, Stress distribution in beams, Flexure formula, Section modulus, Bending of symmetric member, Bending of composite sections, Normal and shear stresses in beams.

Module –III Deflection Of Beams: Slope, Deflection and Radius of curvature, Cantilevers subjected to various types of load, Macaulay's method and Area moment method for deflection of Cantilever beam, Simply supported beam and Overhanging beam subjected to various types of loads, Relation between maximum. Bending and maximum deflection.

Module-IV Torsion of Shafts: Theory of pure torsion, Polar modulus, Torsional Rigidity, angle of twist, Torsional stresses in a shafts, Power transmitted by a shaft, Stepped shafts, Composite shafts, Torsional resilience, Shafts in series and shafts in parallel, Torsion of a tapering rod.

Module-V Columns And Struts: stability of structures, Crushing load, Crippling load, Euler's formula for columns with different end conditions, Rankine's formula, Limitation of Euler's formula. Thin Cylinders and Spheres: Circumferential and Longitudinal stresses, Wire bound pipes, thin spherical shells.

Text & Reference Books:

1. Beer FP, Jonhson Mechanics of Materials, Sixth Edition,Mc Graw Hills.
2. Debarata Nag & Abhijet chanda: strength of material: Wiely.
3. Rattan; strength of materials, second edition Mc Graw Hills.
4. Nash William; Schaum's outline series; fourth Edition Strength of Materials;Mcgraw Hills.
5. Singh Arbind K; Mechanics of solid; PHI
6. Sadhu Singh; strength of materials ; khanna pub.
7. R Subramannian, strength of materials OXFORD University press Third Edition.
8. S Ramamurthum, Strenght of materials, Dhanpat Rai.
9. Stephen Timoshenko; strength of materials part 1& 2 CBS pub.

List of experiments

1. Tensile Strength testing of a given mild steel on UTM.
2. Compressive Strength testing of a given specimen on UTM .
3. Hardness testing of given specimen using Rockwell and Vickers/ Brinell testing.
4. Shear test of a mild steel rod.
5. Bending test of a mild steel specimen.
6. Impact testing on Impact testing machine- Charpy and Izod.
7. Study of Spring Test machine
8. Study of non-destructive testing machine.
9. Study of Fatigue phenomenon and the fatigue failure of different part of fatigue testing machine.
10. Proof load determination for the leaf spring.

Course outcomes: At the completion of this course, students should be able to

CO1	Calculate stresses and strain in different structural members under uni-axial and combine loading.
CO2	Evaluate stresses in beam and shafts under various loading like torsion, pure bending etc.
CO3	Calculate deflection at any section for different types of beams.
CO4	Analyze stresses in the pressure vessel and critical load in the column
CO5	Comparative analysis of different loads.

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
		Theory			Practical			L	T	P	
		End Sem	Mid Sem. Exam	Quiz/ Assignment	End Sem	Lab Work					
MT- 35	Electronic Instrumentation & Drives	70	20	10	30	20	150	3	-	2	4

Module-1 Introduction, Characteristics of Instruments and measurement systems (Static & Dynamic) Error analysis: Sources, types and statistical analysis. Instrument Calibration: Comparison Method. DC and AC Ammeter, Digital voltmeters and multi-meters, Power meter, Bolometer and Calorimeter.

Module 2: DC and AC Bridges, Maxwell's bridge (Inductance and Inductance-Capacitance), Hay's bridge, Schering bridge (High voltage and Relative permittivity), Wein bridge, Anderson's bridge, Impedance measurement by Q meter, Introduction of CRO and its Applications, Signal and Function Generators, Sweep Frequency Generator, Pulse and Square Wave Generator, Beat Frequency Oscillator.

Module 3 : Transducers, Classifications, Strain gauge, Displacement Transducer Linear Variable Differential Transformer (LVDT) and Rotary Variable Differential Transformer (RVDT), Temperature Transducer- Resistance Temperature Detector (RTD), Thermistor, Thermocouple, Piezo-electric transducer, Optical Transducer- Photo emissive, Photo conductive, Photo voltaic, Photo-diode, Photo Transistor, Digital display system and indicators, Classification of Displays, Display devices: Light Emitting diodes (LED) and Liquid Crystal Display (LCD).

Module 4 Digital-to-Analog conversion (DAC) - Variable resistive type, R-2R ladder Type, Binary ladder, Weighted converter using Op-amp and transistor, Practical DAC. Analog-to-Digital Conversion (ADC), Ramp Technique, Dual Slope Integrating Type, Integrating Type (voltage to frequency), Successive Approximations.

Module 5 Electric Drives, types, factors influencing the choice of electrical drives - heating and cooling curves Loading conditions and classification of drive motors, Electrical Motors, principle of operation and performance characteristics of D.C. motors, single phase induction motor, three phase induction motor, synchronous motor, universal motor, servo motor, stepper motor and reluctance motor etc.

Text/Reference Books:

1. Albert D. Helfrick, William David Cooper, "Modern electronic instrumentation and measurement techniques", TMH 2008.
2. Oliver Cage, "Electronic Measurements and Instrumentation", TMH, 2009.
3. Alan S. Morris, "Measurement and Instrumentation Principles", Elsevier (Buterworth Heinmann), 2008.
4. David A. Bell, "Electronic Instrumentation and Measurements", 2nd Ed., PHI, New Delhi 2008.
5. H.S. Kalsi, "Electronics Instrumentation", TMH Ed. 2004
6. A.K.Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai.
7. MMS Anand, "Electronic Instruments & Instrumentation Technology", PHI., 2005.
8. Electric Drives- Kothari D.P. And Rakesh Singh Lodhi, Willey.
9. Electric Drives- Concepts and Applications: Vedam Subrahmanyam, TMH.

List of Experiments:

1. To study digital Multimeter.
2. Study of Cathode Ray Oscilloscope and Function Generator.
3. To study of RVDT, thermocouple, thermistor and RTD.
4. Study of displacement measurement by LVDT and Force measurement by strain gauge.
5. Measurement of Capacitor and Self-induction using Q-meter.
6. Design of digital to analog converter, R-2R ladder Type and analysis of its characteristics.
7. To measurement of the unknown Inductance by using Maxwell's bridge method.
8. To measurement of the unknown capacitance by using Schering bridge method.
9. To measurement of the unknown Frequency by using Wein's bridge method.
10. To measurement of the unknown Inductance by using Hay's bridge method.

COURSE OUTCOMES: At the end of the course the student will be able to:

CO1: Understand basics of electronics instruments and their applications.

CO2: Learn the measurement systems using DC-AC bridges.

CO3: Analyse the applications of transducers and indicators.

CO4: Apply analog and digital conversion techniques.

CO5: Understand various types of Electrical Drives and Electrical Machines.

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			Theory			Practical			L	T	P	
			End. Sem.	Mid Sem. Exam.	Quiz/ Assign	End Sem	Lab Work					
MT- 36	PCC	Production Lab	-	-	-	30	20	50	-	-	4	2

List of Experiments:

1. To design and making of pattern - for one casting drawing.
2. To Prepare Mould for Casting.
3. To prepare a butt joint with the specimens by Arc Welding.
4. To join the sheets by Spot Welding operation.
5. To join the specimens by TIG welding process.
6. To perform Plasma welding and Brazing.
7. To perform Lathe and drilling machining operation.
8. To design making of pattern - for one casting drawing.
9. To make a job on lathe machine with all operations like turning, step turning, thread cutting and knurling.
10. Study of center less grinding machine/ tool and Cutter type grinding machine.
11. Study of radial drilling machine and preparing a job on it.
12. To study a sapping machine to learn about working of quick return mechanism.

Text & Reference Books:

1. Rao PN; Manufacturing Technolod vol 11; TMH.
2. HazraChadhary, Workshop Tech-Il; Media promoter Pub.
3. Lindberg RA; Processes and Materials of Manuåcturing; PHI.
4. Raghuvanshi;BS; Work shop technology Vol-I, II; dhanpat Rai Delhi.
5. Alciatori DG, Histand MB; Introduction to Mechatronics and Measurernent System; TMH.
6. HMT; P ; Oduction Processes; TMR

Course Outcomes: At the completion of this course, students should be able to

CO1	Learn to build a job on welding operation.
C02	Experiments with lathe, drilling grinding machine operations.
C03	Illustrate the working and operations of milling machine.
CO4	Demonstration of shaper machines and operations.
CO5	Analyse Tool wear, its variables and estimation of tool life.

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