

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI

(Autonomous)

Course structure for Four Year Regular B.Tech. Degree Program

(Effective for the batches admitted from 2020-21)

MECHANICAL ENGINEERING (ME)

Semester V (Third year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		C	CIE	SEE
1	Professional Core courses	20APC0327	Machine Tools	3	0	0	3	30	70	100
2	Professional Core courses	20APC0309	Kinematics of Machines	3	0	0	3	30	70	100
3	Professional Core courses	20APC0314	Fluid Mechanics & Hydraulic Machinery	3	0	0	3	30	70	100
4	Open Elective Course/Job oriented elective	20AOEMB02	Entrepreneurship Development	3	0	0	3	30	70	100
		20APE0501	Artificial Intelligence							
		20APE0416	Sensor Networks							
5	Professional Elective courses	20APE0306	Renewable Energy Technologies	3	0	0	3	30	70	100
		20APE0302	Introduction to CAD/CAM							
		20APE0303	Nano Technology							
6	Professional Core courses Lab	20APC0315	Fluid Mechanics & Hydraulic Machinery Lab	0	0	3	1.5	30	70	100
7	Professional Core courses Lab	20APC0329	Machine Tools - 1 Lab	0	0	3	1.5	30	70	100
8	Skill advanced course/ soft skill course*	20ASA0502	Soft skills	1	0	2	2	100	-	100
9	Mandatory course (AICTE suggested)	20AMC9904	Professional Ethics and Human Values	2	0	0	0	30	-	30
Community service project				0	0	0	1.5	0	-	50
Summer Internship 2 Months (Mandatory) after second year (to be evaluated during V semester)				0	0	0	1.5	50	-	50
Total credits							23	390	490	930
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)				4	0	0	4	30	70	100

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Year : III

Semester : I

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20APC0327	Machine Tools	3	0	0	3

Course Outcomes:

- 1 To understand the basic concepts of the philosophy of metal cutting and the mechanism of chip formation
- 2 To understand the basic concepts of turning.
- 3 To understand the basic principle of drilling, shaping and planning operation, parts of the drilling
- 4 To able to understand the principle of milling, grinding, Lapping, Honing and Broaching operation
- 5 Tto understand the design of Jigs and fixtures and uses, Classification of Jigs & Fixtures – Principles of location and clamping

UNIT I

Elementary treatment of metal cutting theory – Elements of cutting process – Geometry of single point tool and angles, chip formation and types of chips – built up edge and its effects, chip breakers. Mechanics of orthogonal cutting –Merchant's Force diagram, cutting forces – cutting speeds, feed, depth of cut, heat generation, tool life, coolants, machinability –economics of machining. cutting Tool materials and cutting fluids –types and characteristics.

UNIT II

Engine lathe – Principle of working- specification of lathe – types of lathes – work holders and tool holders –Taper turning, thread turning and attachments for Lathes.Turret and capstan lathes – collet chucks – other work holders – tool holding devices – box and tool layout. Principal features of automatic lathes – classification – Single spindle and multi-spindle automatic lathes– tool layout and cam design

UNIT III

Drilling and Boring Machines – Principles of working, specifications, types, operations performed – tool holding devices – twist drill – Boring tools – machining time calculation. Shaping, Slotting and Planning machines –Principles of working – Principal parts – specification, classification, Operations performed. Machining time calculations.

UNIT IV

Milling machine – Principles of working – specifications – classifications of milling machines – Principal features – machining operations, Types and geometry of milling cutters– methods of indexing – Accessories to milling machines. Grinding machine –Theory of grinding – classification– cylindrical and surface grinding machine – Tool and cutter grinding machine – special types of grinding machines – Grinding wheel: Different types of abrasives – bonds, specification and selection of a grinding wheel. Static and dynamic balancing of a wheel Truing and Dressing of wheels. Lapping, Honing and Broaching machines – comparison of grinding, lapping and honing. machining time calculations.

UNIT V

Principles of design of Jigs and fixtures and uses, 3-2-1 Classification of Jigs & Fixtures – Principles of location and clamping – Types of clamping & work holding devices, Typical examples of jigs and fixtures

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Unit built machine tools – multispindle heads. power units-principal of working types of UBMTS, characterization, applications.

Text Books:

1. Workshop Technology – Vol II, B.S.RaghuVamshi, Dhanpat Rai & Co, 10th edition, 2013
2. Production Technology by R.K. Jain and S.C. Gupta, Khanna Publishers, 17th edition, 2012

Reference Books:

1. Manufacturing Technology-Kalpakzian- Pearson
2. Metal cutting Principles by Milton C.Shaw, oxford Second Edn, 2nd edition, 2012
3. Production Technology by H.M.T. (Hindustan Machine Tools),TMH, 1st edition, 2001
4. Production Technology by K.L.Narayana, IK International Pub.
5. Machining and machine tools by AB. Chattopadyay, WileyEdn,2013
6. Unconventional Machining process by V.K.Jain, Allied Pub.
7. Manufacturing technology Vol II by P.N. Rao, Tata McGraw Hill, 4th edition, 2013

COs	PO No. and keyword	Competency Indicator	Performance Indicator
CO1	PO 5: Modern tool usage	5.2	5.2.2
CO2	PO 1: Engineering knowledge	1.2	1.2.2
CO3	PO 5: Modern tool usage	5.2	5.2.2
CO4	PO 5: Modern tool usage	5.2	5.2.2
CO5	PO 1: Engineering knowledge	1.6	1.3.1
	PO 7: Environment and sustainability	7.2	7.2.1

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Subject Code	Subject Name	L	T	P	Credits
20APC0309	Kinematics of Machines	3	0	0	3

Course Outcomes:

- 1 To enable the students in selection of appropriate mechanisms.
- 2 To impart the clear idea in constructing velocity & acceleration diagrams for the given mechanism.
- 3 To provide an overview of straight line motion mechanisms, steering mechanisms and Hooke's joint.
- 4 To understand the kinematic analysis of gears & gear trains.
- 5 To develop the knowledge of kinematic analysis of cams.

UNIT I**Mechanisms, Machine and Structure:**

Element or Link – Classification – Rigid Link, flexible and fluid link – Kinematic pair – Types – sliding, turning, rolling, screw and spherical pairs, Lower and Higher pairs, closed and open pairs – Constrained motion – completely, partially or successfully constrained motion, and incompletely constrained motion.

Kinematic chain – Degrees of freedom of planar mechanisms – inversion of mechanism – inversion of quadric cycle chain, single and double slider crank chain.

UNIT II**Velocity and Acceleration analysis of mechanisms:**

Velocity Analysis:

Relative velocity method: Motion of Link – construction of velocity diagrams – determination of angular velocity of points and links – four bar chain, single slider crank chain and other simple mechanisms.

Instantaneous center method: Instantaneous center of rotation – Three centres in line theorem – Graphical determination of instantaneous centre, diagrams for simple mechanisms and determination of angular velocity of points and links.

Acceleration Analysis: Acceleration diagram for simple mechanisms – determination of acceleration of points and angular acceleration of links – Corioli's acceleration – Klein's construction..

UNIT III**Straight line motion mechanisms, Steering mechanisms, and Hooke's Joint:**

Straight line motion mechanisms: Exact and approximate copiers and generated types – Peaucellier, Hart's and Scott Russell – Grosshopper, Watt, T-Chebicheff, Robert mechanisms.

Steering mechanisms: Condition for correct steering – Davis steering gear, Ackerman's steering gear.

Hooke's Joint: Single and double Hooke's joint – velocity ratio, simple problems.

UNIT IV**Gears and Gear trains:**

Gears: Friction wheels and toothed gears – types – law of gearing – condition for constant velocity ratio for transmission of motion – forms of teeth – Cycloidal and involute profiles – velocity of sliding, path of contact, arc of contact and contact ratio – phenomena of interference – methods to avoid interference – condition for minimum number of teeth to avoid interference.

Gear trains: Introduction – train value – types – simple, compound, reverted and epicyclic gear trains – methods of finding train value or velocity ratio of epicyclic gear trains – sun & planetary gear systems – differential gear of an automobile.

UNIT V**Cams:**

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Definitions – Cam and Follower – uses – types of followers and cams – radial cam terminology – types of follower motion – uniform velocity, simple harmonic, uniform acceleration and retardation motion – maximum velocity and maximum acceleration during outward and return strokes in the above cases.

Textbooks:

1. S.S.Rattan, Theory of Machines, Tata McGraw Hill Education (India) Pvt. Ltd.
2. R.S.Khurmi & J.K.Gupta, Theory of Machines, S.Chand Publications.

References

1. Jagadish Lal, Theory of Mechanisms and Machines, Metropolitan company pvt. Ltd
2. R.K.Bansal, Theory of Machines, Lakshmi Publications.
3. Thomas Bevan, Theory of Machines, CBS.
4. P L Ballaney, Theory of Machines, Khanna Publishers.

List of COs	PO no. and keyword	Competency	Performance Indicator
CO 1	PO1: Engineering knowledge	1.1.	1.1.2
CO 2	PO1: Engineering knowledge	1.1	1.1.2
CO 3	PO1: Engineering knowledge	1.1	1.1.1
CO 4	PO2: Problem analysis	2.4	2.4.1
CO 5	PO2: Problem analysis	2.4	2.4.1

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Year : III

Semester : I

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20APC0314	Fluid Mechanics & Hydraulic Machinery	3	0	0	3

Course Outcomes:

- 1 Interpret the behavior under static and dynamic conditions.
- 2 analyze one dimensional viscous flows using conservation laws for compressible and incompressible flows.
- 3 apply boundary layer flows for laminar and turbulent regimes.
- 4 explain Reynolds stresses and its application
- 5 explain different types of pumps and their application.

UNIT I

Fluid Statics: Dimensions and units: physical properties of fluids – specific gravity, porosity surface tension – vapor pressure and their influence on fluid motion – atmospheric gauge and vacuum pressure – measurement of pressure – Piezometer, U-tube differential manometers.

Fluid Kinematics: stream line, path line and streak lines and steam tube, classification of flows-steady & unsteady, uniform, non-uniform, laminar, turbulent, rotational and irrotational flows-equation of continuity for one dimensional flow.

UNIT II

Fluid Dynamics: surface and body forces – Euler's and Bernoulli's equations for flowing stream line, momentum equation and its application on force on pipe bend.

Conduit Flow: Reynold's experiment – Darcy Weisbach equation – Minor losses in pipes – pipes in series and pipes in parallel – total energy line-hydraulic gradient line. Measurement of flow: pitot tube, venturimeter and orifice meter, Flow nozzle and Turbine current meter.

UNIT III

Turbo Machinery: hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done efficiency, flow over radial vanes.

Hydroelectric Power Stations: Elements of hydro electric power station-types-concept of pumped storage plants-storage requirements.

UNIT IV

Hydraulic Turbines: Classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design – draft tube – theory – functions and efficiency.

Performance of Hydraulic Turbines: Unit and specific quantities, characteristics, governing of turbines, selection of type of turbine, cavitation and surge tank.

UNIT V

Pumps: Classification –Rotary & Reciprocating pumps – working – work done – manometric head – loss efficiencies – specific speed – pumps in series and parallel – performance characteristic curves and NPSH.

Non dimensional analysis:

TEXT BOOKS :

1. Fluid Mechanics, FRANK M. WHITE, Mc. Graw Hill Education.
2. Fluid Mechanics, Hydraulic and Hydraulic Machines by Modi & Seth, Standard book house.

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3. A Text of Fluid Mechanics and Hydraulic Machines by Dr. R. K. Bansal – Laxmi Publications (P) Ltd., New Delhi.
4. Mechanics of Fluids by Potter, Wiggert, Ramadan, M. M. M. Sarcar, Cengage Publishers.
5. Subramanyam, IITM,

REFERENCE BOOKS :

1. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.
2. Principles of Fluid Mechanics and Fluid Machines by M. Narayana Pillai, Universities Press.
3. Fluid mechanics and fluid machines by Rajput, S.Chand & Co.

List of COs	PO no. and keyword	Competency Indicator	Performance Indicator
CO: 1	PO 1: Engineering knowledge	1.3	1.3.1
CO: 2	PO 2: Problem analysis	2.1	2.1.3
CO: 3	PO 1: Engineering knowledge	1.3	1.3.1
CO: 4	PO 2: Problem analysis	2.1	2.1.2
CO: 5	PO 1: Engineering knowledge	2.6	2.6.3

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Year: III

Semester : I

Branch of Study : Common to all

Subject Code	Subject Name	L	T	P	Credits
20AOEMB02	Entrepreneurship Development	3	0	0	3

Course Outcomes:

- CO: 1 Understand the concept of Entrepreneurship and challenges in the world of Competition
- CO: 2 Apply the Knowledge in generating ideas for New Ventures and design business plan structure
- CO: 3 Analyze various sources of finance and subsidies to entrepreneurs.
- CO: 4 Evaluate the role of central government and state government in promoting women Entrepreneurship.
- CO: 5 Study the role of incubations in fostering startups.

UNIT – I

Entrepreneurship - Concept, knowledge and skills requirement - Characteristics of successful entrepreneurs - Entrepreneurship process - Factors impacting emergence of entrepreneurship - Differences between Entrepreneur and Intrapreneur - Understanding individual entrepreneurial mindset and personality - Recent trends in Entrepreneurship.

UNIT – II

Starting the New Venture - Generating business idea – Sources of new ideas & methods of generating ideas - Opportunity recognition - Feasibility study - Market feasibility, technical/operational feasibility - Financial feasibility - Drawing business plan - Preparing project report - Presenting business plan to investors.

UNIT – III

Sources of finance - Various sources of Finance available - Long term sources - Short term sources - Institutional Finance – Commercial Banks, SFC's in India - NBFC's in India - their way of financing in India for small and medium business - Entrepreneurship development programs in India - The entrepreneurial journey- Institutions in aid of entrepreneurship development.

UNIT – IV

Women Entrepreneurship - Entrepreneurship Development and Government - Role of Central Government and State Government in promoting women Entrepreneurship - Introduction to various incentives, subsidies and grants – Export- oriented Units - Fiscal and Tax concessions available - Women entrepreneurship - Role and importance - Growth of women entrepreneurship in India - Issues & Challenges - Entrepreneurial motivations.

UNIT – V

Startups – Definition, Role of startups in India, Governmental initiatives to foster entrepreneurship across sectors. Funding opportunities for startups. Business Incubation and its benefits, Pre-Incubation and Post - Incubation process.

Text Books:

1. D F Kuratko and T V Rao, “Entrepreneurship” - A South-Asian Perspective – Cengage Learning, 2012. (For PPT, Case Solutions Faculty may visit : login.cengage.com)
2. Nandan H, “Fundamentals of Entrepreneurship”, PHI, 2013.

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Reference Books:

1. Vasant Desai, "Small Scale Industries and Entrepreneurship", Himalaya Publishing 2012.
2. Rajeev Roy "Entrepreneurship", 2nd Edition, Oxford, 2012.
3. B.Janakiram and M.Rizwanal "Entrepreneurship Development: Text &Cases", Excel Books, 2011.
4. Stuart Read, Effectual "Entrepreneurship", Routledge, 2013

List of COs	PO no. and keyword	Competency	Performance Indicator
CO 1	PO1: Engineering	1.2	1.2.1
	Knowledge	1.3	1.3.1
CO 2	PO3: Design/Development of Solutions	3.2	3.2.1
			3.2.2
CO 3	PO11: Project management and finance	11.2	11.2.1
CO 4	PO6: The engineer and society	6.2	6.2.1
CO 5	PO3: Design/Development of Solutions	3.3	3.2.2

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Year: III

Semester : I

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20APE0501	Artificial Intelligence	3	0	0	3

Course Outcomes:

- CO: 1 Apply searching techniques for solving a problem
- CO: 2 Design Intelligent Agents
- CO: 3 Develop Natural Language Interface for Machines
- CO: 4 Design mini robots
- CO: 5 Summarize past, present and future of Artificial Intelligence

UNIT I

Introduction: What is AI, Foundations of AI, History of AI, The State of Art.

Intelligent Agents: Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

UNIT II

Solving Problems by searching: Problem Solving Agents, Example problems, Searching for Solutions, Uninformed Search Strategies, Informed search strategies, Heuristic Functions, Beyond Classical Search: Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces, Searching with Nondeterministic Actions, Searching with partial observations, online search agents and unknown environments.

UNIT III

Reinforcement Learning: Introduction, Passive Reinforcement Learning, Active Reinforcement Learning, Generalization in Reinforcement Learning, Policy Search, applications of RL

Natural Language Processing: Language Models, Text Classification, Information Retrieval, Information Extraction.

UNIT IV

Natural Language for Communication: Phrase structure grammars, Syntactic Analysis, Augmented Grammars and semantic Interpretation, Machine Translation, Speech Recognition

Perception: Image Formation, Early Image Processing Operations, Object Recognition by appearance, Reconstructing the 3D World, Object Recognition from Structural information, Using Vision.

UNIT V

Robotics: Introduction, Robot Hardware, Robotic Perception, Planning to move, planning uncertain movements, Moving, Robotic software architectures, application domains

Philosophical foundations: Weak AI, Strong AI, Ethics and Risks of AI, Agent Components, Agent Architectures, Are we going in the right direction, What if AI does succeed.

Textbook:

1. Stuart J.Russell, Peter Norvig, "Artificial Intelligence A Modern Approach", 3rd Edition, Pearson Education, 2019.

References:

Nilsson, Nils J., and Nils Johan Nilsson. Artificial intelligence: a new synthesis. Morgan Kaufmann, 1998.
Johnson, Benny G., Fred Phillips, and Linda G. Chase. "An intelligent tutoring system for the accounting cycle: Enhancing textbook homework with artificial intelligence." Journal of Accounting Education 27.1 (2009): 30-39

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Year: III

Semester : I

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20APE0416	Sensor Networks	3	0	0	3

Course Outcomes:

- CO: 1 Understand the concepts of Converters and Sensor data acquisition systems
- CO: 2 Understand the concepts of Sensor Measurements in Structural Monitoring
- CO: 3 Understand the concepts of commonly used sensing technologies and algorithms
- CO: 4 Understand the concepts of Piezoelectric transducers for assessing and monitoring infrastructures
- CO: 5 Understand the concepts of Fiber optic sensors for assessing and monitoring infrastructures

Unit-1 Sensor data acquisition systems and architectures

Introduction, General measurement system, Analog-to-digital converter architectures-Different types of ADCs – parallel comparator type ADC, Counter type ADC, successive approximation ADC and dual slope ADC Digital-to-analog conversion-Basic DAC techniques, Weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, Data acquisition systems-Analog Systems-Digital Systems.

Unit-II Sensors and Sensing Technology for Structural Monitoring

Introduction, Sensor Types, Sensor Measurements in Structural Monitoring- Structural Responses- Environmental Quantities- Operational Quantities- Typical Quantities for Bridge Monitoring- Fibre Optic Sensors- Classification of Fibre Optic Sensors- Typical Fibre Optic Sensors in SHM- Fibre Optic Sensors for Structural Monitoring- Wireless Sensors- Components of Wireless Sensors- Field Deployment in Civil Infrastructure.

Unit-III Commonly used sensors for civil infrastructures and their associated algorithms

Introduction, commonly used sensing technologies- Displacement-Strain-Acceleration-Environment
Associated algorithms- Displacement sensors- Strain gages- Environmental measurements- **Examples of continuous monitoring systems.**

Unit-IV Piezoelectric transducers for assessing and monitoring civil infrastructures

Introduction, Principle of piezoelectricity, piezoelectric transducers for SHM applications, Bonding effects, Limitations of piezoelectric transducers, SHM techniques using piezoelectric transducers, Applications of piezoelectric transducer-based SHM.

Unit-V Fiber optic sensors for assessing and monitoring civil infrastructures

Introduction, Optical fiber concepts, Sensing mechanisms, Sensor packaging, Cables, connectors, and splicing, **Common optical fiber sensors-** Coherent interferometers, Low-coherence interferometers, Fiber Bragg gratings.

Text Books:

1. “Sensor Technologies for Civil Infrastructures”, Volume 1 Sensing Hardware and Data Collection Methods for Performance Assessment **Woodhead Publishing in Civil and Structural Engineering**
Ming L. Wang Jerome P. Lynch Hardcover ISBN: 9780857094322
2. “Wireless Sensor Networks for Civil Infrastructure Monitoring: A Best Practice Guide” ICE Publishing David Rodenas-Herráiz, Kenichi Soga, Paul R A Fidler and Nicholas de Battista

References:

1. Ghatak A and Thyagarajan K. (1998) Introduction to Fiber Optics; Cambridge University Press: Cambridge, UK.
2. Barthorpe, R.J. and Worden, K. (2009) Sensor Placement Optimization. *Encyclopaedia of*

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Structural Health Monitoring, Boller, Chang and Fujino (ed.), John Wiley & Sons, Chichester, UK.

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CO: 1	PO 1: Engineering Knowledge	1.4	1.4.1
CO: 2	PO 2: Problem Analysis	2.4	2.4.3
CO: 3	PO 2: Problem Analysis	2.4	2.4.3
CO: 4	PO 3: Design/Development of solutions	3.4	3.4.2
CO: 5	PO 3: Design/Development of solutions	3.4	3.4.2

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Semester : I

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20APE0306	Renewable Energy Technologies	3	0	0	3

Course Outcomes:

- 1 Explain the current energy scenario and requirement of migration to renewable energy sources
- 2 To understand role significance of solar energy
- 3 To provide importance of Wind Energy
- 4 To understand the role of ocean energy in the Energy Generation
- 5 To understand role of hydrogen in non conventional energy

UNIT I**Classification of Energy:**

Energy chain and common forms of usable energy- Present energy scenario- World energy status- Energy scenario in India- Introduction to renewable energy resources- Introduction to solar Energy- Energy from sun- Spectral distribution of Solar radiation- Instruments for measurement of solar radiation.

UNIT II**Solar Energy**

Solar Radiation, Measurements of Solar Radiation, Flat Plate and Concentrating Collectors, Solar Direct Thermal Applications, Solar Thermal Power Generation, Fundamentals of Solar Photo Voltaic Conversion, Solar Cells, Solar PV Power Generation, Solar PV Applications.

UNIT III**Bio Energy Sources:**

Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking.

Wind Energy:

Wind Energy Estimation, Types of Wind Energy Systems, Performance, Site Selection, Details of Wind Turbine Generator.

UNIT IV**Ocean Energy:**

Ocean Thermal Energy Conversion (OTEC), Principle of operation, development of OTEC plants, Tidal and wave energy, Potential and conversion techniques, mini-hydel power plants.

Geothermal Energy:

Resources, types of wells, methods of harnessing the energy, scope in India.

Unit – V:**Hydrogen Energy:**

Properties of hydrogen as fuel, Hydrogen pathways introduction-current uses, general introduction to infrastructure requirement for hydrogen production, storage, dispensing and utilization, and hydrogen production plants.

Textbooks:

1. Non-Conventional Energy Sources /G.D. Rai.
2. Renewable energy resources: Tiwari and ghosal, Narosa publication.
3. Non conventional Energy Sources, Khanna Publication.

References:

1. Non-Conventional Energy Resources, B.H. Khan, McGrawHill, 2015.

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2. Principles of Solar Energy/ Frank Krieth & John F Kreider.
3. Fang Lin You, Hong ye (2012), Renewable Energy Systems, Advanced conversion technologies and applications, CRC Press
4. John.A.Duffie, William A.Beckman (2013), Solar Engineering of Thermal processes, Wiley
5. Godfrey Boyle (2012), Renewable Energy, power for a sustainable future, Oxford University Press.

List of COs	PO no. and keyword	Competency Indicator	Performance Indicator
CO: 1	PO 1: Engineering knowledge	1.3	1.3.1
CO: 2	PO 5: Modern tool usage	5.2	5.2.2
CO: 3	PO 5: Modern tool usage	5.2	5.1.2
CO: 4	PO 5: Modern tool usage	5.2	5.2.2
CO: 5	PO 1: Engineering knowledge	1.6	1.3.1

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Semester : I

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20APE0302	Introduction to CAD/CAM	3	0	0	3

Course Outcomes:

- 1 Understand the basic concepts components of CAD/CAM. Concepts of Graphics techniques.
- 2 Understand the concepts of Geometric representation methods..
- 3 Understand and apply Numerical CNC Part Programming methods.
- 4 Understand the concepts of Group technology and techniques, production flow Analysis.
- 5 Understand the concepts of FMS and its elements.

UNIT I

Introduction: Definition and scope of CAD/CAM- Computers in industrial manufacturing, design process- Computer Aided Design (CAD)-Computer Aided Manufacturing (CAM)-Computer Integrated Manufacturing (CIM)

Graphics: Data base for graphic modeling-transformation geometry-3D transformations –Clipping-hidden line removal-Colour-shading

UNIT II**Geometric modelling**

Parametric representation of curves, solids & surfaces. Geometric construction methods-Constraint based modeling- Wireframe, Surface- Bezier , B-Spline Surfaces and Solid- Constructive Solid Geometry,Boundary representation and Cellular Decomposition.

UNIT III**NC Control production systems:**

Introduction to NC, CNC, DNC - Manual part Programming – Computer Assisted Part Programming – Examples using NC codes- Adaptive Control – Canned cycles and subroutines – CAD/ CAM approach to NC part programming – APT language

UNIT IV**Role of information systems in manufacturing**

Discrete part manufacture-information requirements of a production organization-manufacturing strategies-Integration requirement - Group technology-coding-Production flow analysis-computer part programming-CAPP implementation techniques.

UNIT V**Automated manufacturing systems**

Flexible Manufacturing systems (FMS) – the FMS concepts – transfer systems – head changing FMS – Introduction to Rapid prototyping, Knowledge Based Engineering, Virtual Reality, Augmented Reality – automated guided vehicle-Robots-automated storage and retrieval systems - computer aided quality control-CMM-Non contact inspection methods.

Textbooks:

1. P.N.Rao, CAD/CAM: Principles & Applications-3rd Edition, Tata McGraw Hill.
2. CAD/CAM Concepts & applications/Alavala/PHI

References:

1. CAD/CAM Theory and Practice / IbrahimZeid / TMH..
2. CAD/CAM/CIM Radha Krishnan & Subramanian / New age
3. Principles of computer Aided Design and Manufacturing / Fanlc / Amirouche / Pearson.
4. Computer Numerical Control Concepts and Programming / Warrens & Seames / Thomson

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(Autonomous)

Course structure for Four Year Regular B.Tech. Degree Program

(Effective for the batches admitted from 2020-21)

MECHANICAL ENGINEERING (ME)

Year : III

Semester : I

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20APE0303	Nano Technology	3	0	0	3

Course Outcomes:

- 1 To identify the essential concepts used in nanotechnology
- 2 To identify the materials, properties
- 3 To Derive charecterization techniques
- 4 To Characterization of carbon allotropes, synthesis of diamond.
- 5 To derive Applications in material science, biology and medicine.

UNIT-I

INTRODUCTION: History of nano science, definition of nano meter, nano materials, nano technology. Classification of nano materials. Crystal symmetries, crystal directions, crystal planes. Band structure.

PROPERTIES OF MATERIALS: Mechanical properties, electrical properties, dielectric properties, thermal properties, magnetic properties, opto electronic properties. Effect of size reduction on properties, electronic structure of nano materials.

UNIT-II

SYNTHESIS AND FABRICATION: Synthesis of bulk polycrystalline samples, growth of single crystals. Synthesis techniques for preparation of nano particle – Bottom Up Approach – sol gel synthesis, hydro thermal growth, thin film growth, PVD and CVD; Top Down Approach – Ball milling, micro fabrication, lithography. Requirements for realizing semiconductor nano structures, growth techniques for nano structures

UNIT-III

CHARECTERIZATION TECHNIQUES: X-Ray diffraction and Scherrer method, scanning electron microscopy, transmission electron microscopy, scanning probe microscopy, atomic force microscopy, piezoresponse microscopy, X-ray photoelectron spectroscopy, XANES and XAFS, angle resolved photoemission spectroscopy, diffuse reflectance spectra, photoluminescence spectra, Raman spectroscopy

UNIT-IV

CARBON NANO TECHNOLOGY: Characterization of carbon allotropes, synthesis of diamond – nucleation of diamond, growth and morphology. Applications of nano crystalline diamond films, graphene, applications of carbon nano tubes.

UNIT-V

APPLICATIONS OF NANO TECHNOLOGY: Applications in material science, biology and medicine, surface science, energy and environment. Applications of nano structured thin films, applications of quantum dots.

TEXT BOOK:

1. Nano science and nano technology / M.S Ramachandra Rao, Shubra Singh/Wiley publishers.
2. Introduction to Nanotechnology by Risal Singh, Shipra Mital Gupta, Oxford Higher Education, First Publication 2016.

REFERENCE BOOKS:

1. Introduction to Nano Technology /Charles P. Poole, Jr., Frank J.Owens/Wiley publishers.

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2. Nanotechnology /Jermy J Ramsden/Elsevier publishers
3. Nano Materials/A.K.Bandyopadhyay/ New Age
4. Nano The Essentials, T.Pradeep, McGrawHill, 2014
5. Nanotechnology the Science of Small / M.A Shah, K.A Shah/Wiley Publisher

List of COs	PO no. and keyword	Competency Indicator	Performance Indicator
CO: 1	PO 2: Problem analysis	2.5	2.1.3
CO: 2	PO 1: Engineering knowledge PO 2: Problem analysis	2.2	2.2.3
CO: 3	PO 1: Engineering knowledge PO 2: Problem analysis	2.1	2.1.3
CO: 4	PO 1: Engineering knowledge PO 2: Problem analysis PO 3: Design/development of solutions	2.2	2.2.3
CO: 5	PO 1: Engineering knowledge PO 2: Problem analysis	2.4	2.4.3

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MECHANICAL ENGINEERING (ME)

Year : III

Semester : I

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20APC0315	Fluid Mechanics & Hydraulic Machinery Lab	0	0	3	1.5

Course Outcomes:

1	Interpret the behavior under static and dynamic conditions.
2	analyze one dimensional viscous flows using conservation laws for compressible and incompressible flows
3	apply boundary layer flows for laminar and turbulent regimes
4	explain Reynolds stresses and its application
5	explain different types of pumps and their application.

1. Calibration of Venturimeter
2. Calibration of Orifice meter
3. Determination of Coefficient of discharge for a small orifice by a constant head method.
4. Determination of Coefficient of discharge for an external mouth piece by variable head method.
5. Calibration of contracted Rectangular Notch and /or Triangular Notch.
6. Determination of Coefficient of loss of head in a sudden contraction and friction factor.
7. Verification of Bernoulli's equation.
8. Impact of jet on vanes.
9. Study of Hydraulic jump.
10. Performance test on Pelton wheel turbine.
11. Performance test on Francis turbine.
12. Efficiency test on centrifugal pump.

List of COs	PO no. and keyword	Competency	Performance Indicator
CO 1	PO1: Engineering knowledge	1.1.	1.1.2
CO 2	PO1: Engineering knowledge	1.1	1.1.2
CO 3	PO1: Engineering knowledge	1.1	1.1.1
CO 4	PO2: Problem analysis	2.4	2.4.1
CO 5	PO2: Problem analysis	2.4	2.4.1

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MECHANICAL ENGINEERING (ME)

Year : III

Semester : I

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20APC0329	Machine Tools - 1 Lab	0	0	3	1.5

Course Outcomes:

- 1 To apply knowledge of tool materials and cutting fluids in the machine shop
- 2 To develop the hands-on experience on different machining processes that will enable them to work in a typical machine shop.
- 3 To apply knowledge of metal cutting parameters, tool wear mechanisms
- 4 To understand the basic calculations of machining parameters.
- 5 To develop the practical knowledge on groove cutting, gear cutting

List of Experiments:

1. Job on plain turning on lathe machine.
2. Job on step turning on lathe machine.
3. Job on threading on lathe machine.
4. Job on taper turning on lathe machine in form tool method.
5. Job on taper turning on lathe machine in attachment method.
6. Job on up and down milling.
7. Job on gear cutting on milling machine.
8. Preparation of hexagonal nut on shaper method.
9. Preparation of square nut on shaper method.
10. Job on cylindrical component in grinding machine.

List of COs	PO no. and keyword	Competency	Performance Indicator
CO 1	PO1: Engineering knowledge	1.1.	1.1.2
CO 2	PO1: Engineering knowledge	1.1	1.1.2
CO 3	PO1: Engineering knowledge	1.1	1.1.1
CO 4	PO2: Problem analysis	2.4	2.4.1
CO 5	PO2: Problem analysis	2.4	2.4.1

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Year : III

Semester : I

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20ASA0502	SOFT SKILLS	1	0	2	2

Course Outcomes:

- 1 To develop awareness in students of the relevance and importance of soft skills
- 2 To provide students with interactive practice sessions to make them internalize soft skills
- 3 To enable them to develop employability skills
- 4 To provide knowledge of grammatical structures and vocabulary students and encourage their appropriate use in speech and writing

UNIT – I:**Grammar:** Articles, Prepositions, Antonyms, Synonyms.**Vocabulary:** Basics of Communication (Definition, Types of communication). Importance of body language in corporate culture, Body language (Facial expressions – eye contact – posture – gestures – Proxemics – Haptics – Dress Code – Paralanguage – Tone, pitch, pause & selection of words), Impromptu speeches.

Articles:

Web links: <https://learnenglish.britishcouncil.org/grammar/a1-a2-grammar/articles-1>
<https://www.youtube.com/watch?v=ueEp6U8td1I>

Prepositions:

Web links: <https://www.grammarbook.com/grammar/probPrep.asp>

Antonyms, Synonyms.

Web links: <https://www.youtube.com/watch?v=-mLRoxWM8dI>
<https://www.youtube.com/watch?v=IEOrOPVxiIM>
https://www.it.iitb.ac.in/~vijaya/ssrvrm/worksheetscd/getWorksheets.com/Language%20Arts/syn_ant.pdf

Basics of Communication (Definition , Types of communication).

Web links: https://wikieducator.org/INTRODUCTION_TO_COMMUNICATION

Importance of body language in Corporate culture

Web links: <https://www.forwardfocusinc.com/consciously-communicate/the-importance-of-body-language-in-the-workplace/>

Body language (Facial expressions – eye contact – posture – gestures – Proxemics – Haptics – Dress Code – Paralanguage –Tone, pitch, pause & selection of words)

Web links: <https://open.lib.umn.edu/communication/chapter/4-2-types-of-nonverbal-communication/>
https://en.wikipedia.org/wiki/Nonverbal_communication*Impromptu speeches.*Web links: <https://www.write-out-loud.com/impromptu-public-speaking-topics.html>;
<https://faculty.washington.edu/mcgarr/COM220/online%20readings/sample%20critique.pdf>**UNIT – II :****Grammar:** Tenses, Idioms and Phrases, One word substitutes.**Vocabulary:** Public speaking - *Oral presentations*, writing skills – *Short Essay writing and E- mail writing.*

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MECHANICAL ENGINEERING (ME)

Tenses

Web links: https://www.englisch-hilfen.de/en/grammar/english_tenses.htmj; <https://onlymyenglish.com/tenses/>;
<https://www.englishpage.com/verbp/verbtenseintro.html>;
<https://www.englishclub.com/grammar/verb-tenses.htm>

Idioms and Phrases:

Web links: <https://www.britannica.com/list/7-everyday-english-idioms-and-where-they-come-from>
<https://eslexpat.com/english-idioms-and-phrases/>;
<https://onlineteachersuk.com/english-idioms/>;

One word substitutes:

Web links: <https://www.careerpower.in/one-word-substitution.html>;
<https://www.hitbullseye.com/Vocab/One-Word-Substitute-List.php>;
<https://englishan.com/one-word-substitution-set-1/>;

Public speaking - *Oral presentations*

Web links: <https://egyankosh.ac.in/bitstream/123456789/26773/1/Unit-14.pdf>;
<https://www.skillsyouneed.com/rhubarb/preparing-oral-presentations.html>;
<https://courses.lumenlearning.com/publicspeakingprinciples/chapter/chapter-12-methods-of-delivery/>

Writing skills – *Short Essay writing and E-mail writing.*

Web links: <https://www.kibin.com/essay-writing-blog/important-essay-writing-skills/>
https://www.scribendi.com/academy/articles/academic_essay_writing_skills.en.html ;
<https://www.microsoft.com/en-us/microsoft-365/business-insights-ideas/resources/improve-email-writing-skills>;

UNIT – III :

Grammar : Direct and Indirect speeches, Active and Passive voice, Drawing inferences (reading comprehensions and listening comprehensions)

Vocabulary: Leadership Skills – Negotiation skills - Team-building – *Debate*. Leadership Skills – Negotiation skills - Team-building

Direct and Indirect speeches:

Web links: <https://onlymyenglish.com/direct-and-indirect-speech/>
<https://learnenglish.britishcouncil.org/grammar/b1-b2-grammar/reported-speech-1-statements>
<https://www.perfect-english-grammar.com/reported-speech.html>

Active and Passive voice,

Web links: <https://www.englishclub.com/grammar/passive-voice.htm>
<https://www.gingersoftware.com/content/grammar-rules/verbs/passive-voice/>
<https://nps.edu/web/gwc/revising-passive-voice-into-active-voice>

Drawing inferences (reading comprehensions and listening comprehensions)

Web links: <https://www.readingrockets.org/strategies/inference>
<https://www.thoughtco.com/making-inferences-3111201>
<https://www.comprehensionconnection.net/2019/03/exploring-difference-between-making.html>

Vocabulary: Leadership Skills – Negotiation skills - Team-building – *Debate*.

Leadership Skills – Negotiation skills - Team-building

Web links: <https://online.hbs.edu/blog/post/negotiation-skills>
<https://www.bumc.bu.edu/facdev-medicine/files/2014/08/BUSM-Leadership-training.pdf>
<https://in.indeed.com/career-advice/career-development/negotiation-skills>
<https://www.thebalancecareers.com/what-is-team-building-1918270>

Debate:

Web links: <https://noisyclassroom.com/debate-topics/>
<https://www.collegeessay.org/blog/debate-topics>
https://www.edu.gov.mb.ca/k12/cur/socstud/frame_found_sr2/tns/tn-13.pdf

UNIT – IV:

Grammar: Common errors, Rearrangement of sentences.

Vocabulary: Resume writing, Pre-interview preparation , Group discussion.

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MECHANICAL ENGINEERING (ME)

Common errors, Rearrangement of sentences:

Web links: <https://www.letsstudytogether.co/sentence-arrangement-questions-pdf-for-banking-exams-ibps-sbi-po-and-clerk/>
<https://www.youtube.com/watch?v=e8nO3zZzkZs>

Vocabulary: Resume writing, Pre-interview preparation , Group discussion.

Web links: <https://www.youtube.com/watch?v=PfJg-67smf4>
<https://www.youtube.com/watch?v=-lXjbph22Fk>

UNIT – V:**Grammar :** Verbal ability tests.**Vocabulary:** Mock interviews, Post interview Etiquette.

Verbal ability tests.

Web links: <https://prepinsta.com/infosys-english-verbal-questions/>
<https://www.indiabix.com/online-test/verbal-ability-test/random>
<https://www.allindiaexams.in/online-test/online-general-english-test/61>

Vocabulary: Mock interviews, Post interview Etiquette.

Web links: <https://www.youtube.com/watch?v=ZOLCma2QbdE>
<https://www.ziprecruiter.com/blog/the-right-way-to-follow-up-after-a-job-interview/>
<https://www.youtube.com/watch?v=KI0D19uox8>

Course Outcomes:Students will be able to:

1. Recognize the importance of verbal and non verbal skills
2. Develop the interpersonal and intrapersonal skills
3. Apply grammatical structures to formulate sentences and correct word forms.
4. Create trust among people and develop employability skills

References:

1. Barun K. Mitra, “Personality Development and Soft Skills”, OXFORD Higher Education 2018.
2. Alka Wadkar, “Life Skills for Success”, Sage publications 2016.
3. Robert M Sheffield, “Developing Soft Skills”, Pearson, 2010.
4. Diana Booher, “Communicate with Confidence” Tata mcgraw hill, 1994.
5. B.N. Gosh, “Managing Soft skills for Personality development”, Tata mcgraw hill 2012.
6. Michael Swan, “Practical English Usage”, Oxford publications.
7. Raymond Murphy, “English Grammar in Use”, Cambridge 5th Edition
8. Norman Lewis, “Word Power Made Easy”, Penguin Publishers.
9. Advanced Grammar in Use A Self-Study Reference and Practice Book for Advanced Learners of English 3rd Edition , Cambridge

List of COs	PO.No. and Key word	Competency Indicator: Description	Performance Indicator Description
CO1	PO 6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent	6.1	6.1.1

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	responsibilities relevant to the professional engineering practice		
CO2	PO 9: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings	9.2	9.2.1
CO3	PO 10: Able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	10.1	10.1.1
CO4	PO 9: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings	9.2	9.2.1

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MECHANICAL ENGINEERING (ME)

Year : III

Semester : I

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20AMC9904	Professional Ethics and Human Values	3	0	0	0

Course Outcomes:

- 1 It ensures students sustained happiness through identifying the essentials of human values and skills.
- 2 The students will understand the importance of Values and Ethics in their personal lives and professional careers.
- 3 The students will learn the rights and responsibilities as an employee, team member and a global citizen.
- 4 Students understand practically the importance of trust, mutually satisfying human behavior and enriching interaction with nature.
- 5 Students can able to develop appropriate technologies and management patterns to create harmony in professional and personal life.

UNIT - I:**12hrs**

Introduction to Human Values: Need, basic Guidelines, Content and Process for Value Education, Self Exploration - 'Natural Acceptance' and Experiential Validation. Continuous Happiness and Prosperity - A look at basic Human Aspirations. Right understanding, Relationship and Physical Facilities. Understanding Happiness and Prosperity correctly.

UNIT - II:**12hrs**

Understanding Harmony in the Family and Society: Harmony in Human - Human Relationship: Understanding harmony in the Family the basic unit of human interaction. Understanding values in human - human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship. Understanding the harmony in the society (society being an extension of family). Visualizing a universal harmonious order in society - Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha) - from family to world family!

UNIT – III:**12hrs**

Introduction to Professional Ethics: Basic Concepts, Governing Ethics, Personal & Professional Ethics, Ethical Dilemmas, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics, Profession and professionalism, Professional Associations, Professional Risks, Professional Accountabilities, Professional Success, Ethics and Profession.

UNIT – IV:**15hrs**

Professional Practices in Engineering: Work Place Rights & Responsibilities, Professions and Norms of Professional Conduct, Norms of Professional Conduct vs. Profession; Responsibilities, Obligations and Moral Values in Professional Ethics, Professional codes of ethics, the limits of predictability and responsibilities of the engineering profession. Central Responsibilities of Engineers – The Centrality of Responsibilities of Professional Ethics; lessons from 1979 American Airlines DC-10 Crash and Kansas City Hyatt Regency Walk away Collapse.

UNIT – V:**12hrs**

Global issues in Professional Ethics: Introduction – Current Scenario, Technology Globalization of MNCs, International Trade, World Summits, Issues, Business Ethics and Corporate Governance, Sustainable

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MECHANICAL ENGINEERING (ME)

Development Ecosystem, Energy Concerns, Ozone Depletion, Pollution, Ethics in Manufacturing and Marketing, Media Ethics, War Ethics, Bio Ethics, Intellectual Property Rights.

Text Books:

- 1.R. R. Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.
2. Professional Ethics: R. Subramanian, Oxford University Press, 2015.
3. Ethics in Engineering Practice & Research, Caroline Whitbeck, 2e, Cambridge University Press 2015.

Reference Books:

1. Prof. K. V. Subba Raju, 2013, Success Secrets for Engineering Students, Smart Student Publications, 3rd Edition.
2. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA
3. Engineering Ethics, Concepts Cases: Charles E Harris Jr., Michael S Pritchard, Michael J Rabins, 4e, Cengage learning, 2015.
4. Business Ethics concepts & Cases: Manuel G Velasquez, 6e, PHI, 2008.

List of COs	PO no. and keyword	Competency Indicator	Performance Indicator
CO1	PO8: Ethics: Apply Ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice.	8.1	8.1.1
CO2	PO8: Ethics: Apply Ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice.	8.1	8.1.1
CO3	PO8: Ethics: Apply Ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice.	8.1	8.1.1
CO4	PO8: Ethics: Apply Ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice.	8.1	8.1.1
CO5	PO8: Ethics: Apply Ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice.	8.1	8.1.1