

SEMESTER – III

Sl No.	Course Code	Course Title	Hours Per Week			Total Credits	ESE	IA
			Lecture	Tutorial	Practical			
1.	161301	Engineering Mechanics	3	1	0	4	70	30
2.	161302	Fluid Mechanics and Machinery	3	0	0	3	70	30
3.	161303	Engineering Mathematics-III (PDE, Prob/Stat)	3	1	0	4	70	30
4.	161304	Basic Mechatronics	3	0	0	3	70	30
5.	161305	Strength of Materials	3	0	0	3	70	30
6.	161306	Universal Human Values	3	0	0	3	70	30
7.	161307	Indian Knowledge System	3	0	0	0	-	-
8.	161301P	Engineering Mechanics Lab	0	0	2	1	30	20
9.	161302P	Fluid Mechanics and Machinery Lab	0	0	2	1	30	20
10.	161305P	Strength of Materials Lab	0	0	2	1	30	20
11.	161308	Internship-I	2 Weeks			2	30	20
TOTAL						25	800	

SEMESTER-III**Course Code- 161301****Engineering Mechanics****3 1 0 4****Unit- 1.0:****Fundamentals of Mechanics****7 hrs**

Overview of engineering mechanics. Vector and scalar quantities. Units of physical quantities. Dimensions of physical quantities. Units and Dimensions. Dimensional analysis.

Unit- 2.0:**Force Systems and Equilibrium****7 hrs**

Force Systems Basic Concepts, Particle Equilibrium in 2-D & 3-D, Rigid Body Equilibrium, System of Forces: coplanar Concurrent Forces, Components in Space, Resultant and Moment of Forces and its Application, Couples and Resultant of Force System, Free Body Diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems.

Unit- 3.0:**Friction and Structural Analysis****7 hrs**

Types of Friction: Limiting, Static, and Dynamic, Laws of Friction, Motion of Bodies and Wedge Friction, Equilibrium in Three Dimensions, Method of Sections and Method of Joints, Tension and Compression in Members, Simple Trusses, Zero Force Members, Beams, Types of Beams, Frames and Machines.

Unit- 4.0:**Centroid, Centre of Gravity, and Moment of Inertia****7 hrs**

Centroid of Simple Figures from First Principle, Centroid of Composite Sections, Centre of Gravity and Its Implications, Area Moment of Inertia: Definition and Theorems Moment of Inertia of Plane Sections, Standard Sections, and Composite Sections, Mass Moment Inertia of Circular Plate, Cylinder, Cone, Sphere, Hook.

Unit- 5.0:**Virtual Work, Energy Method, and Particle Dynamics****7 hrs**

Virtual Displacements and Principle of Virtual Work, Degrees of Freedom and Active Force Diagram, Conservative Forces and Potential Energy, Energy Equation for Equilibrium, Applications of Energy Method for Equilibrium, Stability of Equilibrium, Review of Particle Dynamics: Rectilinear and Plane Curvilinear Motion, Relative and Constrained Motion, Newton's 2nd Law Work-Kinetic Energy, Power, Potential Energy Impulse-Momentum and Impact.

Unit- 6.0: Kinetics of Rigid Bodies**7 hrs**

Introduction to Kinetics of Rigid Bodies Basic Terms and General Principles in Dynamics Types of Motion and Instantaneous Centre of Rotation in Plane Motion Simple Problems D'Alembert's Principle and Its Applications in Plane Motion and Connected Bodies Work-Energy Principle and Its Application in Plane Motion of Connected Bodies Kinetics of Rigid Body Rotation.

Text/ Reference:-

1. Engineering Mechanics statics and dynamics R. C. Hibbeler Pearson Publication, 12th Edition. ISBN-10: 0-13-814929-1 ISBN-13:978-0-13-814929-1
2. Engineering Mechanics statics and dynamics, J. L. Meriam and L. G. Craige, John Willey and Son's publication. 9th Edition. ISBN: 978-1-119-39098-5
3. Engineering Mechanics, S. P. Timoshenko, D. H. Young, J. V. Rao & S.Pati, McGraw- Hill publication, 5th Edition ISBN-10:9781259062667
4. Engineering Mechanics statics and dynamics,A. K. Dhiman, P. Dhiman & D. Kulshreshtha, McGraw-Hill publication ISBN-10:9789339219178



Course Code- 161302

Fluid Mechanics & Machinery

3 1 0 4

Unit- 1.0:

5 hrs

Properties of Fluid: Definition of fluid; Newton's law of viscosity; Units and dimensions; Physical properties of fluids; Control volume; Continuity equation and momentum equation; Incompressible flow; Bernoulli's equation and its applications.

Unit- 2.0:

7 hrs

Dimensional Analysis: Dimensionally homogeneous equations; Buckingham Pi Theorem; Calculation of dimensionless parameters. Similitude and complete similarity; Model scales; Basic boundary layer theory and analysis.

Unit- 3.0:

6 hrs

Fluid Kinematics: Different approaches; Reynolds transport theorem; Flow visualization; Types of flow; Strain rate, stream line, streak line, path lines and stream tubes; Continuity equation in Cartesian coordinates in 3D forms; Velocity and acceleration of fluid particles; Velocity potential function and stream function.

Unit- 4.0:

6 hrs

Momentum Equation: Momentum equation; Navier Stokes equation; Development of Euler's equation; Bernoulli's equation and application; Steady and unsteady flow through orifice; Orifice placed in pipe; Venturimeter; Flow over triangular and rectangular notches; Pitot tube.

Unit- 5.0:

8 hrs

Laminar and Turbulent Flow: Viscous/Laminar flow – Plane Poiseuille flow and Couette flow; Laminar flow through circular pipes; Loss of head and power absorbed in viscous flow; Turbulent flow – Reynolds experiment; Frictional losses in pipe flow; Shear stress in turbulent flow; Major and minor losses (Darcy's and Chezy's equation); Flow through siphon pipes; Branching pipes and equivalent pipe.

Unit- 6.0:

10 hrs

Rotodynamic Machines: Euler's equation; Theory of Rotodynamic machines; Various efficiencies; Velocity components at entry and exit of the rotor; Velocity triangles; Centrifugal pumps – working principle, work done by the impeller and performance curves; Cavitation in pumps; Reciprocating pump – working principle.

Hydraulic Turbines: Classification of water turbines; Heads and efficiencies; Velocity triangles; Axial, radial and mixed flow turbines; Pelton wheel, Francis turbine and Kaplan turbines – working and design principles.

Text/Reference:

1. S.S. Rattan, Fluid Mechanics & Hydraulic Machines, Khanna Book Publishing, 2019.
2. P.J. Pritchard, A.T. McDonald and R.W. Fox, "Introduction to Fluid Mechanics," Wiley India, 2012.
3. F.M. White, "Fluid Mechanics," Tata McGraw Hill, 2011.
4. S. K. Som, G. Biswas and S. Chakraborty, "Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill, 2017.
5. R. K. Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines," Laxmi Publication, 2005.
6. Mechanics of Fluids, Shames, McGraw Hill Book Co., New Delhi, 1988.

Unit 1.0**7 hrs**

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method.

Unit 2.0**8 hrs**

Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables

Unit 3.0**8 hrs**

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

Unit 4.0**5 hrs**

Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Unit 5.0 -**7hrs**

Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis – Probability distributions: Binomial, Poisson and Normal – evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves.

Unit 6.0-**7 hrs**

Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances – Chi- square test for goodness of fit and independence of attributes.

Text/ Reference:-

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications.
3. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall.
4. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

Course Code- 161304

Basic Mechatronics

3 0 0 3

Unit 1.0: Introduction to Mechatronics Systems

8 hrs

Mechatronics Systems, classification and history of mechatronics system, Mechatronics system components, Systems and Design: Mechatronic approach, Integrated Product Design, Modeling, Analysis and Simulation, Man-Machine Interface, Mechatronics system and micro mechatronic systems application, Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology.

Unit 2.0: Sensors, Actuators and Programmable device

9 hrs

Sensors and transducers

Sensors Concept, classification, Development in Transducer technology, Types: Principle/working, ratings/ specifications, cost, and applications of Temperature, Pressure, Water, Light, Sound, Smoke, proximity Sensors, Flow, humidity, voltage, vibration, IR, Opto- Electronics-Shaft encoders, CD Sensors, Vision System.

Drives and Actuators

Actuator Concept, Relay as an actuator, Types- Hydraulic and Pneumatic actuators, Electrical Actuators - servo motor and Stepper motor, drive circuits, open and closed loops control, Embedded Systems: Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems, applications, Microcontroller as a programmable device and of real-world applications.

Unit 3.0: Basic Electronics Components

8 hrs

Introduction to Semi-conductor, Intrinsic and extrinsic semiconductors, Half wave, full wave and bridge rectifiers, Conductors, insulators, Active device: Diodes, P-N Junction Diode, Zener-Diode, Transistors- NPN and PNP, ICs: Integrated Circuits (ICs), Type of IC-Packaging (Metal Can/DIL/Flat etc.), Various Series of Linear/Analog and Digital Series, Displays: Light Emitting Displays (LED), 7-Segment LED, Matrix LED, alphanumeric Display, Liquid Crystal Displays (LCD), Nixie Tubes Introduction to OPAMP-IC 741, Comparison of analog and digital signal, Digital systems, Binary numbers, Boolean identities and laws, Digital system building blocks: Basic logic gates, symbols and truth tables, IC-Definition and advantages.

Unit 4.0: Smart Materials

6 hrs

Introduction to smart material, classification of smart materials, properties of smart material, their need, advantages, disadvantages, and applications, Shape Memory materials, Piezoelectric materials, Chromo active materials, Magnetostrictive Photoactive materials, Magnetorheological materials and fluids, Application of smart material in mechatronics system, Actuators: Materials, Static and dynamic characteristics, examples for positioning, vibration isolation, etc.

Unit 5.0: Wiring and Protective Devices I

6 hrs

Necessity of Protective Devices, Various Protective devices and their functions -fuse wire, Glass cartridge fuse, HRC fuse, Kit-kat fuse, MCB, MCCB, RCCB, ELCB, Relay, Different types of electrician tools and their function, wiring tools, care and maintenance of wiring tools.

Unit 6.0: Wiring and Protective Devices II

5 hrs

Types of wiring systems- Surface conduit, concealed conduit, PVC casing capping, Types of wires, cables used for different current and voltage ratings, Battery - Types of batteries (Lead acid battery, lithium, sealed maintenance free (SMF) battery, Modular battery, Selection criteria of batteries for different applications. , Ampere-Hour Capacity, Efficiency, UPS -types of UPS , Selection criteria of UPS, Sizing of UPS.

Text/Reference:

1. Mechatronic Systems Design and Solid Materials: Methods and Practices, Satya Bir Singh, Prabhat Ranjan, et, Apple Academic Press;1st Ed. 2023, ISBN-10 : 1774637723, ISBN-13 :

978-1774637722 .

2. Mechatronics (Electronic Control Systems In Mechanical and Electrical Engineering) William,Bolton, Pearson Education, 7th Ed. 2023, ISBN-10 : 9357052844, ISBN-13 : 978-9357052849.
3. Control of Mechatronic Systems: Model-Driven Design and Implementation Guidelines, Patrick O. J. Kaltjob Wiley; 1st Ed. 2020, ISBN-10 : 1119505801, ISBN-13 : 978-1119505808.
4. Mechatronics: As per AICTE, K.P. Ramachandran G.K. Vijayaraghavan M.S.Balasundaram, Wiley, 2019, ISBN-10 : 8126540400, ISBN-13 : 978-8126540402.
5. Mechatronics: Principles, Concepts and Applications, Nitaigour Mahalik McGraw, Hill Education , 2017, ISBN-10 : 0070483744, ISBN-13 : 978-0070483743.



Unit- 1.0 **7 hrs**

Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle, theories of failure,

Unit- 2.0 **6 hrs**

Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers.

Unit- 3.0 **6 hrs**

Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

Unit- 3.0 **8 hrs**

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.

Unit- 4.0 **7 hrs**

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.

Unit- 5.0 **8 hrs**

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure.

Text /Reference:

1. Egor P.Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
2. R.Subramanian, Strength of Materials, Oxford University Press, 2007.
3. Ferdinand P.Been, Russel Johnson Jr. and John J.Dewole, Mechanics of Materials, Tata McGraw Hill Publishing Co. Ltd., New Delhi 2005.

Unit- 1.0:**7 hrs****Introduction to Value Education:**

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education Sharing about Oneself, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Exploring Human Consciousness, Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations,

Unit- 2.0:**7 hrs****Harmony in the Human Being:**

Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.

Unit- 3.0:**7 hrs****Harmony in the Family and Society:**

Harmony in the Family – the Basic Unit of Human Interaction, ‘Trust’ – the Foundational Value in Relationship, ‘Respect’ – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.

Unit- 4.0:**7 hrs****Harmony in the Nature/Existence**

Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.

Unit- 5.0:**7 hrs****Implications of the Holistic Understanding – a Look at Professional**

Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession .

Unit- 6.0:**7 hrs**

Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.

Text /Reference:

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-8703447.
2. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4. The Story of Stuff (Book).
5. The Story of My Experiments with Truth – by Mohandas Karamchand Gandhi.
6. Small is Beautiful – E. F Schumacher.

7. Slow is Beautiful – Cecile Andrews.
8. Economy of Permanence – J C Kumarappa.
9. Bharat Mein Angreji Raj – Pandit Sunderlal.
10. Rediscovering India – by Dharampal.
11. Hind Swaraj or Indian Home Rule – by Mohandas K. Gandhi.
12. India Wins Freedom – Maulana Abdul Kalam Azad.
13. Vivekananda – Romain Rolland (English)
14. Gandhi – Romain Rolland (English)



Course Code- 161307**Indian Knowledge System****3 0 0 0****Unit-1.0****7 hrs****Introduction to Indian Knowledge Systems**

Overview of IKS, Organization of IKS , Conception and constitution of knowledge in indian tradition, The oral tradition, Models and Strategies of IKS.

Unit-2.0**5 hrs****Overview of IKS Domains**

The vedas as the basis of IKS, Overview of all the six vedāṅgas.

Unit-3.0**8 hrs****Relevance in Current Technical Education System I**

Relevance of following IKS domains in present technical education system: Arthashastra (Indian economics and political systems), Ganita and Jyāmīti (Indian mathematics, astronomy and geometry, Rasayana (Indian chemical Sciences).

Unit-4.0**8 hrs****Relevance in Current Technical Education System II**

Ayurveda (Indian Biological Sciences / Diet & Nutrition), Jyotiṣa (observational astronomy and calendar systems), Prakṛiti (Indian system of terrestrial/ material sciences/ecology and atmospheric sciences).

Unit-5.0**7 hrs****Relevance in Current Technical Education System III**

Vastu (Indian system of aesthetics-iconography and built-environment /architecture), Nyāya (Indian systems of social ethics, logic and law).

Unit-6.0**7 hrs**

Śilpa and Nāṭya (Indian classical arts: performing and fine arts), Sāṅkhya and Yoga Darśana (Indian psychology, yoga and consciousness studies), Vṛkṣāyurveda (plant science/sustainable agriculture/food preservation methods).

Text/Reference:-

1. Introduction to Indian Knowledge System: Concepts and Applications, Archak, K.B. (2012)., Kaveri Books, New Delhi, ISBN-13:978-9391818203
2. Introduction To Indian Knowledge System: Concepts and Applications, Mahadevan, B.
Bhat, Vinayak Rajat, Nagendra Pavana R.N., PHI, ISBN: 9789391818203.
3. Glimpse into Kautilya's Arthashastra Ramachandrudu P. (2010) , Sanskrit Academy, Hyderabad, ISBN:9788380171074.
4. "Introduction" in Studies in Epics and Purāṇas, (Eds.), KM Munshi and N Chandrashekara Aiyer Bhartiya Vidya Bhavan.

Perform any 10 Experiments

List of Experiments:

1. Practical based on mechanical advantage of different machines.
2. Verification of triangle law & parallelogram law of forces.
3. Verification of polygon law of forces.
4. Determination of moment of inertia of a flywheel.
5. Crank Lever apparatus.
6. Verification of support reactions of a simply supported beam.
7. Verification of condition of equilibrium of a system of forces.
8. Verification of axial forces in the members of a truss.
9. Verification of equilibrium of three dimensional forces.
10. Determination of coefficient of friction between two surfaces.
11. Verification of centroid of different laminae.
12. Verification of Newton's laws of motion.



Perform any ten experiments**List of Experiments:**

1. Determination of density & viscosity of oil.
2. To determine the meta-centric height of a floating body.
3. Measurement of Coefficient of Discharge of given Orifice and Venturimeter
4. To determine the coefficient of discharge of Notch (V and Rectangular types)
5. To determine the friction factor for the pipes.
6. To verify the Bernoulli's Theorem.
7. To find critical Reynolds number for a pipe flow.
8. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
9. To show the velocity and pressure variation with radius in a free and forced vortex.
10. Performance on hydraulic turbines:
 - a. Pelton wheel
 - b. Francis turbine
 - c. Kaplan turbine.
11. Performance on hydraulic pumps:
 - a. Single stage and multi stage centrifugal pumps.
 - b. Reciprocating pump.
 - c. Performance test of a two stage reciprocating air compressor.
 - d. Performance test on an air blower.



Perform any ten experiments

List of Experiments:

1. Hooke's Law.
2. Hardness Test: Rockwell, Brinell, Vicker.
3. Izod & Charpy Impact Test.
4. Bending Test.
5. Torsion Test.
6. Shear test.
7. Compressive strength test.
8. Fatigue Test.
9. Verification of Maxwell's reciprocal theorem.
10. Continuous beam deflection test.
11. Strain Measurement.



Internship I Guidelines:

Internship I is of a minimum duration of two weeks which can be completed in an Industry/Institute in consultation with concerned Engineering College/Institute. After completion of Internship a detailed report of the Internship mentioning the training undertaken along with certificate should be submitted.

