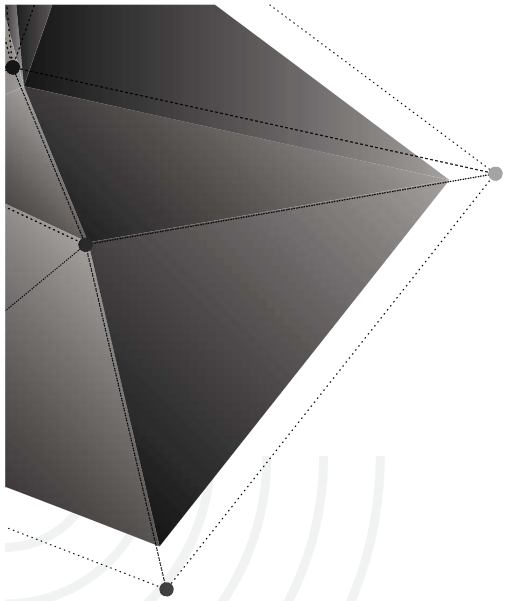
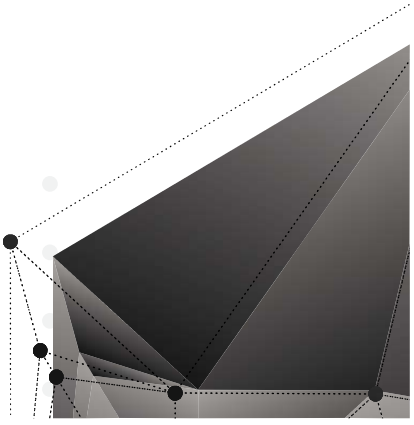


FOURTH SEMESTER

'MECHATRONICS'



STRENGTH OF MATERIALS

Course Code:	454001
Course Title	Strength of Materials
No. of Credits	5 (TH:4,T:0,P:2)

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

1. Demonstrate an understanding of different types of forces, stress, and strain, and their nature on engineering materials.
2. Analyze and evaluate the mechanical properties of common engineering materials.
3. Apply the concepts of stress and strain to interpret stress-strain diagrams and determine the significance of various points on the diagrams.
4. Understand the concept of factor of safety and its importance in engineering design.
5. Establish the relationship between elastic constants and their significance in material behavior.
6. Calculate stress and strain values in bodies of uniform and composite sections under the influence of normal forces, and analyze thermal stresses.

COURSE CONTENTS

Unit 1 - Simple Stresses and Strains

1.1 Types of forces; Stress, Strain and their nature;

1.2 Mechanical properties of common engineering materials;

1.3 Significance of various points on stress – strain diagram for M.S. and C.I. specimens;

1.4 Significance of factor of safety;

1.5 Relation between elastic constants;

1.6 Stress and strain values in bodies of uniform section and of composite section under the influence of normal forces;

1.7 Thermal stresses in bodies of uniform section and composite sections

1.8 Related numerical problems on the above topics

Unit 2 - Shear Force & Bending Moment Diagrams

2.1 Types of beam;

2.2 Types of Load;

2.3 SFD and BM Diagram for various types of beam;

2.4 Analytical method for SF & BM of Simply supported beam;

2.5 Over hanging beam with point loads;

2.6 Combination of point and UDL for the above; Related numerical problems

Unit : 3 - Theory of Simple Bending & Deflection of Beams

3.1 Explanation of terms: Neutral layer, Neutral Axis, Modulus of Section, Moment of Resistance, Bending stress, Radius of curvature (Definition only);

3.2 Problems involving calculations of bending stress, modulus of section and moment of resistance;

3.3 Calculation of safe loads and safe span and dimensions of cross- section;

3.4 Definition and explanation of deflection as applied to beams (Standard cases only);

3.5 Related numerical problems.

Unit 4 - Torsion in Shafts and Springs

4.1 Definition and function of shaft;

4.2 Calculation of polar M.I. for solid and hollow shafts;

4.3 Assumptions in simple torsion;

4.4 Problems on design of shaft based on strength & rigidity;

4.5 Numerical Problems related to comparison of strength and weight of solid and hollow shafts

4.6 Classification of springs;

4.7 Deflection formula for closed coil helical spring (without derivation);

4.8 Stiffness of spring;

4.9 Related numerical problems.

Unit 5 - Thin Cylindrical Shells

5.1 Explanation of longitudinal and hoop stresses in the light of circumferential and longitudinal failure of shell;

5.2 Related numerical Problems for safe thickness and safe working pressure.

PRACTICAL OUTCOMES: - At the end of the course, students will be able to:

1. Develop the ability to determine Rockwell's Hardness Number for various materials such as mild steel, high carbon steel, brass, copper, and aluminum, providing insights into their hardness properties.
2. Gain proficiency in conducting Izod impact tests to evaluate the resistance of materials to impact loads, enabling the assessment of their toughness.
3. Gain proficiency in conducting Charpy impact tests to evaluate the resistance of materials to impact loads, providing insights into their toughness properties.
4. Acquire the skills to perform torsion tests on mild steel, establishing the relationship between torque and angle of twist, and determining shear modulus and shear stress, contributing to the understanding of material behavior under torsional forces.
5. Develop the ability to determine Young's Modulus of Elasticity, yield points, percentage elongation, and percentage reduction in area by conducting tests on mild steel, enabling the characterization of its mechanical properties through stress-strain analysis.
6. Acquire the skills to determine the modulus of rigidity, strain energy, shear stress, and stiffness using the load deflection method, specifically in open and closed coil spring setups, contributing to the understanding of material behavior under bending and shear forces.

List of Practicals:

1. Determination of Rockwell's Hardness Number for various materials like mild steel, high carbon steel, brass, copper and aluminium.
2. Finding the resistance of materials to impact loads by Izod test.
3. Finding the resistance of materials to impact loads by Charpy test.
4. Torsion test on mild steel – relation between torque and angle of twist determination of shear modulus and shear stress.
5. Finding Young's Modulus of Elasticity, yield points, percentage elongation and percentage
6. reduction in area, stress strain diagram plotting, tests on mild steel.
7. Determination of modulus of rigidity, strain energy, shear stress and stiffness by load deflection method (Open & Closed coil spring)
8. Single or double Shear test on M.S. bar to finding the resistance of material to shear load.
9. To determine tensile test using UTM.
10. To determine bending, shear and compression test using UTM.

Text & Reference Books:

.1. Measurement system (Application and Design) – Ernest O Doebelin.

1. Strength of Materials – D.S. Bedi, Khanna Book Publishing Co. (P) Ltd., Delhi, 2017.
2. Strength of Materials – B.C.Punmia, Ashok Kumar Jain & Arun Kumar Jain, Laxmi Publications, New Delhi, 2013.
3. Strength of Materials – S. Ramamrutham, Dhanpat Rai & Publication New Delhi.
4. Strength of Materials – R.S. Khurmi, S.Chand Company Ltd. Delhi.
5. A Text Book strength of Material– R.K. Bansal, Laxmi Publication New Delhi.

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ELECTRONICS INSTRUMENTATION AND SENSORS

Course Code:	454002
Course Title	Electronics Instrumentation & Sensors
No. of Credits	5 (TH:4,T:0,P:2)

COURSE OUTCOMES: After undergoing the course, the students will be able to:

1. Demonstrate a comprehensive understanding of the principles and characteristics of analog instruments, including accuracy, precision, sensitivity, range, and drift.
2. Classify and differentiate between different types of instruments, such as indicating, recording, and integrating instruments, and understand their applications.
3. Operate and interpret measurements obtained from analog instruments, including permanent magnet moving coil instruments, moving iron instruments, analog multimeters, dynamometer watt meters, and single-phase induction type energy meters.
4. Utilize oscilloscopes effectively, including understanding their block diagram, vertical and horizontal deflection systems, measurement techniques, and probe structures.
5. Apply knowledge of various bridge circuits, including their construction, working principles, and applications for resistance, capacitanceand inductance measurements.
6. Utilize digital instruments, displays, and recorders, including digital multimeters, digital frequency counters, digital tachometers, different types of displays (such as seven-segment displays and alphanumeric displays), and recorders like strip-chart recorders and X-Y recorders.

COURSE CONTENTS

Unit : 1– Analog Instruments:

1.1 Characteristics of Instruments – True value, Accuracy, Precision, Sensitivity, Reproducibility, Range, Drift, Static Error & Correction, Resolution; (Definitions only)

1.2 Classification of Instruments– Primary and Secondary Instruments;

1.3 Operating forces–Deflecting, Controlling & Damping force;

1.4 Instruments - PMMC,PMMI type of instruments;

1.5 Analog multimeter, Dynamometer Wattmeter, Energy meter.

UNIT 2 – CRO & Bridges:

2.1 CRO - Block diagram of oscilloscope with brief function of each block, Measurement of frequency, time delay, phase angle;

2.2 Digital Storage Oscilloscope (Brief introduction);

2.3 Bridges – Construction, working & applications of wheat stone bridge, Schering Bridge, Maxwell's bridge;

Unit - 3 : Digital Instruments, Displays and Recorders:

3.1 Digital Instruments, Digital Vs Analog Instruments, Block diagram of Digital Multimeter, Digital frequency counter, Digital Tachometer;

3.2 Seven Segment Display, Liquid Vapour display (LVD);

3.3 Strip-chart recorder, X-Y recorder;

Unit - 4 : Transducers

4.1 Classification, Selection Criteria, Characteristics;

4.2 Working Principles and Application of following, Transducers: RTD, Thermocouple, Thermistor ;

4.3 Potentiometer, LVDT, Strain Gauge, Load Cell, Piezoelectric Transducers.

4.4 Transducers used for Force, Torque, Pressure measurement.

Unit - 5 : Advance and Smart Sensor Technology:

5.1 Fibre optic Sensors

5.2 Smart Sensors

5.3 Automotive Sensors (On-Board automobile sensors)

5.4 Recent trends in Sensor Technology

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

1. Perform measurements of unknown inductance using the Maxwell Bridge.
2. Measure resistance using the Wheatstone Bridge.
3. Understand the working principles and applications of various oscilloscopes, including the C.R.O., Digital Storage oscilloscope, and their Probes.
4. Measure displacement using a Linear Variable Differential Transformer (LVDT).
5. Explore the characteristics of temperature transducers such as RTD (Pt-100) and Thermistor.
6. Study the measurement of strain/force using a strain gauge/load cell.

List of Practicals:

1. Measure unknown inductance using following bridges Maxwell Bridge.
2. Measure resistance by wheat stone bridge.
3. Study the working and applications of
   (i) C.R.O.
   (ii) Digital Storage oscilloscope
4. Measurement of displacement with the help of LVDT.
5. Draw the characteristics of the following temperature transducers:
   (i) RTD (Pt-100)
   (ii) Thermistor.
6. Measurement of strain/force with the help of strain gauge load cell.
7. Study the characteristics of Capacitor Level Sensor for Level Measurement of a Liquid in a Tank.
8. Study the characteristics of a Piezo Resistive Sensor for Pressure Measurement of a Liquid in a Tank.
9. Study the characteristics of a Thermocouple.
10. Study the characteristics and operation of Magnetic Sensor.

References /Suggested Learning Resources:

1. Electrical & Electronic Measurement & Instruments A.K. Sawhney Dhanpat Rai & Sons, India.
2. Electronic Instrument and Measurement Technique W.D. Cooper Prentice Hall International, India.
3. Electronic Measurement & Instrumentation J.G. Joshi Khanna Publishing House, Delhi
4. Measurement systems application and design E.O. Doebelin and D. N. Manik the Mcgraw-Hill.
5. Electronic Measurements and Instrumentation Oliver and Cage the Mcgraw-Hill.
6. Basic Electrical Measurement M.B. Stout Prentice hall of India, India.
7. Electronic Instrumentation H. S. Kalsi the Mcgraw-Hill
8. Electrical and Electronics Measurement and Instrumentation by Prithwiraj Pukrait, Budhaditya Biswas, Santanu Das,Chiranjib Koley The Mcgraw-Hill

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MICRO CONTROLLER & APPLICATIONS

Course Code:	454003
Course Title	Micro Controller & Applications
No. of Credits	5 (TH:4,T:0,P:2)

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

1. Understand the fundamentals of microprocessors and microcontrollers, including the architecture of the 8085 and Intel MCS-51 family.
2. Develop proficiency in programming the 8051 microcontroller, including knowledge of the instruction set, addressing modes, conditional instructions, I/O programming, arithmetic logic instructions, single bit instructions and interrupt handling.
3. Gain practical skills in interfacing the 8051 microcontroller with external devices, such as keyboards, LCDs, LEDs, ADCs, DACs, and sensors.
4. Apply C programming techniques to program the 8051 microcontroller, covering I/O programming, timers/counters, serial communication, interrupts, and user interfaces like LCD, keypad, LED, and RS232 communication.
5. Understand the need for RISC processors and gain knowledge of ARM processor fundamentals.
6. Explore ARM core-based microcontrollers, specifically the LPC214X, and learn about its features, including I/O ports, ADC/DAC, and timers.

COURSE CONTENTS

Unit - 1 : Introduction

- Introduction to Microprocessors and Microcontrollers;
- Intel MCS- 51 family features;
- 8051 -organization and architecture.

Unit - 2 : Programming With 8051

- 8051 instructions set, Addressing modes;
- Conditional instructions, I/O Programming;
- Arithmetic logic instructions, Single bit instructions;
- Interrupt handling;
- Programming counters, timers and Stack.

Unit 3 - Interfaces

- MCS51 and external Interfaces;
- User interface – keyboard, LCD, LED;

Unit 4 - C Programming With 8051

- I/O Programming;
- Timers/counters;
- Serial Communication;
- User Interfaces- LCD, Keypad, LED and communication interfaces [RS232].

Unit - 5 : Arm Processor Core Based Microcontrollers

- Need for RISC Processor-ARM processor fundamentals
- ARM core based controller [LPC214X];

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

1. Demonstrate proficiency in programming microcontrollers (8051 and ARM) using both Assembly and C languages.
2. Develop and implement various algorithms and constructs, such as sorting of arrays and arithmetic logic instructions, in Assembly language.
3. Utilize ports, timers, and interrupts to perform input/output operations and generate delays in microcontroller programming (Assembly and C).
4. Interface and control external devices such as LCD displays, keypads, stepper motors, and PWM pins using both Assembly and C languages.
5. Implement standard UART communication protocols for data transmission and reception in microcontroller applications (Assembly and C).
6. Program and utilize GPIO pins and timers in ARM microcontrollers using the C programming language for controlling external devices and managing time-dependent operations.

List of Practicals:

1. Programming 8051 Micro controller using ASM and C, and implementation in flash 8051 microcontroller.
2. Programming with Arithmetic logic instructions [Assembly]
3. Program using constructs (Sorting of any 5 no. in an array) [Assembly]
4. Programming using Ports [Assembly and C]
5. Delay generation using Timer [Assembly and C]
6. Implementation of standard UART communication (using hyper terminal) [Assembly and C].
7. Interfacing LCD Display. [Assembly and C]
8. Interfacing with Keypad [Assembly and C]
9. Interfacing with stepper motor. [Assembly and C]
10. Motor speed control using PWM pin. [Assembly and C]
11. GPIO programming in ARM microcontroller. [C Programming].
12. Timer's programming in ARM Microcontroller. [C Programming].

References /Suggested Learning Resources:

1. The 8051 Micro Controller and Embedded Systems Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely PHI Pearson Education, 5th Indian reprint.
2. Microprocessor and Microcontrollers Krishna Kant Eastern Company Edition, Prentice Hall of India, New Delhi.
3. Microprocessor & Microcontroller Architecture: Programming & Interfacing using 8085, 8086, 8051 Soumitra Kumar Mandal McGraw Hill Edu.
4. Microcontrollers: Architecture implementation and Programming Tabak Daniel, Hintz Kenneth j Tata McGraw Hill, 2007.
5. ARM Developer's Guide.UM10139 LPC214X User manual – Rev.4 Andrew N.Sloss, Dominic Symes, Chris Wright User manual – Rev.4.
6. Microprocessors and interfacing: programming and hardware Douglas V. Hall Tata McGraw Hill, 2editon, 2000.
7. Microcontroller – Fundamentals and Applications with Pic Valder – Perez Yeesdee Publishers, Tayler &Francis.

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THEORY OF MACHINES & MECHANISMS

Course Code:	454004
Course Title	Theory of Machines & Mechanisms
No. of Credits	5 (TH:4,T:0,P:2)

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

1. Understand the concept of cams and followers, their applications, and different follower motions, including displacement diagrams such as uniform velocity, SHM, uniform acceleration, and retardation.
2. Compare different types of power transmission drives, including belt, chain, rope, and gear drives, and analyze their advantages and limitations.
3. Calculate important parameters and perform calculations for belt drives, including angle of lap, belt length, slip, creep, and determination of velocity ratio.
4. Explain the concept and function of flywheels in single-cylinder 4-stroke I.C. engines and analyze their effect on energy fluctuation and speed stability.
5. Identify different types of governors, including centrifugal, Watt, and Porter governors, and understand their working principles and applications.
6. Describe the function and construction of brakes, dynamometers, clutches, and bearings, and analyze their roles in power transmission and machine operation.
7. Perform calculations and solve numerical problems related to clutches, bearings, and balancing of rotating masses using graphical methods.
8. Identify the causes of vibrations in machines, understand their harmful effects, and explore potential remedies to minimize vibration levels.

COURSE CONTENTS

Unit - 1 : Cams And Followers

1.1 Concept Definition and application of CAM and Followers;

1.2 Different follower motions and their displacement diagrams like uniform velocity, SHM, uniform acceleration and Retardation.

Unit - 2 : Power Transmission

2.1 Types of Drives – Belt, Chain, Rope, Gear drives & their comparison;

2.2 Types of Belt Drives and Material for flat and V-belt;

2.3 Angle of lap, Belt length, Slip and Creep, Determination of Velocity Ratio, Ratio of tight side and slack side tension (Basic Definition and Formulae);

2.4 Derivation for open belt drive;

2.5 Condition for maximum power transmission (Simple numerical);

2.6 Chain Drives;

2.7 Gear Drives and Gear trains;

2.8 Rope Drives – Types, Applications and Advantages & limitations of Steel ropes.

Unit - 3 : Flywheel and Governors

3.1 Flywheel Concept, function and application of flywheel with the help of turning moment diagram for single cylinder 4-Stroke I.C. Engine (Simple Numerical Problems)

3.2 Coefficient of fluctuation of energy;

3.3 Coefficient of fluctuation of speed and its significance;

3.4 Governors Types;

3.5 Terminology of Governors;

3.6 Comparison between Flywheel and Governor.

Unit - 4 : Brakes, Dynamometers, Clutches & Bearings

4.1 Function of brakes and dynamometers;

4.2 Construction and working of Brakes;

4.3 Construction and working of Dynamometers;

4.4 Clutches (Basic Concept);

4.5 Function of Clutch and its application;

4.6 Simple numerical on single and Multiplate clutch (No Derivation);

4.7 Types of Bearings (No Derivation);

Unit - 5 : Balancing & Vibrations

5.1 Concept of balancing;

5.2 Balancing of single rotating mass;

5.3 Graphical method for balancing of several masses revolving in same plane;

5.4 Simple Numerical Problems; Causes of vibrations in machines;

5.5 Their harmful effects and remedies.

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

1. Understand the inversions of both the four-bar chain mechanism and the single slider crank chain mechanism, including their working principles and applications.
2. Perform dynamic force analysis of a single-cylinder four-stroke engine, gaining knowledge of the forces involved and their impact on engine performance.
3. Gain practical knowledge of different types of governors and their use in controlling engine speed and stability.
4. Analyze the working principles and characteristics of various cam and follower mechanisms, understanding their applications and limitations.
5. Explore various methods of power transmission and their advantages and disadvantages in different applications.
6. Acquire hands-on experience in the dynamic balancing procedure of rotating parts to minimize vibration and optimize system efficiency.

List of Practicals:

1. Study of inversions of four bar chain mechanism
2. Study of inversions of single slider crank chain mechanism
   (a) Crank slotted lever mechanism
   (b) Whitworth quick return motion mechanism
3. Dynamic force analysis of single cylinder four stroke engine.
4. Study of flywheel
5. Study of governor
6. Study of different cam and follower
7. Study of different gear trains
8. Study of power transmission methods
9. Study of different types of break and dynamometer
10. Study of types of vibration and their measurement methods
11. Study of dynamic balancing procedure of rotating parts

Reference Books:

1 Theory of machines – S.S. Rattan, Tata McGraw-Hill publications.

2 Theory of machines – R.K. Bansal, Laxmi publications.

3 Theory of machines – R.S. Khurmi & J.K. Gupta, S. Chand publications.

4 Dynamics of Machines – J.B.K. Das, Sapna Publications.

5 Theory of machines – Jagdishlal, Bombay Metro – Politan book Ltd.

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ADVANCED MANUFACTURING PROCESSES

Course Code:	454005
Course Title	Advanced Manufacturing Processes
No. of Credits	5 (TH:4,T:0,P:2)

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

1. Understand the concept of jigps and fixtures, their design considerations, and the principles of clamping.
2. Identify different types of fixtures and their applications in machining operations.
3. Acquire knowledge of jig boring on vertical milling machines, including machine types and construction details.
4. Gain an understanding of modern machining processes such as ultrasonic machining, electric discharge machining (EDM), wire cut EDM, abrasive jet machining, laser beam machining, and electrochemical machining.
5. Familiarize with CNC milling machines, including their constructional features, axis identification, electronic control systems, automatic tool changers, and tool magazines.
6. Develop skills in CNC programming, including preparatory functions (G code), miscellaneous functions (M code), part programming, and principles of computer-aided part programming.

COURSE CONTENTS

Unit - 1 : Jigs & Fixtures

1. Definition of jig;
2. General consideration in the design of drill jigs and bush;
3. Types of fixtures;
4. Basic principles of clamping, Types of clamp;

Unit 2 - Jig Boring

1. Introduction of Jig boring on vertical milling machine;
2. Types and construction details of jig boring machines;
3. Plastic Processing:
   - Processing of plastics;
   - Introduction of Moulding, Extruding; Casting, Calendering;
   - Fabrication methods;

Unit - 3 : Modern Machining Processes

1. Introduction and Comparison of MMP with traditional machining;
2. Principle, working and applications of Ultrasonic Machine
3. Principle, working and applications of Electric Discharge Machine
4. Principle, working and applications of Wire cut EDM
5. Principle, working and applications of abrasive Jet Machining

6. Principle, working and applications of laser Beam Machining
7. Principle, working and applications of Electro Chemical Machining

Unit - 4 : CNC Machines

1. CNC Lathe, vertical and horizontal machining center (Constructional features, Axis identification)
2. Introduction to numerically controlled system, Electronic control system, Automatic tool changer and tool magazine
3. CNC programming
4. Preparatory functions (G code)
5. Miscellaneous functions (M code)
6. Part programming including subroutines and canned cycles
7. Principles of computer aided part programming

Unit - 5 : Machine Tool Automation:

1. Introduction and Need
2. Single spindle automates, transfer lines
3. Elements of control system in machines for automation
4. Introduction to PLC

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

1. Understand the principles and operations of CNC machinery, including lathes and VMCs, as well as the components and controls of NC grinders.
2. Proficiently set up workpieces and tools for various machining operations on CNC lathes, VMCs, and NC grinders.
3. Perform precision turning, milling, grinding, and EDM operations, while applying appropriate toolpaths, speeds, and feeds for efficient material removal and desired surface finish.
4. Analyze material characteristics and select suitable cutting tools, electrodes, and grinding wheels for different processes.
5. Employ CAD/CAM software to generate, modify, and optimize toolpaths, G-code programs, and EDM strategies for complex shapes and multi-axis operations.
6. Evaluate the dimensional accuracy, surface finish, and overall quality of machined components, considering both traditional and modern machining techniques, and make informed decisions for process selection based on industrial applications.

List Of Practicals:

CNC Lathe:

- Introduction to CNC lathe machine controls and components.
- Setting up workpieces in the chuck and collet.
- Facing and turning operations using CNC lathe.

- External threading using single-point threading tool.
- Internal threading using threading tool and tool offsets.
- Taper turning using compound slide.
- Grooving and parting off operations.
- Drilling and boring operations using live tooling.
- Introduction to G-code programming for simple turning operations.
- Using CAD/CAM software to generate G-code for complex shapes.

VMC (Vertical Machining Center):

- Familiarization with VMC machine controls and tool holders.
- Setup of workpiece and clamping methods on the VMC table.
- Basic facing and contouring using milling cutters.
- Hole drilling and tapping operations.
- Profile milling using end mills and ball nose cutters.
- Pocket milling and slot milling operations.
- 3D surface machining using adaptive toolpaths.
- Tool length and diameter offset setting.
- Introduction to CAM software for toolpath generation.
- Using probing systems for workpiece alignment and tool measurement.

Numerically Controlled Grinders:

- Understanding the components and controls of Numerically controlled grinders.

- Surface grinding of flat workpieces.
- Cylindrical grinding for external and internal surfaces.
- Tool and cutter grinding for sharpening of tools.
- Setting up workpiece and grinding wheel dressing.
- Introduction to wheel balancing and truing.
- Generating complex profiles using Numerically controlled grinders.
- Fine-tuning grinding parameters for desired finishes.
- Introduction to adaptive feed control for optimizing grinding efficiency.
- Precision measurement of ground components.

EDM (Electrical Discharge Machining):

- Overview of EDM machine components and working principles.

Modern Machining Processes:

- Overview of working of Laser Cutting
- Overview of working of Waterjet Cutting
- Overview of working of Ultrasonic Machining
- Overview of working of Abrasive Flow Machining
- Overview of working of Electrochemical Machining (ECM)
- Overview of working of Electrochemical Deburring (ECD)
- Overview of working of Additive Manufacturing (3D Printing)

Reference Books:

1. "Nontraditional Manufacturing Processes" by Gary F. Benedict.
2. "Nontraditional Machining Processes" by E. J. Brandt and W. A. Mairs.
3. "Advanced Machining Processes of Metallic Materials: Theory, Modelling and Applications" by Wit Grzesik.

Text & Reference Books :

1. Elements of Workshop Technology (Volume I & II) – Hajra Chowdry & Bhattacharaya, Media Promoters, 11th Edition, 2007.
2. Introduction of Basic Manufacturing Processes and Workshop Technology – Rajendersingh, New age International (P) Ltd. New Delhi, 2006.
3. Production Technology –HMT, 18th edition, Tata McGraw Hill, New Delhi.
4. Manufacturing process – Myro N Begman, 5 th edition, Tata McGraw Hill, New Delhi.
5. CNC machines – Pabla B. S. & M. Adithan, New Age international limited.
6. Non Conventional Machining – P. K. Mistra, Narvasa Publishining House.
7. Manufacturing Processes – Begman & Amsted, John Willey and Sons.
8. Advanced manufacturing technology – David L. Goetsch.
9. Exploring Advanced Manufacturing Technologies – Stephen F. Krar & Arthur Gil, Industrial Press.

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FLUID MECHANICS & HYDRAULIC MACHINERY

Course Code:	454006
Course Title	Fluid Mechanics & Hydraulic Machinery
No. of Credits	4 (TH:4,T:0,P:0)

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

1. Understand the basic properties of fluids, including surface tension and capillarity, and their effects on fluid behavior.
2. Measure fluid pressure using various techniques such as manometers and Bourdon pressure gauge.
3. Apply fluid flow principles, including the continuity equation and Bernoulli's theorem, to analyze fluid flow.
4. Utilize devices such as Venturimeter, orifice meter, and Pitot tube to measure fluid flow rates and velocities.
5. Analyze the impact of jets on different surfaces and understand their engineering applications.
6. Comprehend the construction, working principles, efficiency calculations, and cavitation effects in hydraulic turbines and centrifugal pumps

COURSE CONTENTS

Unit - 1 : Introduction of Basic Properties of Fluid

1. Surface tension, Capillarity;
2. Fluid Pressure & Pressure Measurement:
   a. Fluid pressure, Pressure head, Pressure intensity;
   b. Concept of vacuum and gauge pressures, atmospheric pressure, absolute pressure;
   c. Simple and differential manometers;
   d. Bourdan pressure gauge;
   e. Concept of Total pressure on immersed bodies, center of pressure;

Unit - 2 : Fluid Flow:

1. Types of fluid flows;
2. Continuity equation;
3. Bernoulli's theorem;
4. Principle of operation of Venturimeter, Orifice meter, Pitot tube;
5. Minor and major losses in pipes, Hydraulic gradient and total gradient line;

Unit - 3 : Impact of Jets

1. Impact of jet on fixed and vertical flat plates;
2. Impact of jet on curved vanes;
3. Simple Numerical on work done and efficiency.

Unit - 4 : Hydraulic Turbines

1. Layout of hydroelectric power plant (Basic Concept);
2. Classification and selection of hydraulic turbines;

3. Construction and working principle of Pelton wheel;
4. Francis and Kaplan turbines (Derivation for work and efficiency);
5. Draft tubes – types and construction;
6. Concept of cavitation in turbines;
7. Simple problem related to Calculation of Work done, Power, efficiency of turbines;

Unit - 5 : Centrifugal Pumps

1. Principle working and applications of centrifugal pump
2. Numerical on calculations of overall efficiency and power required to drive pumps
3. Reciprocating Pumps: Working principle & applications;
4. Concept of Slip;
5. Cavitation and separation.

References:

1. Fluid Mechanics & Hydraulic Machines, S.S. Rattan, Khanna Publishing House, New Delhi
2. Hydraulic, fluid mechanics & fluid machines– Ramamrutham S, Dhanpath Rai and Sons, New Delhi.
3. Hydraulics and fluid mechanics including Hydraulic machines – Modi P.N. and Seth S.M., Standard Book House. New Delhi
4. One Thousand Solved Problems in Fluid Mechanics – K. Subramanya, Tata McGraw Hill.
5. Hydraulic, fluid mechanics & fluid machines – S. Ramamrutham, Dhanpat Rai and Sons, New Delhi
6. Fluid Mechanics and Hydraulic Machines – R. K. Bansal, Laxmi Publications, New Delhi

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‘Elective 1-1’
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Course Code:	454007
Course Title	Artificial Intelligence & Machine Learning
No. of Credits	4 (TH:4,T:0,P:0)

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

1. Understand the history and foundations of artificial intelligence, including its origins and key milestones in its development.
2. Gain knowledge and proficiency in problem-solving techniques in AI.
3. Develop an understanding of adversarial search in decision support systems and technologies.
4. Acquire knowledge of representation, reasoning, expert systems, and the basics of planning in AI.
5. Learn the basics tools and techniques used in machine learning.

COURSE CONTENTS

Unit - I : Introduction

History & foundations of AI, Problem solving: Uninformed and informed Search.

Unit - II : Adversarial Search

Two players games, games with uncertainty; Decision support systems and technologies; Knowledge representation, Reasoning.

Unit - III : Machine Learning Basics

Decision trees, Ensemble learning, Reinforcement learning, Evolutionary computation, Neural networks, Visualization.

Unit - IV :

Basic idea of Linear regression, concept of SSE; gradient descent; closed form; normal equations; features.

Unit - V :

Classification problems; Decision boundaries; Probability and classification, Bayes optimal decisions.

References:

1. Russell, Norvig, Artificial intelligence: A modern approach, 2nd edition. Pearson/Prentice Hall.
2. M.C. Trivedi, A classical approach to Artificial Intelligence, Khanna Publishing House, New Delhi (2018)
3. V.K. Jain, Machine Learning, Khanna Publishing House, New Delhi (2018)
4. Ethem Alpaydin, Introduction to Machine Learning, Second Edition,
5. http://mitpress.mit.edu/catalog/item/default.asp?ttype=2&tid=12012.

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‘Elective 1-2’
SOFT COMPUTING

Course Code:	454008
Course Title	Soft Computing
No. of Credits	4 (TH:4,T:0,P:0)

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

1. Classify and differentiate problem solving methods and tools.
2. Apply A*, AO*, Branch and Bound search techniques for problem solving.
3. Formulate an optimization problem to solve using evolutionary computing methods.
4. Design and implement GA, PSO and ACO algorithms for optimization problems in Mechanical Engineering.
5. Apply soft computing techniques for design, control and optimization of Manufacturing systems.

COURSE CONTENTS

Unit - I : Introduction

Soft Computing, Difference between Hard and Soft computing, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing.

Unit - II : Neural Networks

Introduction to Neural Network, Learning rules and various activation functions, Single layer Perceptrons, Back Propagation networks, Architecture of Backpropagation (BP) Networks, Neural Network.

Unit - III : Fuzzy Systems

Fuzzy Control Systems, Fuzzy Classification.

Unit - IV : Genetic Algorithm

History of Genetic Algorithms (GA), Working Principle, Various Encoding methods.

Unit - V : Hybrid Systems

Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems.

Text & Reference Books:

1. Tettamanzi Andrea, Tomassini and Marco, Soft Computing Integrating Evolutionary, Neural and Fuzzy Systems, Springer, 2001.
2. Elaine Rich, Artificial Intelligence, McGraw Hill, 2/e, 1990.
3. Kalyanmoy Deb, Multi-objective Optimization using Evolutionary Algorithms, John Wiley and Sons, 2001.

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'Audit Course'
ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

Course Code	AS401
Course Title	Essence of Indian Traditional Knowledge
No. of Credits	0 (TH:2,T:0,P:0)

COURSE OUTCOMES: After completion of this course, student will be able to:

1. Develop a comprehensive understanding of the essence of Indian knowledge and tradition.
2. Explore the rich philosophical systems of ancient India and their relevance today.
3. Gain familiarity with the Vedic literature and scriptures, and appreciate their wisdom.
4. Analyze Indian epics and mythology to understand their cultural and spiritual significance.
5. Learn and apply principles of yoga, meditation, and mindfulness for personal well-being.
6. Discover the principles and practices of Ayurveda and natural healing for holistic health.

COURSE CONTENTS

1. Introduction to Indian Knowledge and Tradition
2. Ancient Indian Philosophical Systems
3. Vedic Literature and Scriptures
4. Indian Epics and Mythology
5. Yoga, Meditation, and Mindfulness Practices
6. Ayurveda and Natural Healing Systems
7. Indian Classical Arts and Music
8. Indian Architecture and Sculpture
9. Indian Festivals and Rituals
10. Ethical and Moral Values in Indian Culture

References /Suggested Learning Resources:

1. "Indian Philosophy: A Very Short Introduction" by Sue Hamilton
2. "The Vedas: An Introduction to Hinduism's Sacred Texts" by Roshen Dalal
3. "The Ramayana: A Shortened Modern Prose Version of the Indian Epic" by R.K. Narayan
4. "The Upanishads" translated by Eknath Easwaran
5. "Autobiography of a Yogi" by Paramahansa Yogananda
6. "Ayurveda: The Science of Self-Healing" by Dr. Vasant Lad.

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MINOR PROJECT WORK

Course Code:	AS402
Course Title	Minor Project Work
No. of Credits	2 (TH:0,T:0,P:4)

OBJECTIVE:

The Minor Project work is an integral part of the Engineering Diploma program, designed to provide students with an opportunity to apply theoretical knowledge gained throughout their studies to real-world engineering challenges. This module aims to foster creativity, problem-solving abilities, and practical skills essential for successful engineering professionals.

PRACTICAL OUTCOMES: After undergoing the minor project work, the student will be able to:

1. Understand the practical applications of engineering concepts in real-world scenarios.
2. Develop hands-on experience in designing, implementing, and testing engineering projects.
3. Enhance problem-solving and critical thinking skills through project execution.
4. Improve documentation and presentation skills for effective project communication.

GENERAL GUIDELINES:

1. Introduction to Minor Projects

- Overview of the module's purpose and objectives
- Importance of practical application in engineering
- Understanding the project life cycle and its stages

2. **Project Ideation and Proposal Development**
- Identifying engineering problems and project ideas
- Formulating clear project objectives and scope
- Developing a comprehensive project proposal

3. **Project Planning and Management**
- Creating a project plan with defined milestones and timelines
- Resource allocation and budgeting for the project
- Risk assessment and mitigation strategies

4. **Engineering Design and Analysis**
- Principles of engineering design and problem-solving
- Conducting feasibility studies and simulations (if applicable)
- Engineering analysis techniques and tools

5. **Prototyping and Implementation**
- Hands-on development of project prototypes
- Conducting experiments and data collection
- Troubleshooting and problem-solving during implementation

6. **Project Documentation and Reporting**
- Techniques for effective project documentation
- Writing comprehensive project reports and design documentation
- Organizing and presenting project data

7. Project Presentation and Communication

- Principles of effective communication in engineering
- Preparing engaging & informative project presentations
- Addressing questions & feedback during the presentation

8. Project Evaluation and Assessment

- Criteria for evaluating project success and achievement of objectives
- Conducting fair and unbiased project assessments
- Peer evaluations and constructive feedback.

ACTIVITIES AND EXECUTION GUIDELINES

1. Project Proposal Submission:

Students will submit their project proposals to the assigned mentors. The proposals should be well-structured, indicating the project's significance, expected outcomes, resources required, and a preliminary plan of action.

2. Project Execution:

During this period, students will work on their projects under the guidance of their mentors. They are encouraged to employ innovative techniques and apply engineering principles to achieve project objectives successfully.

3. Project Documentation:

Students will submit their final project reports and related documentation. The documentation should encompass all project phases, methodologies, experimental data, analysis, and outcomes.

4. Project Presentation:

Each student will deliver a comprehensive presentation to a panel of evaluators, showcasing their project's key aspects, results, and conclusions.

ASSESSMENT CRITERION

1. Project Proposal and Objective (10%)

Students are required to submit a comprehensive project proposal outlining the problem statement, objectives, scope, and methodology of the project. This component will account for 10% of the total marks.

2. Project Implementation (60%)

The core of the assessment will be based on the successful implementation of the project. Students will be evaluated on their ability to execute the project plan, adhere to timelines, and demonstrate practical engineering skills. This segment will carry 60% of the total marks.

3. Documentation (15%)

Proper documentation is vital to effective project management and communication. Students will be evaluated on the clarity, completeness, and organization of their project reports, design diagrams, code (if applicable), and any other relevant material. This component will contribute 15% of the total marks.

4. Project Presentation (15%)

Communication and presentation skills are crucial for engineers to articulate their ideas effectively. Students will be assessed based on their ability to present their project's

objectives, methodology, results, and conclusions in a clear and concise manner. This segment will be worth 15% of the total marks.

The Minor Project module is a pivotal component of the Engineering Diploma program that provides students with hands-on experience, encourages critical thinking, and prepares them for real-world engineering challenges. By adhering to the module guidelines and distribution of marks, students can excel in their projects and demonstrate their engineering prowess effectively.

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