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)

INDUCTION PROGRAM (3 Weeks duration)
❖ Physical activity ❖ Creative Arts ❖ Universal Human Values ❖ Literary ❖ Proficiency Modules ❖ Lectures by Eminent People ❖ Visits to local Areas ❖ Familiarization to Dept./Branch & Innovations

Semester I (First year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P	C	CIE	SEE	Total
1	Basic Science course	20ABS9901	Algebra and Calculus	3	-	-	3	30	70	100
2	Basic Science courses	20ABS9903	Engineering Physics	3	-	-	3	30	70	100
3	Engineering Science Courses	20AES0202	Basics of Electrical & Electronics Engineering	3	-	-	3	30	70	100
4	Engineering Science Courses	20AES0301	Engineering Graphics	1	-	4	3	30	70	100
5	Engineering Science Courses	20AES0501	Problem Solving and Programming	3	-	-	3	30	70	100
6	Engineering Science Courses (LAB)	20ABS9908	Engineering Physics Lab	-	-	3	1.5	30	70	100
7	Basic Science course (LAB)	20AES0204	Basics of Electrical & Electronics Engineering Lab	-	-	3	1.5	30	70	100
8	Engineering Science Courses (LAB)	20AES0503	Problem Solving and Programming Lab	-	-	3	1.5	30	70	100
			Total credits				**19.5**	**240**	**560**	**800**

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Semester II (First year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P	C	CIE	SEE	Total
1	Basic Science courses	20ABS9906	Differential Equations and Vector Calculus	3	-	-	3	30	70	100
2	Basic Science course	20ABS9905	Engineering Chemistry	3	-	-	3	30	70	100
3	Humanities and Social science	20AHS9901	Communicative English	3	-	-	3	30	70	100
4	Engineering Science Courses	20AES0509	Basics of Python Programming	3	-	-	3	30	70	100
5	Engineering Science Courses	20AES0304	Engineering Workshop Practice	1	-	4	3	30	70	100
6	Humanities and Social science LAB	20AHS9902	Communicative English Lab	-	-	3	1.5	30	70	100
7	Basic Science course (LAB)	20ABS9910	Engineering Chemistry Lab	-	-	3	1.5	30	70	100
8	Engineering Science Courses/Prof Core (Interdisciplinary) (LAB)	20AES0510	Basics of Python Programming Lab	-	-	3	1.5	30	70	100
	Mandatory course (AICTE suggested)	20AMC9902	Constitution of India	3	-	-	0	30	-	30
			Total credits				**19.5**	**270**	**560**	**830**

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Semester III (Second year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P	C	CIE	SEE	Total
1	Basic Science courses	20ABS9913	Probability and Statistics, Partial Differential Equation	3	-	-	3	30	70	100
2	Professional Core Course	20APC0308	Thermodynamics	3	-	-	3	30	70	100
3	Professional Core courses	20APC0301	Engineering Mechanics	3	-	-	3	30	70	100
4	Professional Core courses	20APC0306	Material Science and Engineering	3	-	-	3	30	70	100
5	Professional Core courses	20APC0303	Machine Drawing	3	-	-	3	30	70	100
6	Professional Core courses (LAB)	20APC0307	Material Science and Engineering Lab	-	-	3	1.5	30	70	100
7	Professional Core courses (LAB)	20APC0313	Mechanical Engineering Workshop Practice	-	-	3	1.5	30	70	100
8	Professional Core courses (LAB)	20APC0324	CAD Lab	-	-	3	1.5	30	70	100
	Skill oriented course*	20ASC0301	CATIA Lab	1	-	2	2	100	-	100
	Mandatory course (AICTE suggested)	20AMC9903	Environmental Studies	3	-	-	0	30	-	30
			Total credits				**21.5**	**370**	**560**	**930**

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Semester IV (Second year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P	C	CIE	SEE	Total
1	Engineering Science Courses	20AES0505	Internet of Things (IoT)	3	-	-	3	30	70	100
2	Basic Science Course /Prof core course	20AES0324	Thermal Engineering	3	-	-	3	30	70	100
3	Professional Core courses	20APC0312	Manufacturing Technology	3	-	-	3	30	70	100
4	Professional Core courses	20APC0302	Mechanics of Materials	3	-	-	3	30	70	100
5	Humanities and Social Sciences	20AHSMB01	Managerial Economics and Financial Analysis	3	-	-	3	30	70	100
6	Humanities and Social Sciences	20AHS9905	Universal Human Values	3	1	-	3	30	70	100
7	Engineering Science Courses (LAB)	20AES0506	Internet of Things (IoT) Lab	-	-	3	1.5	30	70	100
8	Professional Core courses (LAB)	20APC0326	Thermal Engineering Lab	-	-	3	1.5	30	70	100
9	Professional Core courses (LAB)	20APC0304	Mechanics of Materials Lab	-	-	3	1.5	30	70	100
10	Skill oriented course*	20ASC0302	Manufacturing Process Lab	1	-	2	2	100	-	100
			Total credits				**24.5**	**370**	**630**	**1000**

Community Service project with credits

(To visit the selected community to conduct survey (Socio-economic & domain survey) and conduct sensitization/awareness program/activities at the end of IV- semester before commencement of V-semester and complete immersion Programme also during V-Semester and submit report in V - semester. Assessment will be done at the end of V-Semester)

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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	Total
1	Professional Core courses	20APC0327	Machine Tools	3	-	-	3	30	70	100
2	Professional Core courses	20APC0309	Kinematics of Machines	3	-	-	3	30	70	100
3	Professional Core courses	20APC0314	Fluid Mechanics & Hydraulic Machinery	3	-	-	3	30	70	100
4	Open Elective Course/Job oriented elective	20AHSMB02	Entrepreneurship Development	3	-	-	3	30	70	100
		20APE0521	Artificial Intelligence							
		20APE0417	Sensor Networks							
5	Professional Elective courses	20APE0306	Renewable Energy Technologies	3	-	-	3	30	70	100
		20APE0302	Introduction to CAD/CAM							
		20APE0303	Nano Technology							
6	Professional Core courses Lab	20APC0315	Fluid Mechanics & Hydraulic Machinery Lab	-	-	3	1.5	30	70	100
7	Professional Core courses Lab	20APC0319	Machine Tools – 1 Lab	-	-	3	1.5	30	70	100
8	Skill advanced course/ soft skill course*	20ASA0502	Soft skills	1	-	2	2	100	-	100
9	Mandatory course (AICTE suggested)	20AMC9904	Professional Ethics and Human Values	2	-	-	0	30	-	30
10	CSP	20CSP0301	Community Service Project	-	-	-	1.5	100	-	100
Total credits							**21.5**	**440**	**490**	**930**

S. No	Professional Electives	Open Electives
1	Energy Conservation and Waste Heat Recovery	Wastewater Treatment and Recycling
2	Rapid Manufacturing	Solar Energy Engineering and Technology
3	Joining Technologies for Metals	Public Speaking
4	Metal Additive Manufacturing	Sustainable Energy Technology
5	Applied Thermodynamics	Renewable Energy Systems
6	Fundamentals Of Composite and Cellular Materials	Intellectual Property
7	Finite Element Method: Variational Methods to Computer Programming	Production and Operation Management
8	Joining Technologies for Metals	Disaster Management
9	Fundamentals of Conduction and Radiation	Basic Electronics
10	Powder Metallurgy	An Introduction to Artificial Intelligence

*Student shall register any number of MOOC courses from the above lists of Professional / Open electives listed by the department as approved by the BOS. But student is required to submit the pass certificate on NPTEL platform for at least one course with in the Programme duration (Before IV-II examination notification).

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Semester VI (Third year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P	C	CIE	SEE	Total
1	Professional Core courses	20APC0317	Heat Transfer	3	-	-	3	30	70	100
2	Professional Core courses	20APC0316	Design of Machine Elements	3	-	-	3	30	70	100
3	Professional Core courses	20APC0318	Dynamics of Machines	3	-	-	3	30	70	100
4	Professional Elective courses	20APE0308	Finite Element Analysis	3	-	-	3	30	70	100
		20APE0304	Applied Thermodynamics							
		20APE0305	Composite materials							
5	Professional Core courses Lab	20APC0328	CAM Lab	-	-	3	1.5	30	70	100
6	Professional Core courses Lab	20APC0329	Heat Transfer Lab	-	-	3	1.5	30	70	100
7	Professional Core courses Lab	20APC0330	Machine Tools – 2 Lab	-	-	3	1.5	30	70	100
8	Skill advanced course/ soft skill course*	20ASC0303	Crystal structure Analysis Lab	1	-	2	2	100	-	100
9	Mandatory course (AICTE)	20AMC9901	Biology for Engineers	3	-	-	-	30	-	30
			Total credits				**18.5**	**340**	**490**	**830**
Industrial/Research Internship (Mandatory) 2 Months during summer vacation										

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Semester VII (Fourth year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P	C	CIE	SEE	Total
1	Professional Elective courses	20APE0307	Alternative Fuels and Emission Control in Automotives	3	-	-	3	30	70	100
		20APE0311	Refrigeration & Air Conditioning							
		20APE0309	Computational Fluid Dynamics							
2	Professional Elective courses	20APE0310	Digital Manufacturing and Industry 4.0	3	-	-	3	30	70	100
		20APC0323	Operations Research							
		20APE0312	Production and Operations Management							
3	Professional Elective courses	20APE0313	Quality & Reliability Engineering	3	-	-	3	30	70	100
		20APE0314	Power Plant Engineering							
		20APE0315	Fuel cell Technologies							
4	Professional Elective courses	20APE0317	Electrical & Hybrid Vehicles	3	-	-	3	30	70	100
		20APE0301	Automobile Engineering							
		20APE0316	IC Engines & Gas Turbines							
5	Open Elective Courses/ Job oriented elective (CBCS)	20APE0119	Air Pollution and Control	3	-	-	3	30	70	100
		20AHSMB04	Intellectual Property Rights							
		20APE0117	Ground Improvement Techniques							
6	*Humanities and Social Science Elective	20AOE9901	English For Research Paper Writing	3	-	-	3	30	70	100
		20AHE9903	Professional Communication							
		20AHE9913	Effective Public Speaking Skills							
7	Skill advanced course/ soft skill course*	20AHE9902	Principles of Effective Public Speaking	1	-	2	2	100	-	100
Industrial/Research Internship 2 Months (Mandatory) after third year (to be evaluated during VII semester				-	-	-	3	100	-	100
			Total credits				**23**	**380**	**420**	**800**

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Semester VIII (Fourth year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P	C	CIE	SEE	Total
1	Major Project	20APR0301	Project work	-	-	-	9	60	140	200
2	PR	20APR0302	Internship	-	-	-	3	100	-	100
3	MOOC	OE / PE	MOOC – NPTEL (12 Week)	-	-	-	3	25	75	100
			Total credits				**15**	185	215	400

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Semester I (First year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P	C	CIE	SEE	Total
1	Basic Science course	20ABS9901	Algebra and Calculus	3	-	-	3	30	70	100
2	Basic Science courses	20ABS9903	Engineering Physics	3	-	-	3	30	70	100
3	Engineering Science Courses	20AES0202	Basics of Electrical & Electronics Engineering	3	-	-	3	30	70	100
4	Engineering Science Courses	20AES0301	Engineering Graphics	1	-	4	3	30	70	100
5	Engineering Science Courses	20AES0501	Problem Solving and Programming	3	-	-	3	30	70	100
6	Engineering Science Courses (LAB)	20ABS9908	Engineering Physics Lab	-	-	3	1.5	30	70	100
7	Basic Science course (LAB)	20AES0204	Basics of Electrical & Electronics Engineering Lab	-	-	3	1.5	30	70	100
8	Engineering Science Courses (LAB)	20AES0503	Problem Solving and Programming Lab	-	-	3	1.5	30	70	100
			Total credits				**19.5**	**240**	**560**	**800**

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Year :I B.Tech **Semester** : I **Branch of Study :** Common to All

Subject Code:20ABS9901	Subject Name: **Algebra and Calculus**	L T P 3 0 0	Credits 3	CLC 3

Course Outcomes:

1.Make use of matrix algebra techniques that is needed by engineers for practical applications.
2.Utilize mean value theorems to real life problems.
3.Interpret with functions of several variables which is useful in optimization.
4.Analyze 2- dimensional and 3- dimensional concepts in coordinate systems
5.Utilize the concept of special functions

Unit I : Matrix Operations and Solving Systems of Linear Equations 12 hrs

Rank of a matrix by echelon form, Consistency of system of homogeneous and non-homogeneous equations linear equations. Eigen values and Eigen vectors of the matrix of the linear transformation and their properties, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem,

Unit II : Quadratic Forms and Mean Value Theorems 9 hrs

Diagonalisation of a matrix, quadratic forms and nature of the quadratic forms, reduction of quadratic form to canonical forms by orthogonal transformation.
Rolle's Theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's and Maclaurin's theorems of functions of single variable with remainders (without proof);

Unit III: Multivariable calculus 9 hrs

Partial derivatives, total derivatives, chain rule, change of variables, Jacobians, maxima and minima of functions of two variables, method of Lagrange multipliers.

Unit IV: Multiple Integrals 10hrs

Double integrals, change of order of integration, double integration in polar coordinates, change of Variables in double integration (Cartesian to polar),areas of plane regions enclosed by plane curves. Evaluation of triple integrals(Cartesian coordinates only).

Unit V: Special Functions 10 hrs

Beta and Gamma functions and their properties, relation between beta and gamma functions, Bessel functions, Bessel's equation, Recurrence formulae or $J_n(x)$, Generating function- Orthoganality of Bessels functions.

Textbooks:

1. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.

References:

1. Dr.T.K.VIyengar, B.Krishna Gandhi, S. Ranganathamamd M.V.S.S.N Prasad, Mathematics – 1, S.Chand publications.
2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
3. B.V.Ramana, Higher Engineering Mathematics, McGraw Hill Education.
4. N.Bali, M.Goyal, C.Watkins, Advanced Engineering Mathematics, Infinity Science Press.

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Course Title	Course Outcomes COs	Programme Outcomes(POs) & Programme Specific Outcomes(PSOs)												
		PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Algebra & calculus	CO1	3													
	CO2	3													
	CO3	3													
	CO4		3												
	CO5		3												

***3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated**

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Year :I B.Tech **Semester** : I **Branch of Study :** Common to CE & ME

Subject Code:20ABS9903	Subject Name: **Engineering Physics**	L T P 3 0 0	Credits:3	CLC 3

Course Outcomes

1.Apply the fundamental laws of mechanics to solve engineering problems.
2. Analyze and apply the concepts of architectural acoustics and ultrasonics.
3. Analyze the properties of dielectric materials and magnetic materials for device applications.
4. Examine the types of Lasers and propagation of electromagnetic waves in optical fibers for various applications.
5. List the basic sensors and interpret the properties of nanomaterials for various applications.

Unit I : Mechanics **8 Hrs**

Basic laws of vectors and scalars –Conservative and non-conservative forces- Vector differentiation and Gradient, F=-grad V - Angular momentum and Torque-Conservation of Energy, Momentum and Angular Momentum - motion of variable mass system, motion of a rocket -Moment of Inertia-radius of Gyration-Gravitational Force, Field and Potential- Kepler`s Laws-Proof of Kepler`s laws.

Unit II : Acoustics and Ultrasonics **8 Hrs**

Introduction to Acoustics – Reverberation – Reverberation time– Sabine's formula- Derivation using growth and decay method – Absorption coefficient and its determination –factors affecting acoustics of buildings and their remedies.
Introduction to Ultrasonics – Production of Ultasonic wave by magnetostriction& piezoelectric methods Properties-acoustic grating -Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, applications.

Unit III: Dielectric and Magnetic Materials10 Hrs

Dielectric polarizability, Susceptibility and Dielectric constant-Types of polarizations: Electronic , Ionic, Orientation Polarizations (Qualitative)-Frequency dependence of polarization-Lorentz (internal) field-Claussius-Mossotti equation-Applications of Dielectrics.
Introduction-Magnetic dipole moment – Magnetization – Magnetic susceptibility and permeability – Origin of permanent magnetic moment – Classification of Magnetic materials-Domain Concepts of ferromagnetism – Hysteresis – soft and hard magnetic materials-Magnetic device applications.

Unit IV: Lasers and Fiber Optics **10 Hrs**

Introduction-Characteristics of Laser – Spontaneous and Stimulated emission of radiation-Einstein's Coefficients-Population Inversion-Pumping Mechanisms -He- Ne laser, Nd-YAG laser-Semiconductor laser-Applications of lasers.
Introduction to Optical Fibers – Total Internal Reflection-Construction of optical fibers, Critical angle of propagation – Acceptance angle – Numerical Aperture-Classification offibers based on Refractive index, profile & modes – Propagation of electromagnetic wave through optical fiber-importance of V number-Block Diagram of Fiber optic Communication system-Industrial Applications.

Unit V: Sensors and Nanomaterials **8 Hrs**

Sensors:(qualitative description only): Different types of sensors and applications; Strain Gauge, Fibre optic methods of pressure sensing; Gas sensor.
Nanomaterials–Significance of nanoscale - Physical, Mechanical, Magnetic, properties of nanomaterials – Synthesis of nanomaterials: Top-down-Ball Milling, Bottom-up- Sol-gel, methods –Applications of Nanomaterials.

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Textbooks:

1. M. N. Avadhanulu, P.G. Kshirsagar&TVS Arun Murthy". A Text book of Engineering Physics"-S.Chand Publications,11th Edition2019
2. Shatendra Sharma, Jyotsna Sharma," Engineering Physics",Pearson Education,2018.

References:

1. K.Thyagarajan "Engineering Physics",-Mc Graw Hill Publishing Company Ltd,2016.
2. MKVarma "Introduction to Mechanics"-Universities Press-2015.
3. D.K. Bhattacharya and A.Bhaskaran,"Engineering Physics"-Oxford Publications-2015.
4. IanRSinclair,Sensor andTransducers,3rd eds,2001,Elsevier(Newnes).

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3													
CO2	3													
CO3	3													
CO4	3													
CO5	3													

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

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Year: I **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
20AES0202	Basics of Electrical &Electronics Engineering	3	0	0	3

Course Outcomes: Students should be able to
CO 1: Apply concepts of KVL/KCL in solving DC circuits
CO 2: Illustrate working principles of induction motor - DC Motor
CO 3: Identify type of electrical machine based on their operation
CO 4: Describe operation and characteristics of diodes and transistors.
CO 5: Make use of diodes and transistors in simple, typical circuit applications.
CO 6: Understand operation of basic op-amp circuits.

PART-A (Electrical Engineering)

UNIT-I: **DC & AC Circuits:**

Electrical circuit elements (R - L and C) - Kirchhoff laws - Series and parallel connection of resistances with DC excitation. Superposition Theorem - Representation of sinusoidal waveforms - peak and rms values - phasor representation - real power - reactive power - apparent power - power factor - Analysis of single-phase ac circuits consisting of RL - RC - RLC series circuits.

UNIT-II: **DC & AC Machines:**

Principle and operation of DC Generator - EMF equations - OCC characteristics of DC generator – principle and operation of DC Motor – Performance Characteristics of DC Motor - Speed control of DC Motor – Principle and operation of Single Phase Transformer - OC and SC test on transformer - principle and operation of Induction Motor [Elementary treatment only]

UNIT-III: Basics of Power Systems:

Layout & operation of Hydro, Thermal, Nuclear Stations - Solar & wind generating stations – Typical AC Power Supply scheme – Elements of Transmission line – Types of Distribution systems: Primary & Secondary distribution systems.

Text Books:

1. D. P. Kothari and I. J. Nagrath - “Basic Electrical Engineering” - Tata McGraw Hill - 2010.
2. V.K. Mehta & Rohit Mehta, “Principles of Power System” – S.Chand – 2018.

References:

1. L. S. Bobrow - “Fundamentals of Electrical Engineering” - Oxford University Press - 2011.
2. E. Hughes - “Electrical and Electronics Technology” - Pearson - 2010.
3. C.L. Wadhwa – “Generation Distribution and Utilization of Electrical Energy”, 3rd Edition, New Age International Publications.

PART-B (Electronics Engineering)

UNIT I Analog Electronics:

Overview of Semiconductors, PN junction diode, Zener diode, Applications of diode as switch and rectifier, Zener diode as regulator, special purpose diodes: schottky diode, tunnel diode, varactor diode, photodiode, phototransistor and LED.

BJT construction, operation, configuration and characteristics, JFET and MOSFET construction, operation, characteristics (CS configuration), applications

Operational Amplifiers: Introduction, block diagram, basic op-amp circuits: Inverting, Non Inverting, summer, subtractor, voltage follower.

UNIT II Digital Electronics:

Introduction, Switching and Logic Levels, Digital Waveform, characteristics of digital ICs, logic gates, number systems, combinational circuits - adders, multiplexers, decoders; introduction to sequential circuits, flip flops, shift register, binary counter.

UNIT III Communication Systems:

Introduction, Elements of Communication Systems, EM spectrum, basics of electronic communication, Amplitude and Frequency modulation, Pulse modulation, Communication receivers, Examples of communication systems: Microwave & Satellite, Fibre optic, Television, mobile communication (block diagram approach).

Text Books:

1. D.P. Kothari, I.J.Nagrath, Basic Electronics, 2nd edition, McGraw Hill Education (India) Private Limited

2. S.K. Bhattacharya, Basic Electrical and Electronics Engineering, 2nd edition, Pearson India Private Limited.

References:

1. R. Muthu subramanian, S. Salivahanan, "Basic Electrical and Electronics Engineering", Tata McGraw-Hill Education, Reprint 2012.

2. David Bell, Electronic Devices and Circuits: Oxford University Press, 5th edition. 2008.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	1								2	
CO2	3	2	1	2									1	
CO3	3	1	1										1	
CO4	3	2	1	2									2	
CO5	3	1	1	2	1								2	
CO6	3	1											1	

(Levels of Correlation, viz., 1.Low, 2.Moderate, 3.High)

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MECHANICAL ENGINEERING (ME)

Year: I **Semester: I/II** **Branch of Study: Common to all Branches**

Subject Code	Subject Name	L	T	P	Credits
20AES0301	Engineering Graphics	1	0	4	3

Course Outcomes:

CO: 1 Draw various curves applied in engineering.
CO: 2 Draw the projection of points and lines located in different quadrants
CO: 3 Draw the projection of planes and solids located in different quadrants.
CO: 4 Draw sectional views and develop surfaces of a given object.
CO: 5 Draw orthographic projections and Isometric projection.

Unit I: Introduction to Engineering graphics: Principles of Engineering Graphics and their significance- Conventions in drawing-lettering - BIS conventions.

a) Conic sections including the rectangular hyperbola- general method only,
b) Cycloid, epicycloids and hypocycloid

Unit II: Projection of points, lines: Projection of points in any quadrant, lines inclined to one or both planes, finding true lengths, angle made by line, traces.

Unit III: Projections of Planes: Projection of points in any quadrant, lines inclined to one or both planes, finding true lengths, angle made by line. Projections of regular plane surfaces.
Projections of Solids: Projections of regular solids inclined to one or both planes by rotational or auxiliary views method.

Unit IV: Sections of solids: Section planes and sectional view of right regular solids- prism, cylinder, pyramid and cone. True shapes of the sections.
Development of surfaces: Development of surfaces of right regular solids-prism, cylinder, pyramid, cone and their sectional parts.

Unit V: Orthographic Projections: Systems of projections, conventions and application to orthographic projections.
Isometric Projections: Principles of isometric projection- Isometric scale; Isometric views: lines, planes, figures, simple and compound solids.

Text Books:

1. K.L.Narayana & P.Kannaiah, Engineering Drawing, 3/e, Scitech Publishers
2. N.D.Bhatt, Engineering Drawing, 53/e, Charotar Publishers
3. Dhanajay A Jolhe, Engineering Drawing, Tata McGraw-Hill
4. Shah and Rana, Engineering Drawing, 2/e, Pearson Education
5. Basant Agarwal & C.M.Agarwal, Engineering Drawing, Tata McGraw-Hill

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3														
CO2	3	1													
CO3	3											1			
CO4	3											2			
CO5	3				3							3			

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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Course structure for Four Year Regular B.Tech. Degree Program
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MECHANICAL ENGINEERING (ME)

Course Code	Problem Solving And Programming		L	T	P	C
20AES0501			3	0	0	3
Pre-requisite	Basic Mathematics	Semester	I - I			

Course Objectives:

- Introduce the internal parts of a computer, and peripherals.
- Introduce the Concept of Algorithm and use it to solve computational problems
- Identify the computational and non-computational problems
- Teach the syntax and semantics of a C Programming language
- Demonstrate the use of Control structures of C Programming language
- Illustrate the methodology for solving Computational problems

Course Outcomes (CO):

CO1: Able to know interconnection of peripherals and connects of algorithms and flowcharts
CO2: Able to know problem solving aspects, design and analysis of algorithm
CO3: Able to know flow control, input output and implementation functions
CO4: Able to solve computational problems using functions, array and pointers
CO5: Able to organise real world heterogeneous data and apply searching ,sorting techniques with exception handling

UNIT – I		8 Hrs

Computer Fundamentals: What is a Computer, Evolution of Computers, Generations of Computers, Classification of Computers, Anatomy of a Computer, Memory revisited, Introduction to Operating systems, Operational overview of a CPU.
Introduction to Programming, Algorithms and Flowcharts: Programs and Programming, Programming languages, Compiler, Interpreter, Loader, Linker, Program execution, Fourth generation languages, Fifth generation languages, Classification of Programming languages, Structured programming concept, Algorithms, Pseudo-code, Flowcharts, Strategy for designing algorithms, Tracing an algorithm to depict logic, Specification for converting algorithms into programs.

UNIT – II		9 Hrs

Introduction to computer problem solving: Introduction, the problem-solving aspect, top-down design, implementation of algorithms, the efficiency of algorithms, and the analysis of algorithms.
Fundamental algorithms: Exchanging the values of two variables, counting, summation of a set of numbers, factorial computation, sine function computation, generation of the Fibonacci sequence, reversing the digits of an integer.

UNIT – III		8 Hrs

Types, Operators, and Expressions: Variable names, data types and sizes, constants, declarations, arithmetic operators, relational and logical operators, type conversions, increment and decrement operators, bitwise operators, assignment operators and expressions, conditional expressions precedence and order of evaluation.
Input and output: standard input and output, formatted output-Printf, formatted input-Scanf.
Control Flow: Statements and blocks, if-else, else-if, switch, Loops-while and for, Loops-Do- while, break and continue, Goto and labels.
Functions and Program Structure: Basics of functions, functions returning non-integers, external variables, scope variables, header variables, register variables, block structure, initialization, recursion, the C processor.

UNIT – IV		9 Hrs

Factoring methods: Finding the square root of a number, the smallest divisor of a number, the greatest common divisor of two integers, generating prime numbers.
Pointers and arrays: Pointers and addresses, pointers and function arguments, pointers and arrays, address arithmetic, character pointers and functions, pointer array; pointers to pointers, Multi-dimensional arrays, initialization of arrays, pointer vs. multi-dimensional arrays, command line arguments, pointers to functions, complicated declarations.
Array Techniques: Array order reversal, finding the maximum number in a set, removal of duplicates from an order array, finding the k^{th} smallest element

UNIT – V		9 Hrs

Sorting and Searching: Sorting by selection, sorting by exchange, sorting by insertion, sorting by partitioning, binary search.
Structures: Basics of structures, structures and functions, arrays of structures, pointers to structures, self-referential structures, table lookup, typedef, unions, bit-fields.
Some other Features: Variable-length argument lists, formatted input-Scanf, file access, Error handling-stderr and exit, Line Input and Output, Miscellaneous Functions.

Textbooks:

1. Pradip Dey, and Manas Ghosh, "Programming in C", 2018, Oxford University Press.
2. R.G. Dromey, "How to Solve it by Computer". 2014, Pearson.
3. Brian W. Kernighan, and Dennis M. Ritchie, "The C Programming Language", 2nd Edition, Pearson.

Reference Books:

1. RS Bichkar "Programming with C", 2012, Universities Press.
2. Pelin Aksoy, and Laura Denardis, "Information Technology in Theory", 2017, Cengage Learning.

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3. Byron Gottfried and Jitender Kumar Chhabra, "Programming with C", 4th Edition, 2019, McGraw Hill Education.

Online Learning Resources:

www.nptel.ac.in

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2											3	
CO2	3	3	2										2	
CO3	2	3	3										2	
CO4	2	1	3	2									2	
CO5	2	1	3	3	2			2				3	2	2

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

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MECHANICAL ENGINEERING (ME)

Year :I B.Tech **Semester** : I **Branch of Study :** Common to CE & ME

Subject Code:20ABS9908	Subject Name: **Engineering Physics Lab**	L T P 0 0 3	Credits:1.5

Course Outcomes

1. Operate various optical instruments and estimate wavelength of laser and particles size using laser.
2. Estimate the susceptibility and related magnetic parameters of magnetic materials and plot the intensity of the magnetic field of circular coil carrying current with distance.
3. Evaluate the acceptance angle of an optical fiber and numerical aperture and determine magnetic susceptibility of the material and its losses by B-H curve.
4. Identify the type of semiconductor i.e., n-type or p-type using Hall effect.
5. Apply the concepts of sensors and nanomaterials for various applications.

List of Experiments

1. Determination of wavelength of LASER light using diffraction grating.
2. Determination of particle size using LASER.
3. Hall effect-Determination of Hall voltage and Hall coefficient of a given semiconductor.
4. Determination of Magnetic field along the axis of a circular coil carrying current.
5. Determination of Rigidity modulus of a wire-Torsional pendulum
6. Study the variation of B versus H by magnetizing the magnetic material (B-H curve)
7. Determination of numerical aperture of a given optical fiber and angle of acceptance
8. Study the variation of pressure using Strain Guage sensor
9. Study the variation of temperature using Strain Guage sensor.
10. Determination of Dielectric constant of dielectric material using charging and discharging of capacitor.
11. Determination of spring constant using Coupled Oscillator.
12. Determination of ultrasonic velocity in liquid using Acoustic grating.
13. Measurement of magnetic susceptibility by Gouy's method.
14. Study the variation of pressure using optical fiber sensors.
15. Determination of crystallite size and lattice parameters using X-ray diffraction (XRD) technique.

References:

1. S. Balasubramanian, M.N.Srinivasan, "A Text book of Practical Physics"-S Chand Publishers, 2017.
2. http://vlab.amrita.edu/index.php-VirtualLabs, Amrita University.
3. https://archive.nptel.ac.in/courses/112/106/112106227/

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3			3										
CO2	3			3										
CO3	3			3										
CO4	3			3										
CO5	3			3										

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

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MECHANICAL ENGINEERING (ME)

Year: I **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L T P	Credits
20AES0204	Basics of Electrical &Electronics Engineering Lab	0 0 3	1.5

Course Outcomes: Students should be able to

CO1: Verify Kirchoff's Laws & Superposition theorem for dc supply

CO2: Analyze the performance of AC and DC Machines by testing.

CO3.Study I – V Characteristics of PV Cell & Perform speed control of dc shunt motor

CO4: Ability to operate diodes for finding V-I Characteristics.

CO5: Ability to construct and operate rectifiers without & with filters

CO6: Ability to construct and operate BJT & FET Characteristics.

List of Experiments:

PART-A

1. Verification of Kirchhoff laws.
2. Verification of Superposition Theorem.
3. Open circuit characteristics of a DC Shunt Generator.
4. Speed control of DC Shunt Motor.
5. OC & SC test of 1 – Phase Transformer.
6. Brake test on 3 - Phase Induction Motor.
7. Brake test on DC Shunt Motor

PART-B

1. PN Junction Diode Characteristics.
2. Zener Diode Characteristics.
3. Rectifiers (With and Without Filter).
4. BJT Characteristics (CB Configuration).
5. BJT Characteristics (CE Configuration).
6. FET Characteristics (CS Configuration).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2										2	
CO2	3	2	2										2	
CO3	3	1	1										2	
CO4	3	2	2										2	
CO5	3	1	2										2	
CO6	3	1											2	

(Levels of Correlation, viz., 1.Low, 2.Moderate, 3.High)

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Course Code	Problem Solving And Programming Lab		L	T	P	C
20AES0503			0	0	3	1.5
Pre-requisite	Basic Mathematics	Semester	I - I			

Course Objectives:

The course is designed to provide complete knowledge of C language. Students will be able to develop logics which will help them to create programs, applications in C. Also by learning the basic programming constructs they can easily switch over to any other language in future.

Course Outcomes (CO):

CO1: Assemble and disassembling parts of a Computer
CO2: Identify to control structure to solving the problem
CO3: Analyze different sorting algorithms
CO4: Design solutions for computational problems
CO5: Develop C programs which utilize the memory efficiently using programming constructs like pointers.

Laboratory Experiments

1. Assemble and disassemble parts of a Computer
2. Design a C program which reverses the number
3. Design a C program which finds the second maximum number among the given list of numbers.
4. Construct a program which finds the kth smallest number among the given list of numbers.
5. Design an algorithm and implement using C language the following exchanges a ← b ← c ← d ← a
6. Develop a C Program which counts the number of positive and negative numbers separately and also compute the sum of them.
7. Implement the C program which computes the sum of the first n terms of the series Sum = 1 – 3 + 5 -7 + 9
8. Design a C program which determines the numbers whose factorial values are between 5000 and 32565.
9. Design an algorithm and implement using a C program which finds the sum of the infinite series $1 - x^2/2! + x^4/4! - x^6/6! + ...$
10. Design a C program to print the sequence of numbers in which each number is the sum of the three most recent predecessors. Assume first three numbers as 0, 1, and 1.
11. Implement a C program which converts a hexadecimal, octal and binary number to decimal number and vice versa.
12. Develop an algorithm which computes the all the factors between 1and100 for a given number and implement it using C.
13. Construct an algorithm which computes the sum of the factorials of numbers between m and n.
14. Design a C program which reverses the elements of the array.
15. Given a list of n numbers, Design an algorithm which prints the number of stars equivalent to the value of the number. The starts for each number should be printed horizontally.
16. Implement the sorting algorithms a. Insertion sort b. Exchange sort c. Selection sort d. Partitioning sort.
17. Illustrate the use of auto, static, register and external variables.
18. Design algorithm and implement the operations creation, insertion, deletion, traversing on a singly linked list.
19. Develop a C program which takes two numbers as command line arguments and finds all the common factors of those two numbers.
20. Design a C program which sorts the strings using array of pointers.

Instructors may add some experiments to the above list. Moreover, 50% of the experiments are to be changed every academic year. Instructors can choose the experiments, provided those experiments are not repetitions.

Textbooks:

1. Pradip Dey, and Manas Ghosh, “Programming in C”, 2018, Oxford University Press.
2. R.G. Dromey, “How to Solve it by Computer”. 2014, Pearson.
3. Brian W. Kernighan, and Dennis M. Ritchie, “The C Programming Language”, 2nd Edition, Pearson.

Reference Books:

1. B. Govindarajulu, “IBM PC and Clones Hardware Trouble shooting and Maintenance”, Tata McGraw-Hill, 2nd edition, 2002.
2. R.G. Dromey, “How to Solve it by Computer”. 2014, Pearson.

Online Learning Resources:

www.nptel.ac.in/cprogramming

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI

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

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MECHANICAL ENGINEERING (ME)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2							2				2	
CO2	2	2	2										2	
CO3	2	2											2	
CO4	2	2	3	2									2	2
CO5	2	2	3	3	2							3	2	2

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

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MECHANICAL ENGINEERING (ME)
Semester II (First year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P	C	CIE	SEE	Total
1	Basic Science courses	20ABS9906	Differential Equations and Vector Calculus	3	-	-	3	30	70	100
2	Basic Science course	20ABS9905	Engineering Chemistry	3	-	-	3	30	70	100
3	Humanities and Social science	20AHS9901	Communicative English	3	-	-	3	30	70	100
4	Engineering Science Courses	20AES0509	Basics of Python Programming	3	-	-	3	30	70	100
5	Engineering Science Courses	20AES0304	Engineering Workshop Practice	1	-	4	3	30	70	100
6	Humanities and Social science LAB	20AHS9902	Communicative English Lab	-	-	3	1.5	30	70	100
7	Basic Science course (LAB)	20ABS9910	Engineering Chemistry Lab	-	-	3	1.5	30	70	100
8	Engineering Science Courses/Prof Core (Interdisciplinary) (LAB)	20AES0510	Basics of Python Programming Lab	-	-	3	1.5	30	70	100
	Mandatory course (AICTE suggested)	20AMC9902	Constitution of India	3	-	-	0	30	-	30
			Total credits				**19.5**	**270**	**560**	**830**

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MECHANICAL ENGINEERING (ME)

Year : I B.Tech – II Sem **Branch of Study: Common to EEE, CE, ME and ECE**

Subject Code	Subject Name: **Differential Equations and Vector Calculus**	**L**	**T**	**P**	Credits	CLC
20ABS9906		**3**	**0**	**0**	3	3

Course Outcomes:

1.Apply the mathematical concepts of ordinary differential equations of higher order.
2. Solve the differential equations related to various engineering fields .
3. Identify solution methods for partial differential equations that model physical processes .
4. Interpret the physical meaning of different operators such as gradient, curl and divergence .
5. Evaluate the work done against a field, circulation and flux using vector calculus .

UNIT I: Linear Differential Equations of Higher Order **9 hrs**

Definitions, complete solution, operator D, rules for finding complimentary function, inverse operator, rules for finding particular integral (e^{ax}, sinax (or) cosax, X^k, $e^{ax}v$, x v(x)), method of variation of parameters.

UNIT II: Equations Reducible to Linear Differential Equations and Applications 9 hrs

simultaneous linear equations with constant coefficients ,Cauchy's and Legendre's linear equations, Applications to oscillations of a spring, L-C-R Circuit problems and Mass spring system.

UNIT III: Partial Differential Equations of First order and Higher Order **9 hrs**

Linear Equations of First order P.D.E: Method of Grouping, Method of Multipliers.
Non-linear Equations of First Order PDE: f (p , q) = 0, f (z, p ,q) = 0, f (x , p) = F (y , q) and z = px +qy + f (p , q) OR Clairaut's Equation.
Homogenous Linear P.D.E with constant coefficients of Higher order: Finding complementary function,Finding Particular Integrals of e^{ax+by}, Sin (ax+by) Or Cos (ax +by), X^mY^n and for any function of F (x, y). Non-Homogenous Linear P.D.E of constant coefficient

UNIT IV:Vector differentiation **9 hrs**

Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient, del applied to vector point functions-Divergence and Curl, vector identities.

UNIT V: Vector integration **9 hrs**

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and applications of these theorems.

Text Books :

1. B. S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2011.

References:

1. Dr.T.K.V.Iyengar, Engineering Mathematics-I,S.Chand publishers
2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics,Laxmi publication,2008
4. B. V. Ramana, Higher Engineering Mathematics, Mc Graw Hill Education.

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Correlation of COs with the POs & PSOs for B.Tech
AK-20 Regulations
*3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated

Course Title	Course Outcomes COs	Programme Outcomes(POs) & Programme Specific Outcomes(PSOs)													
		PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Differential Equations & Vector	CO1	3													
	CO2		2												
	CO3	3													
	CO4	3													
	CO5		2												

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MECHANICAL ENGINEERING (ME)

I B.Tech. **Common to I Sem – CE, II Sem ME**

Subject Code	Subject Name	L T P	Credits:3	CLC
20ABS9905	Engineering chemistry	3 0 0		3

Course Outcomes:

1. Understand the disadvantages of using hard water in domestically and industrially and select suitable treatments
2. Apply the electrochemical principles to the construction of battery and fuel cells, understand the corrosion prevention methods and factors affecting corrosion
3. Outline the preparation, mechanism, properties and applications of polymer and conducting polymers and Interpret the different types of conventional and nonconventional fuels
4. Understand the manufacturing of Portland cement and properties of concrete
5. Utilize the applications of physicochemical methods in surface characterization of solids

Unit 1: Water Technology **(8 hrs)**

Introduction –Soft Water and hardness of water, Estimation of hardness by EDTA Method. Boiler troubles - scale and sludge, Industrial water treatment – specifications for drinking water, Bureau of Indian Standards(BIS) and World health organization(WHO) standards, zeolite and ion-exchange processes, desalination of brackish water, reverse osmosis (RO) and electrodialysis.

Unit 2: Electrochemistry and Applications: **(10 hrs)**

Electrodes – concepts, electrochemical cell, Nernst equation, cell potential calculations.

Primary cells – Button Cells & Zinc –Air Battery, Fuel cells- hydrogen-oxygen, methanol fuel cells – working of the cells.

Secondary cells – lead acid, nickel-metal hydride and lithium ion batteries- working of the batteries including cell reactions.

Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry electrochemical corrosion, Pilling Bedworth ratios and uses, environmental factors (pH, temperature, DO) affecting corrosion rate, protection – corrosion inhibitors with specific examples, cathodic and anodic protection, electroplating and electro less plating (Nickel and Copper).

Unit 3: Polymers and Fuel Chemistry: **(12 hrs)**

Polymers-Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, coordination polymerization, copolymerization and stereospecific polymerization with specific examples and mechanisms of polymer formation.

Plastics-Thermoplastics and Thermosetting Plastics,

Elastomers–Buna-S, Buna-N–preparation, properties and applications.

Conducting polymers – polyacetylene, polyaniline, polypyrroles – mechanism of conduction and applications.

Fuels – Types of fuels, calorific value, numerical problems based on calorific value; Analysis of coal, refining of petroleum, liquid fuels, fuels for IC engines, knocking and anti-knock agents, Octane and Cetane values, cracking of oils; alternative fuels- propane, methanol and ethanol, bio fuels.

Unit 4: Cement and Concrete Chemistry: **(8 hrs)**

Introduction to building materials – Portland cement, constituents, manufacturing process-raw materials for manufacturing process, reactions below 1300 ^{o}C and reactions between 1300 and 1450 ^{o}C, reactions during cooling, grinding or storage, chemical equations, phases of cement clinker (alite, belite, aluminate and ferrite), reactivity of clinker phases, parameters to characterize the clinker formation: lime saturation factor (LSF), silica ratio (SR) and alumina ration (AR), chemistry of setting and hardening of cement (hydration, hydrolysis, equations), scheme of concrete formation, admixtures for concrete

improvement – retarders, accelerators, air-entraining agents, grinding agents, super plasticizers, dispersants, etc.

Unit 5: Surface Chemistry and Applications: (10 hrs)

Introduction to surface chemistry, colloids, synthesis of colloids (any two methods with examples), stabilization of colloids, micelle formation, BET equation (no derivation), chemical and electrochemical methods for the preparation of nanometal and metal oxides (not more than two methods), characterization of surface by physicochemical methods (SEM, TEM and XRD), applications of colloids and nanomaterials – catalysis, medicine, sensors, etc.

Text books:

1. Jain and Jain, Engineering Chemistry, 16/e, Dhanpat Rai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.
3. Engineering Chemistry by G V Subba Reddy, K N Jayaveera and C Ramachandraiah, Mc Graw Hill education (India) Private Limited.

Reference books:

1. H.F.W. Taylor, Cement Chemistry, 2/e, Thomas Telford Publications, 1997.
2. D.J. Shaw, Introduction to Colloids and Surface Chemistry, Butterworth-Heineman, 1992.
3. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.

Correlation of COs with the POs & PSOs

***3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated**

Course Title	Course Outcomes COs	Programme Outcomes(POs) & Programme Specific Outcomes(PSOs)													
		PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Engineering chemistry	CO1	3													
	CO2	3		1											
	CO3	3		1											
	CO4	3													
	CO5	3				2									

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MECHANICAL ENGINEERING (ME)

I B.Tech **Branch : Common to all**

Subject Code 20AHS9901	Subject Name **COMMUNICATIVE ENGLISH**	L T P 3 0 0	Credit: 3	CLC 2

Course Objectives

* Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers
- Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
- Help improve speaking skills through participation in activities such as role plays, discussions and structured talks/oral presentations
- Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information
- Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

SYLLABUS

UNIT -1
Lesson: On the Conduct of Life: William Hazlitt
Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.
Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.
Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.
Writing: Beginnings and endings of paragraphs – introducing the topic, summarizing the main idea and/or providing a transition to the next paragraph.
Grammar and Vocabulary- I : Parts of Speech, Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countable and uncountable; singular and plural; basic sentence structures; simple question form – Wh questions; word order in sentences.
Vocabulary -2: Formal/academic words and phrases.

UNIT -2
Lesson: The Brook: Alfred Tennyson
Listening: Answering a series of questions about main idea and supporting ideas after listening to audio texts.
Speaking: Discussion in pairs/small groups on specific topics followed by short structured talks.
Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.
Writing: Paragraph writing (specific topics) using suitable cohesive devices;
Mechanics of writing – punctuation, capital letters.
Grammar & Vocabulary building-1: Cohesive devices – linkers, sign posts and transition signals; use of articles and zero article; prepositions.
Vocabulary building: 2 Idioms and Phrases, Homonyms, Homophones and Homographs.

UNIT -3
Lesson: The Death Trap: Saki
Listening: Listening for global comprehension and summarizing what is listened to.
Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed **Reading:** Reading a text in detail by making basic inferences – recognizing and interpreting specific context clues; strategies to use text clues for comprehension.
Writing: Summarizing – identifying main idea/s and rephrasing what is read.
Grammar and Vocabulary building-II: Direct and indirect speech, reporting verbs for academic purposes.

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Technical Writing-1: personal experiences, unforgettable incidents, travelogues. (Imaginative, Narrative and Descriptive)

UNIT-4

Lesson: Innovation: Muhammad Yunus

Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.

Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) – asking for and giving information/directions

Reading: Studying the use of graphic elements in texts to convey information, reveal trends / patterns / relationships, communicate processes or display complicated data.

Writing: Letter Writing: Official Letters/Report writing**, *e-mail writing***

Grammar and Vocabulary: Quantifying expressions – adjectives and adverbs; comparing and contrasting; Voice – Active & Passive Voice.

Vocabulary:2 : Jigsaw Puzzles, Vocabulary Activities through Web tools

UNIT -5

Lesson: Politics and the English Language: George Orwell

Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.

Speaking: Formal oral presentations on topics from academic contexts – without the use of PPT slides.

Reading: Reading for comprehension.

Writing: Writing structured essays on specific topics using suitable claims and evidences.

Grammar and Vocabulary: Editing short texts –identifying and correcting common errors in grammar and usage.

Technical Writing-2: Narrative short story, News paper articles on science fiction.

Course Outcomes:

Students will be able to

1. Understand the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English.
2. Apply grammatical structures to formulate sentences and correct word forms.
3. Analyze discourse markers to speak clearly on a specific topic in informal discussions.
4. Evaluate reading/listening texts and to write summaries based on global comprehension of these texts.
5. Create a coherent paragraph interpreting a figure/graph/chart/table

Text Book:

1. Language and Life: A Skills Approach- I Edition 2019, Orient Black Swan

Reference Books:

1. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
2. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018.
3. Raymond Murphy's English Grammar in Use Fourth Edition (2012) E-book
4. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.
5. Oxford Learners Dictionary, 12th Edition, 2011
6. Norman Lewis Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary (2014)
7. Speed Reading with the Right Brain: Learn to Read Ideas Instead of Just Words by David Butler

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Web links

www.englishclub.com
www.easyworldofenglish.com
www.languageguide.org/english/
www.bbc.co.uk/learningenglish
www.eslpod.com/index.html
www.myenglishpages.com

Correlation of COs with the POs & PSOs for B.Tech
AK-20 Regulations
*3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated

Course Title	Course Outcomes COs	Programme Outcomes(POs)											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
Communicative English	CO1										3		
	CO2									3			
	CO3										3		
	CO4										3		
	CO5										3		

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MECHANICAL ENGINEERING (ME)

Course Code	Basics of Python Programming		L	T	P	C
20AES0509			3	0	0	3
Pre-requisite	NILL	Semester	I-II			

Course Objectives:

- To learn the fundamentals of Python
- To elucidate problem-solving using a Python programming language
- To introduce a function-oriented programming paradigm through python
- To get training in the development of solutions using modular concepts
- To introduce the programming constructs of python

Course Outcomes (CO):

CO1: Understanding the syntax and semantics of Python programming.
CO2: Apply modularity to programs.
CO3: Select appropriate data structure of Python for solving a problem.
CO4: Implement Mutable and Immutable data types
CO5: Interpret the concepts of object oriented programming as used in Python

UNIT - I	9Hrs

Introduction: What is a program, Running python, Arithmetic operators, Value and Types. **Variables, Assignments and Statements**: Assignment statements, Script mode, Order of operations, string operations, comments. **Functions**: Function calls, Math functions, Composition, Adding new Functions, Definitions and Uses, Flow of Execution, Parameters and Arguments, Variables and Parameters are local, Stack diagrams, Fruitful Functions and Void Functions, Why Functions.

UNIT - II	9 Hrs

Case study: The turtle module, Simple Repetition, Encapsulation, Generalization, Interface design, Refactoring, docstring. **Conditionals and Recursion**: floor division and modulus, Boolean expressions, Logical operators, Conditional execution, Alternative execution, Chained conditionals, Nested conditionals, Recursion, Infinite Recursion, Keyboard input. **Fruitful Functions**: Return values, Incremental development, Composition, Boolean functions, more recursion, Leap of Faith, Checking types

UNIT - III	9 Hrs

Iteration: Reassignment, Updating variables, The while statement, Break, Square roots, Algorithms. **Strings**: A string is a sequence, len, Traversal with a for loop, String slices, Strings are immutable, Searching, Looping and Counting, String methods, The in operator, String comparison. **Case Study**: Reading word lists, Search, Looping with indices. **Lists**: List is a sequence, Lists are mutable, Traversing a list, List operations, List slices, List methods, Map filter and reduce, Deleting elements, Lists and Strings, Objects and values, Aliasing, List arguments.

UNIT - IV	8 Hrs

Dictionaries: A dictionary is a mapping, Dictionary as a collection of counters, Looping and dictionaries, Reverse Lookup, Dictionaries and lists, Memos, Global Variables. **Tuples:** Tuples are immutable, Tuple Assignment, Tuple as Return values, Variable-length argument tuples, Lists and tuples, Dictionaries and tuples, Sequences of sequences. **Files:** Persistence, Reading and writing, Format operator, Filename and paths, Catching exceptions, Databases, Pickling, Pipes, Writing modules. **Classes and Objects**: Programmer-defined types, Attributes, Instances as Return values, Objects are mutable, Copying.

UNIT - V	10Hrs

Classes and Functions: Time, Pure functions, Modifiers, Prototyping versus Planning **Classes and Methods**: Object oriented features, Printing objects, The init method, The __str__method, Operator overloading, Type-based Dispatch, Polymorphism, Interface and Implementation **Inheritance**: Card objects, Class attributes, Comparing cards, decks, Printing the Deck, Add Remove shuffle and sort, Inheritance, Data encapsulation. **The Goodies:** Conditional expressions, List comprehensions, Generator expressions, any and all, Sets, Counters, default dict, Named tuples, Gathering keyword Args

Textbooks:

1. Allen B. Downey, “Think Python”, 2nd edition, SPD/O’Reilly, 2016.

Reference Books:

1. Martin C.Brown, “The Complete Reference: Python”, McGraw-Hill, 2018.
2. Kenneth A. Lambert, B.L. Juneja, “Fundamentals of Python”, CENGAGE, 2015.
3. R. Nageswara Rao, “Core Python Programming”, 2nd edition, Dreamtech Press, 2019

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2		2									
CO2	2			2									2	1
CO3	2	2	2	2									2	1
CO4	2		3		2								2	1
CO5	2	2	3		3				2				2	1

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

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MECHANICAL ENGINEERING (ME)
Year : I Semester : II Branch of Study : CE, ECE, ME, EEE

Subject Code	Subject Name	L	T	P	Credits
20AES0304	Engineering Workshop Practice	1	0	4	3

Course Outcomes:

CO: 1 Apply wood working skills in real world applications.
CO: 2 Build different parts with metal sheets in real world applications.
CO: 3 Apply fitting operations in various applications.
CO: 4 Apply different types of basic electric circuit connections.
CO: 5 Demonstrate soldering and brazing.

Wood Working:
Familiarity with different types of woods and tools used in wood working and make following joints

a) Half – Lap joint
b) Mortise and Tenon joint
c) Corner Dovetail joint or Bridle joint

Sheet Metal Working:
Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets

a) Tapered tray b) Conical funnel

c) Elbow pipe d) Brazing

Fitting:
Study the difference types of fits and tolerances, surface finishing materials. Familiarity with different types of tools used in fitting and do the following fitting exercises

a) V-fit b) Dovetail fit

c) Semi-circular fit d) Bicycle tyre puncture and change of two wheeler tyre

Electrical Wiring:

Study the different types of circuits and connections,
Familiarities with different types of basic electrical circuits and make the following connections.

a) Parallel and series b) Two-way switch

c) Godown lighting d) Tube light

e) Three phase motor f) Soldering of wires

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					2			3						
CO2			2												
CO3		3			3										
CO4				2											
CO5	2		2						3						

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B. Tech I-Year **Branch : Common to all**

Subject Code: 20AHS9902	Subject Name: **Communicative English Lab**	L T P 0 0 2	Credits: 1.5	CLC - 1

Course Objectives:

1. Students will be exposed to a variety of self instructional, learner friendly modes of language learning.
2. Students will learn better pronunciation through Phonetics.
3. Students will be trained to use language effectively to face interviews, group discussions, public speaking
4. Students will be initiated into greater use of the computer in resume preparation, report writing, format making etc.

Syllabus

Unit 1
1. Phonetics
2. Non - verbal communication
3. Vocabulary (word formation, one word substitutes, words often misused & confused, collocations idioms & phrases)

Unit 2
1. Reading Comprehension
2. JAM
3. Distinction between Native and Indian English accent (Speeches by TED and Kalam).

Unit 3
1. Situational dialogues/Giving Directions
2. Describing objects/places/persons

Unit 4
1. Fun – Buzz (Tongue twisters, riddles, puzzles etc)
2 Formal Presentations

Unit 5
1. Debate (Contemporary / Complex topics)
2. Group Discussion

Course Outcomes

1. Create awareness on mother tongue influence and neutralize it in order to improve fluency in spoken English.
2. Understanding the different aspects of the language with emphasis on LSRW skills and make use of different strategies in discussions.
3. Improve words knowledge and apply skills in various language learning activities.
4. Analyze speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.
5. Evaluate and exhibit acceptable etiquette essentials in social and professional presentations.

Software Source:

K-Van Solutions Software

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Reference:

Teaching English - British Council

Correlation of COs with the POs & PSOs for B.Tech
AK-20 Regulations
*3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated

Course Title	Course Outcomes COs	Programme Outcomes(POs)											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
Communicative English - Lab	CO1										3		
	CO2									3			
	CO3										3		
	CO4										3		
	CO5										3		

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MECHANICAL ENGINEERING (ME)

I.B.Tech **Common to I Sem – CE, II Sem ME**

Subject Code 20ABS9910	Subject Name ENGINEERING CHEMISTRY LAB	L T P 0 0 3	Credits:1.5

Course Outcomes:

CO1: Demonstrate volumetric analysis involved with emphasis on solution preparation, dilution and chemical Calculations.
CO2: Develop knowledge to prepare advanced materials
CO3: Acquire knowledge to measure the strength of an acid present in secondary batteries
CO4: Familiarize with digital and instrumental methods of analysis
CO5: Apply important chemical concepts and principles to analyse mixture of components by chromatographic techniques.

List of Experiments:

1. Determination of Hardness of a groundwater sample.
2. Estimation of iron (II) using Diphenylamine indicator (Dichrometry – Internal indicator method)
3. Determination of pH metric titration of (i) strong acid vs. strong base,
4. Conductometric titrations of (i) strong acid vs. strong base (ii) Weak acid Vs Strong base
5. Determination of Strength of an acid in Pb-Acid battery
6. Preparation of phenol-formaldehyde resin
7. Preparation of TIO_2/ZnO nano particles(Precipitation Method)
8. Estimation of Calcium in port land Cement
9. Adsorption of acetic acid by charcoal
10. Thin layer chromatography
11. Determination of Viscosity of lubricating oils by Red Viscometer 1 &2
12. Determination of Copper by Iodometry

Correlation of COs with the POs & PSOs

***3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated**

Course Title	Course Outcomes COs	Programme Outcomes(POs) & Programme Specific Outcomes(PSOs)													
		PO1	PO2	PO3	PO4	PO5	PO 6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Engineering Chemistry Lab	CO1				3										
	CO2				3										
	CO3				3										
	CO4				3										
	CO5				3										

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Course Code	Basics of Python Programming Lab		L	T	P	C
20AES0510			0	0	3	1.5
Pre-requisite	NIL	Semester	I-II			

Course Objectives:

- To train the students in solving computational problems
- To elucidate solving mathematical problems using Python programming language
- To understand the fundamentals of Python programming concepts and its applications.
- To understand the object-oriented concepts using Python in problem solving.

Course Outcomes (CO):

CO1: Write, Test and Debug Python Programs
CO2: Implement Conditionals and Loops for Python Programs
CO3: Use functions and represent Compound data using Lists, Tuples and Dictionaries
CO4: Read and write data from & to files in Python and develop Application using Python
CO5: Implement the problem in terms of real world object using OOPs concepts

List of Experiments:

1. Install Python Interpreter and use it to perform different Mathematical Computations. Try to do all the operations present in a Scientific Calculator
2. Write a function that draws a grid like the following:

```
+ - - - - + - - - - +
|         |         |
|         |         |
|         |         |
|         |         |
+ - - - - + - - - - +
|         |         |
|         |         |
|         |         |
|         |         |
+ - - - - + - - - - +
```

3. Write a function that draws a Pyramid with # symbols

```
          #
        # # #
      # # # # #
    # # # # # # #
```

   Up to 15 hashes at the bottom
4. Using turtles concept draw a wheel of your choice
5. Write a program that draws Archimedean Spiral
6. The letters of the alphabet can be constructed from a moderate number of basic elements, like vertical and horizontal lines and a few curves. Design an alphabet that can be drawn with a minimal number of basic elements and then write functions that draw the letters. The alphabet can belong to any Natural language excluding English. You should consider at least Ten letters of the alphabet.
7. The time module provides a function, also named time that returns the current Greenwich Mean Time in "the epoch", which is an arbitrary time used as a reference point. On UNIX systems, the epoch is 1 January 1970.
   >>> import time
   >>>time.time()
   1437746094.5735958
   Write a script that reads the current time and converts it to a time of day in hours, minutes, and seconds, plus the number of days since the epoch.
8. Given n+r+1 <= 2r . n is the input and r is to be determined. Write a program which computes minimum value of r that satisfies the above.
9. Write a program that evaluates Ackermann function
10. The mathematician Srinivasa Ramanujan found an infinite series that can be used to generate a numerical approximation of 1/ π :
    Write a function called estimate_pi that uses this formula to compute and return an estimate of π.

$$\frac{1}{\pi} = \frac{2\sqrt{2}}{9801} \sum_{k=0}^{\infty} \frac{(4k)!(1103 + 26390k)}{(k!)^4 396^{4k}}$$

    It should use a while loop to compute terms of the summation until the last term is smaller than 1e-15 (which is Python notation for 10 -15). You can check the result by comparing it to math.pi.
11. Choose any five built-in string functions of C language. Implement them on your own in Python. You

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should not use string related Python built-in functions.

12. Given a text of characters, Write a program which counts number of vowels, consonants and special characters.
13. Given a word which is a string of characters. Given an integer say 'n', Rotate each character by 'n' positions and print it. Note that 'n' can be positive or negative.
14. Given rows of text, write it in the form of columns.
15. Given a page of text. Count the number of occurrences of each latter (Assume case insensitivity and don't consider special characters). Draw a histogram to represent the same
16. Write program which performs the following operations on list's. Don't use built-in functions
    a) Updating elements of a list
    b) Concatenation of list's
    c) Check for member in the list
    d) Insert into the list
    e) Sum the elements of the list
    f) Push and pop element of list
    g) Sorting of list
    h) Finding biggest and smallest elements in the list
    i) Finding common elements in the list
17. Write a program to count the number of vowels in a word.
18. Write a program that reads a file, breaks each line into words, strips whitespace and punctuation from the words, and converts them to lowercase.
19. Go to Project Gutenberg (http://gutenberg.org) and download your favorite out-of-copyright book in plain text format. Read the book you downloaded, skip over the header information at the beginning of the file, and process the rest of the words as before. Then modify the program to count the total number of words in the book, and the number of times each word is used. Print the number of different words used in the book. Compare different books by different authors, written in different eras.
20. Go to Project Gutenberg (http://gutenberg.org) and download your favorite out-of-copyright book in plain text format. Write a program that allows you to replace words, insert words and delete words from the file.
21. Consider all the files on your PC. Write a program which checks for duplicate files in your PC and displays their location. Hint: If two files have the same checksum, they probably have the same contents.
22. Consider turtle object. Write functions to draw triangle, rectangle, polygon, circle and sphere. Use object oriented approach.
23. Write a program illustrating the object oriented features supported by Python.
24. Design a Python script using the Turtle graphics library to construct a turtle bar chart representing the grades obtained by N students read from a file categorizing them into distinction, first class, second class, third class and failed.
25. Design a Python script to determine the difference in date for given two dates in YYYY:MM:DD format(0 <= YYYY <= 9999, 1 <= MM <= 12, 1 <= DD <= 31) following the leap year rules.
26. Design a Python Script to determine the time difference between two given times in HH:MM:SS format.(0 <= HH <= 23, 0 <= MM <= 59, 0 <= SS <= 59)

References:

1. Allen B. Downey , " Think Python: How to Think Like a Computer Scientist", Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.
2. Shroff "Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013.
3. David M.Baezly "Python Essential Reference". Addison-Wesley Professional; Fourth edition, 2009.
4. David M. Baezly "Python Cookbook" O'Reilly Media; Third edition (June 1, 2013)

Online Learning Resources/Virtual Labs:

http://www.edx.org

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	2								1	1
CO2	2	1	3		2								1	2
CO3	2	1	3		2								2	2
CO4	2	1	3		2								2	2
CO5	3	2	2		2				2			3	2	2

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

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B.Tech **Semester: I** **Branch: Common to all**

MANDATORYCOURSE

Subject Code	Subject Name	L	T	P	Credits: 0
20AMC9902	CONSTITUTION OF INDIA	3	0	0	

Course Outcomes:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the Powers and functions of Governor, President, and Judiciary.
5. Discuss the functions of local administration bodies.

Syllabus

Unit: 1 **4hrs**

History of Making of the Indian Constitution - History Drafting Committee, (Composition & Working)

Unit: 2 **8hrs**

Philosophy of the Indian Constitution - Preamble Salient Features

Unit: 3 **8hrs**

Contours of Constitutional Rights & Duties - Fundamental Rights - Right to Equality - Right to Freedom - Right against Exploitation - Right to Freedom of Religion - Cultural and Educational Rights - Right to Constitutional Remedies - Directive Principles of State Policy - Fundamental Duties.

Unit:4 **8hrs**

Organs of Governance - Parliament – Composition - Qualifications and Disqualifications - Powers and Functions - Executive, President, Governor - Council of Ministers -Judiciary, Appointment and Transfer of Judges, Qualifications - Powers and Functions.

Unit:5 **8hrs**

Local Administration - District's Administration head: Role and Importance - Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation - Panchayati raj: Introduction, PRI: Zilla Panchayat - Elected officials and their roles, CEO Zilla Panchayat: Position and role - Block level: Organizational Hierarchy (Different departments) - Village level: Role of Elected and Appointed officials - Importance of grass root democracy.

Suggested books for reading:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

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Correlation of COs with the POs & PSOs for B.Tech
AK-20 Regulations
*3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated

Course Title	Course Outcomes COs	Programme Outcomes(POs)											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
Constitution of India	CO1						3						
	CO2						3						
	CO3						2						
	CO4						3						
	CO5						3						

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Semester III (Second year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P	C	CIE	SEE	Total
1	Basic Science courses	20ABS9913	Probability and Statistics, Partial Differential Equation	3	-	-	3	30	70	100
2	Professional Core Course	20APC0308	Thermodynamics	3	-	-	3	30	70	100
3	Professional Core courses	20APC0301	Engineering Mechanics	3	-	-	3	30	70	100
4	Professional Core courses	20APC0306	Material Science and Engineering	3	-	-	3	30	70	100
5	Professional Core courses	20APC0303	Machine Drawing	3	-	-	3	30	70	100
6	Professional Core courses (LAB)	20APC0307	Material Science and Engineering Lab	-	-	3	1.5	30	70	100
7	Professional Core courses (LAB)	20APC0313	Mechanical Engineering Workshop Practice	-	-	3	1.5	30	70	100
8	Professional Core courses (LAB)	20APC0324	CAD Lab	-	-	3	1.5	30	70	100
	Skill oriented course*	20ASC0301	CATIA Lab	1	-	2	2	100	-	100
	Mandatory course (AICTE suggested)	20AMC9903	Environmental Studies	3	-	-	0	30	-	30
			Total credits				**21.5**	**370**	**560**	**930**

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MECHANICAL ENGINEERING (ME)

Year : II B.Tech **Semester: I** **Branch of Study: CE and ME**

Subject Code:20ABS9913	Subject Name: Probability and Statistics and Partial Differential Equations	L T P 3 0 0	Credits 3	CLC 2

Course Outcomes:

1) Utilize the concepts of Central Tendency, Correlation, Regression concepts.
2) Apply discrete and continuous probability distributions
3) Inference the components of a classical hypothesis test for large samples.
4) Inspect the statistical inferential methods based on small sampling tests.
5) Solve the general solution of the PDEs bearing applications

Unit I: Descriptive statistics : **9 hrs**

Measures of Central tendency, Measures of Variability (spread or variance), correlation, correlation coefficient, rank correlation, regression coefficients, method of least squares, regression lines

Unit II: Probability **9 hrs**

probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem, random variables (discrete and continuous)**,** probability distribution: Binomial - Poisson approximation to the binomial distribution and normal distribution-their properties.

Unit III: Testing of Hypothesis **9 hrs**

Formulation of null hypothesis, critical regions, level of significance. Large sample tests: test for single proportion, difference of proportions, test for single mean and difference of means.

Unit IV: Small Sample Tests **10 hrs**

Student t-distribution (single mean, two means and paired t-test), Testing of equality of variances (F-test), $\chi 2$ - test for goodness of fit.

Unit V: Applications of Partial Differential Equations **8 hrs**

Method of separation of variables, solution of 1D-wave, 1D-heat and 2D-Laplace's equation in Cartesian coordinates

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43/e, 2010.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9/e, John Wiley & Sons, 2006.

References:

1. S.Chand ,Engineering Mathematics-II by Dr.T.K.V.Iyengar, Dr.B.Krishna Gandhi, S.Ranganatham, Dr.M.V.S.S.N.Prasad
2. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9/e, Wiley India, 2009.
3. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India,1995.
4. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, 2008.

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MECHANICAL ENGINEERING (ME)

Correlation of COs with the POs & PSOs for B.Tech (ECE)
AK-20 Regulations
*3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated

Course Title	Course Outcomes COs	Programme Outcomes(POs) & Programme Specific Outcomes(PSOs)													
		PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Probability and Statistics and Partial Differential Equations	CO1	3													
	CO2	3													
	CO3	3													
	CO4	3													
	CO5		3												

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Year : II **Semester** : I **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20APC0308	Thermodynamics	3	0	0	3

Course Outcomes:

1 Explain the importance of thermodynamic properties related to conversion of heat energy into work.
2 Apply the laws of thermodynamics to boilers, heat pumps, refrigerators, heat engines, compressors and nozzles.
3 To understand concept of Entropy and Availability of system
4 Utilize steam properties to design steam-based components.
5 Compare thermodynamic relations and air standard cycles.

UNIT I

Introduction: Basic Concepts: Macroscopic and microscopic viewpoints, definitions of thermodynamic terms, quasi – static process, point and path function, forms of energy, ideal gas and real gas, Zeroth law of thermodynamics.

Properties of Steam and use of Steam Tables: Pure Substances, P-V-T surfaces, T-s and h-s diagram, Mollier chart, dryness fraction, property tables, analysis of steam undergoing various thermodynamic processes using Mollier chart– steam calorimetry

UNIT II

First law of Thermodynamics: Joule's experiment - first law of thermodynamics, corollaries-perpetual motion machines of first kind, first law applied to non-flow and flow process- limitations of first law of thermodynamics.

Second Law of Thermodynamics: Kelvin - Planck statement and Clausius statement and their equivalence, corollaries - perpetual motion machines of second kind - reversibility and irreversibility, cause of irreversibility - Carnot cycle, heat engine, heat pump and refrigerator, Carnot theorem, Carnot efficiency

UNIT III

Entropy: Clausius inequality - Concept of Entropy- entropy equation for different processes and systems

Availability and Irreversibility: Definition of exergy and energy, expressions for availability and irreversibility. Availability in steady flow, non-flow processes and irreversibility.

UNIT IV

Avogadro's law, equation of state, ideal gas equation, Vander Waal's equation, reduced properties, law of corresponding states, compressibility chart. Gibbs-Dalton law, volumetric analysis of gas mixture, apparent molecular weight and gas constant, specific heat of a gas mixture, adiabatic mixing of perfect gases, gas and vapour mixtures.

UNIT V

Thermodynamic Relations: Maxwell relations, TdS equations, difference in heat capacities, ratio of heat capacities, Energy equation, Joule Thompson coefficient, Clausius-Clapeyron equation. Reactive mixture of gases

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Text Books:

1. P. K. Nag, Engineering Thermodynamics, 5/e, Tata McGraw Hill, 2013.
2. Yunus A. Cengel, Michaela A. Boles, Thermodynamics, 7/e, Tata McGraw Hill, 2011.

Reference Books:

1. J. B. Jones and G. A. Hawkins, Introduction to Thermodynamics, 2/e, John Wiley & Sons, 2012.
2. Moran, Michael J. and Howard N. Shapiro, Fundamentals of Engineering Thermodynamics, 3/e, Wiley, 2015
3. Claus Borgnakke Richard E. Sonntag, Fundamentals of Thermodynamics, 7/e, Wiley, 2009
4. R. K. Rajput, S. Chand & Co., Thermal Engineering, 6/e, Laxmi publications, 2010.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		2					2							
CO2		2	2	1						2					
CO3	3	2						2		2					
CO4				1				2		2					
CO5				1											

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MECHANICAL ENGINEERING (ME)
Year : II **Semester** : I **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20APC0301	Engineering Mechanics	3	0	0	3

Course Outcomes:
1 To acquire the basic knowledge of the analysis of general structures when external loads are applied.
2 To understand the forces and their systems, equilibrium of systems of forces.
3 To know about friction and their types, area moment of inertia, mass moment of inertia
4 Ability to know about kinematics, kinetics and concepts of mechanical vibrations.
5 To understand the basic concepts in structural mechanics.

UNIT I
Introduction to Engineering Mechanics: Composition and resolution of forces, parallelogram law, principle of transmissibility, types of force systems - concurrent and concurrent coplanar forces, resultant of coplanar force systems couple, moment of a force Varignon's theorem, concept of equilibrium of coplanar force systems.

UNIT II
Friction: Laws of friction, types of friction, equilibrium of force systems involving frictional forces. Free body diagrams involving frictional forces.
Analysis of Structures: Introduction to plane trusses, analysis of plane trusses by method of joints.

UNIT III
Properties of Surfaces and Volumes: Centroid and center of gravity, derivation of centroids from first moment of area, centroids of composite sections, center of gravity of common volumes - cylinder, cone, sphere, theorem of Pappus-guldinus.

Moment of Inertia: Area moment of inertia of plane and composite shapes, parallel axis theorem, perpendicular axis theorem, polar moment of inertia, mass moment of inertia of common volumes thin plates, cylinder, cone, sphere, rectangular prism, radius of gyration

UNIT IV
Virtual Work: Equilibrium of ideal systems, work done by a force, work done by a couple, principle of virtual work.
Kinematics: Equations of motion for rigid bodies, constant and variable acceleration, rectilinear and curvilinear motion and motion under gravity -projectile motion, use of rectangular coordinates, radius of curvature, rotation of a rigid body about a fixed axis.

UNIT V
Kinetics: Principles of dynamics - Newton's Laws of motion, D'Alembert's principle in rectilinear translation, principle of work and energy.
Ideal Systems: Principle of conservation of energy, concept of power, conservation of linear and angular momentum, principle of momentum and impulse, impact - types of impact.

Text Books:
1. N H Dubey, Engineering Mechanics: Statics and Dynamics, McGraw Hill, 2014.
2. S Timoshenko, DH Young, JV Rao, Sukumar Pati, Engineering Mechanics (in SI units), 5/e, McGraw Hill, 2013.
3. S S Bhavikatti, Engineering Mechanics, 4/e, New Age International, 2008

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References:

1. Irving Shames, G K M Rao, Engineering Mechanics: Statics and Dynamics, 4/e, Pearson, 2009.
2. K L Kumar, Veenu Kumar, Engineering Mechanics, 4/e, Tata McGraw Hill, 2010.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		2												
CO2	3	3		3		3			1						
CO3				3		3									
CO4	3	3		3					1						
CO5	3	3	2						1						

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Year : II **Semester** : I **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20APC0306	Material Science and Engineering	3	0	0	3

Course Outcomes:

1 Explain the principles of binary phases
2 Apply heat treatment to different applications and its defects
3 Select steels and cast irons for a given application
4 Utilize nonferrous metals and alloys in engineering
5 Choose composites for various applications. Assess the properties of Nano-materials and their applications

UNIT I

Structure of Metals: Crystal Structures: Unit cells, Metallic crystal structures, Imperfection in solids: Point, Line, interstitial and volume defects; dislocation strengthening mechanisms and slip systems.

Constitution of Alloys: Necessity of Alloying, substitutional and interstitial solid solutions-Phase diagrams: Interpretation of binary phase diagrams and microstructure development; Iron-Iron carbide diagram and microstructural aspects of ferrite, cementite, austenite, ledeburite, andcastiron.

UNIT II

Heat Treatment of Steels: Annealing, tempering, normalizing and spheroidizing, Continuous cooling curves and interpretation of final micro structures and properties austempering, mar tempering, casehardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening.

UNIT III

Steels: Plain carbon steels, used limitations of plain carbon steels. AISI & BIS classification of steels. Classification, Microstructure, properties and applications of alloy steels and tool steels.

Cast irons: Micro structure, properties and applications of white cast iron, malleable cast iron, grey cast iron, nodular cast iron and alloy cast iron.

UNIT IV

Non-ferrous Metals and Alloys: Micro structure, properties and applications of copper, bearing materials and its alloys, aluminum and its alloys. Study of Al-Cu phase diagram, precipitation hardening. Microstructure, properties and applications of titanium and its alloys

UNIT V

Ceramics, Polymers and Composites: Structure, properties and applications of ceramics, polymers and Composites. Introduction to super alloys and Nano materials.

Text Books:

1. Sydney H. Avner, Introduction to Physical Metallurgy, 2/e, Tata McGraw- Hill, 1997.
2. George E. Dieter, Mechanical Metallurgy, 3/e, McGraw-Hill, 2013.

Reference Books:

1. V. Raghavan, Material Science and Engineering, 5/e, Prentice Hall of India, 2004.
2. R. Balasubramaniam, Callister's Material Science and Engineering, 2/e, Wiley India, 2014.
3. Y. Lakhtin, Engineering Physical Metallurgy, University Press of the Pacific, 2000

4. L. H.Van Vlack, Elements of Material Science and Engineering, 6/e, Pearson Education, 2008

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3		2											
CO2	3			2			1								
CO3	3	3			2		1								
CO4							1		3						
CO5		3			2		1		3						

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MECHANICAL ENGINEERING (ME)

Year : II **Semester** : I **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20APC0303	Machine Drawing	3	0	0	3

Course Outcomes:

1 Understand the Concepts of Conventional Representation of Materials & Machine Elements
2 Draw the Machine Elements and simple parts
3 Draw the assembled views for the part drawings of the Engine parts
4 Draw the assembled views for the part drawings of the other machine parts – Screws jacks, Machine Vices Plummer block, Tailstock.
5 Draw the assembled views for the part drawings of the Valves

UNIT I

Machine Drawing Conventions: Need for drawing conventions-conventional representation of material, common machine elements and parts such as screws, nuts, bolts, keys. Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features. Title boxes, their sizes, location and details - common abbreviations& their liberal usage.

UNIT II

Design of Machine elements and simple parts:

Selection of views, additional views for the following machine elements and parts with drawing proportions**.** Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws, keys, cottered joints and knuckle joint, riveted joints for plates, flanged and protected flanged joint. Shaft coupling, spigot and socket joint, journal and foot step bearing.

UNIT III

Assembly Drawings: Drawings of assembled views for the part drawings of the following.
Engine parts- stuffing boxes, Cross heads, Eccentrics, Petrol Engine-connecting rod, piston assembly.
Other Machine parts- Screw jack, machine vice, single tool post.
Valves: Steam stop valve, feed check valve. Non- return value

Textbooks:

1. Machine Drawing- K.L. Narayana, P.Kannaiah & K.Venkata Reddy, New Age Publishers, 4th Edition, 2012.
2. Machine Drawing / N.D. Bhatt / Charotar
3. Machine Drawing – N Siddeswar, P. Kannaiah, VVS Sastry, Mc Graw Hill,2015.

References:

1. Machine Drawing- P.S. Gill, S.K. Kataria & Sons, 17th Edition, 2012
2. Machine Drawing- Dhawan, S.Chand Publications, 1st Revised Edition,1998.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3													
CO2	2									3					
CO3	2				3			2							
CO4										3					
CO5															

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Year : II **Semester** : I **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20APC0307	Material Science and Engineering Lab	0	0	3	1.5

Course Outcomes:

CO: 1 Identify various microstructures of steels and cast irons.
CO: 2 Visualize grains and grain boundaries
CO: 3 Evaluate hardness of treated and untreated steels.
CO: 4 Summarize the importance of hardening of steels.
CO: 5 Study the Micro structure of Heat treated steels.

List of Experiments:

1. Study of microstructure of pure metals – Iron, copper and aluminum.
2. Study of microstructure of low carbon steel, mild steel and high carbon steel.
3. Study of microstructure of cast irons.
4. Study of microstructure of non-ferrous alloys – aluminum, copper, titanium, nickel and their alloys.
5. Study hardenability of steels by Jominy End Quench Test.
6. Study of microstructure of heat treated steels.
7. Find hardness of various untreated and treated steels.
8. Study of microstructure of ceramics, polymeric materials.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		3		2										
CO2		3		2			3								
CO3	3		3		2										
CO4		3					3								
CO5				2											

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Year : II **Semester** : I **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20APC0313	Mechanical Engineering Workshop Practice	0	0	3	1.5

Course Outcomes:

CO: 1 Make moulds for sand casting
CO: 2 Develop different weld joints
CO: 3 Assemble or disassemble of machine components
CO: 4 Make plastic components
CO: 5 Use power tools and find applications of hydraulic and pneumatic circuits

I Foundry Practice: (2 Sessions)

1. (a) Determination of average grain size for sand sample using sieve shaker

(b) Preparation of a green sand mould using single piece pattern

2. Preparation of a green sand mould using split piece pattern with core and demonstration of casting.

II Welding Practice: (2 Sessions)

i) Lap joint, butt joint and T joint using arc welding.

ii) Lap joint using resistance spot welding

iii) Lap and butt joints using gas welding

III Assembling/Disassembling Practice: (3 Sessions)

i) Bicycle

ii) Clutch and carburetor

iii) Two wheeler engine

IV Manufacture of a Plastic Component (2 Sessions)

i) Use of injection moulding machine

ii) Joining of plastic components

V Use of Power Tools (2 Sessions)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					2									
CO2			2												
CO3		3					1				2				
CO4				2			1				2				
CO5	3		2												

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Year : II **Semester** : I **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20APC0324	COMPUTER AIDED DRAFTING Lab	0	0	3	1.5

Course Outcomes:

1 Understand the CAD software
2 Understand the elements of CAD tools
3 Design the draw, modify toolbar
4 Design the solids, intersection in 3D
5 Analyze the perceptive views and orthographic views

LIST OF EXPERIMENTS:

I Introduction to Computer Aided Drafting software packages.
II. Practice on basic elements of a Computer Aided Drafting packages
III. Practice on features of a Computer Aided Drafting package
IV Drafting of Solids, Intersection of Solids
V Drafting of Perspective views
VI Drafting of Orthographic views of simple parts

Note: Any of the standard Software Packages like – AUTO CAD, Pro-E, Uni – Graphics, Catia …. Etc may be used

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		3			1									
CO2	3	2	3		3										
CO3		2			3										
CO4	3		3		3										
CO5	3	2				1									

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Year : II **Semester** : I **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20ASC0301	CATIA Lab	1	0	2	2

Course Outcomes:

1 Design of 2D models using software
2 Design of 3D models and analysis
3 Create simulation of any simple components
4 Design and simulation of machine components
5 Analysis of any components using software

List of experiments:

1. Any simple 2D drawing using CATIA.
2. 3D modelling using CATIA, Creo, Solid works, etc.,
3. Simulation of simple 3D models.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3				2										
CO2		3						3							
CO3	3			3	3										
CO4		2						3							
CO5		1		3	1										

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Year: I &II B.Tech **AK20 Regulations**
Semester: I **Branch: Common to All**

Subject Code	Subject Name	L	T	P	Credits
20AMC9903	Environmental Studies	3	0	0	0

Course Outcomes

1. Students get sufficient information that clarifies modern environmental concepts like equitable use of natural resources, more sustainable life styles etc.
2. Students realize the need to change their approach, so as to perceive our own environmental issues correctly, using practical approach based on observation and self learning.
3. Students become conversant with the fact that there is a need to create a concern for our environment that will trigger pro-environmental action; including simple activities we can do in our daily life to protect it.
4. . Interpretation of different types of environmental pollution problems and designing of new solid waste management techniques usage
5. To get knowledge on various environmental acts and to engage all the students life - long learning of rain water harvesting

UNIT – I **(18Hr)**

Multidisciplinary Nature o**f Environmental Studies:** Introduction – Multidisciplinary Nature of Environmental Studies – Definition, Scope and Importance – Need for Public Awareness.
Natural Resources: Renewable and non-renewable energy resources – Natural resources and associated problems.
Forest resources: Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people.
Water resources: Use and over utilization of surface and sub-surface – Floods, drought, conflicts over water, dams – benefits and problems.
Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticides problems, water logging, salinity, case studies.
Energy resources: Renewable and non-renewable energy resources.

UNIT – II **(20Hr)**

Ecosystems: Concept of an ecosystem. – Structure and functions of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).
Biodiversity And Its Conservation : Introduction- Definition: genetic, species and ecosystem diversity – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man – wildlife conflicts – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT – III **(10Hr)**

Environmental Pollution: Definition, Causes, effects and its control measures of: Air Pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution and Nuclear hazards.
Solid Waste Management: Causes**,** effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone, Tsunami and landslides.

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UNIT – IV **(15Hr)**

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting and watershed management – Resettlement and rehabilitation of people – Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Public awareness.

UNIT – V **(10Hr)**

Human Population and the Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmed. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

TEXT BOOKS:

1. Text book of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission, Universities Press.
2. Environmental Studies by Kaushik, New Age Publishers.
3. Environmental Studies by Sri Krishna Hitech publishing Pvt. Ltd.

REFERENCES:

1. Environmental studies by R.Rajagopalan, Oxford University Press.
2. Comprehensive Environmental studies by J.P.Sharma, Laxmi publications.
3. Introduction to Environmental engineering and science by Gilbert M. Masters and Wendell P. Ela - Printice hall of India Private limited.
4. Environmental studies by A. Ravi Krishnan, G. Sujatha Sri Krishna Hitech publications.

Correlation of COs with the POs & PSOs
AK-20 Regulations
***3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated**

Course Title	Course Outcomes COs	Programme Outcomes(POs) & Programme Specific Outcomes(PSOs)												
		PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12		
Environmental Studies	CO1	3	2					1					1		
	CO2		3					2							
	CO3		3			2							1		
	CO4		2												
	CO5					3		2					1		

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Semester IV (Second year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P	C	CIE	SEE	Total
1	Engineering Science Courses	20AES0505	Internet of Things (IoT)	3	-	-	3	30	70	100
2	Basic Science Course /Prof core course	20AES0324	Thermal Engineering	3	-	-	3	30	70	100
3	Professional Core courses	20APC0312	Manufacturing Technology	3	-	-	3	30	70	100
4	Professional Core courses	20APC0302	Mechanics of Materials	3	-	-	3	30	70	100
5	Humanities and Social Sciences	20AHSMB01	Managerial Economics and Financial Analysis	3	-	-	3	30	70	100
6	Humanities and Social Sciences	20AHS9905	Universal Human Values	3	1	-	3	30	70	100
7	Engineering Science Courses (LAB)	20AES0506	Internet of Things (IoT) Lab	-	-	3	1.5	30	70	100
8	Professional Core courses (LAB)	20APC0326	Thermal Engineering Lab	-	-	3	1.5	30	70	100
9	Professional Core courses (LAB)	20APC0304	Mechanics of Materials Lab	-	-	3	1.5	30	70	100
10	Skill oriented course*	20ASC0302	Manufacturing Process Lab	1	-	2	2	100	-	100
			Total credits				**24.5**	**370**	**630**	**1000**

Community Service project with credits

(To visit the selected community to conduct survey (Socio-economic & domain survey) and conduct sensitization/awareness program/activities at the end of IV- semester before commencement of V-semester and complete immersion Programme also during V-Semester and submit report in V - semester. Assessment will be done at the end of V-Semester)

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MECHANICAL ENGINEERING (ME)

B.Tech-II Year **Semester: II** **Branch :Common to EEE, ECE, CE, ME**

COURSE CODE	COURSE TITLE	L	T	P	CREDITS
20AES0505	Internet of Things (IoT)	3	0	0	3

Course Outcomes:

- CO1: Interpret the vision of IoT from a global context.
- CO2: Determine the Market perspective of IoT.
- CO3: Compare and Contrast the use of Devices, Gateways and Data Management in IoT.
- CO4: Implement state of the art architecture in IoT.
- CO5: Illustrate the application of IoT in Industrial Automation and identify Real World Design Constraints.

Unit-I

M2M to IoT-The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics.

Unit-II

M2M to IoT - A Market Perspective- Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview- Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Unit-III

M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management

Unit-IV

IoT Architecture-State of the Art - Introduction, State of the art.

Unit-V

IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control. Industrial Automation- Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things

TEXT BOOK:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014. (ISBN-13:978-0124076846)

REFERENCE BOOKS / WEBLINKS:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014. (ISBN-13: 978-8173719547)

2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013. (ISBN-13: 978- 1430257400)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1				2					3			2	1
CO2					2					2	2		1	1
CO3	3		1		3					2			2	
CO4					2					3			2	
CO5	1				3					2			2	

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

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Year : II **Semester** : II **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20AES0324	Thermal Engineering	3	0	0	3

Course Outcomes:

1. To be able to understand working of different I.C Engines and recognize basic elements and subsystems of an I.C. Engine
2. To be able to know about S.I Engine fuel air requirements and understand fuel supply systems in an S.I Engine.
3. Ability to understand necessity and functioning of cooling, lubrication and ignition system of an I.C. Engine.
4. To be able to understand in-cylinder combustion in S.I and C.I Engines and know about the parameters that influence normal and abnormal combustions.
5. To be able to know about working principle of various types of air compressors and solve problems related to reciprocating air compressor

UNIT I

I.C. ENGINES: Definition of Engine And Heat Engine, I.C Engine Classification – Parts of I.C. Engines, Working of I.C. Engines, Two Stroke & Four Stroke I.C. Engines SI & CI Engines, Valve and Port Timing Diagrams.

UNIT II

Fuel System: S.I. Engine: Fuel Supply Systems, carburetor types Air Filters, Mechanical and Electrical Fuel Pump – Filters– Gasoline Injection Systems.. Cooling & Lubrication Systems: Cooling Requirements, Air Cooling, Liquid Cooling, Thermo Siphon, Water And Forced Circulation System; Lubrication Systems-Flash, Pressurized and Mist Lubrication. Ignition System: Function Of An Ignition System, Battery coil Ignition System, Magneto Coil Ignition System, Electronic Ignition System using Contact Breaker, Electronic Ignition using Contact Triggers – Spark Advance And Retard Mechanism.

UNIT III

Fuels and Combustion: S I engine: Normal Combustion and Abnormal Combustion – Importance of Flame Speed and Effect of Engine Variables – Type of Abnormal Combustion, Pre-Ignition and Knocking (Explanation) – Fuel Requirements and Fuel Rating, Anti Knock Additives, Combustion Chambers. C.I. Engines: Stages Of Combustion – Delay Period And Its Importance – Effect Of Engine Variables – Diesel Knock– Combustion Chambers (DI And IDI), Fuel Requirements And Fuel Rating.

UNIT IV

Testing and Performance : Parameters of Performance - Measurement of Cylinder Pressure, Fuel Consumption, Air Intake, Exhaust Gas Composition, Brake Power – Determination of Frictional Losses And Indicated Power – Performance Test – Heat Balance Sheet and Chart.

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UNIT V

Air Compressors: Reciprocating Compressors, Effect of Clearance volume in Compressors, Volumetric Efficiency, Single Stage and Multi Stage Compressors.

GAS TURBINES: Simple Gas Turbine Plant – Ideal Cycle, Essential Components – Parameters of Performance. jet propulsion: Principle of Operation – Classification of Jet Propulsive Engines – Working Principles with Schematic Diagrams and Representation on T-S Diagram.

Text Books:

1. Internal Combustion Engines / V. Ganesan- TMH, 4th Edition,2012
2. Thermal Engineering / Rajput / Lakshmi Publications, 9th Edition,2013

Reference Books:

1. I.C. Engines fundamentals, Heywood, McGrawHIll, 1st Edition,2011
2. IC Engines – Mathur& Sharma – DhanpathRai& Sons, ,2010
3. Engineering fundamentals of IC Engines – Pulkrabek, Pearson, PHI, 2nd Edition,2009
4. Thermal Engineering, Rudramoorthy – TMH, 10th Edition,2010
5. Thermodynamics & Heat Engines, B. Yadav, Central publishing house., Allahabad, 2002
6. Thermal Engineering – R.S. Khurmi & J.K.Gupta – S.Chand, 15th Edition,2012

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		1						2			3				
CO2					3				1						
CO3	1									2					
CO4		1					1		1						
CO5								2			3				

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Year : II **Semester** : II **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20APC0312	Manufacturing Technology	3	0	0	3

Course Outcomes:

1. Demonstrate different metal casting processes and gating systems
2. Classify working of various welding processes
3. Evaluate the forces and power requirements in rolling process
4. Apply the principles of various forging operations
5. Outline the manufacturing methods of plastics and ceramics.

UNIT I

Introduction: Importance and selection of manufacturing processes, classification and selection of manufacturing processes.

Casting Processes: Introduction to casting process, process steps; pattern: types, materials and allowance; Cores and design of gating system , Gating ratio and time of filling the cavity; Solidification of casting: Concept, solidification of pure metal and alloy; Special casting processes: Shell casting, investment casting, die casting, centrifugal casting, casting defects and remedies.

UNIT II

Metal Forming: Introduction, nature of plastic deformation, hot and cold working, mechanics of metal forming; Rolling: Principle, types of rolling mill and products, roll passes, forces in rolling and power requirements; Extrusion: Basic extrusion process and its characteristics, hot extrusion and cold extrusion, wire drawing, tube drawing.

UNIT III

Forging: Principles of forging, tools and dies. Types: Smith forging, drop forging, forging hammers, rotary forging and forging defects. Sheet metal forming: blanking, piercing, bending, stamping.

UNIT IV

Material Joining Processes: Classification of welding processes, types of welds and welded joints, arc welding, submerged arc welding, gas tungsten arc welding, gas metal arc welding. applications, advantages and disadvantages of the above processes, other fabrication processes. soldering and brazing: Types and their applications, Welding defects: causes and remedies.

UNIT V

Plastics: Types, properties and their applications, processing of plastics, extrusion of plastics, transfer molding and compression molding, injection molding, thermoforming, rotational molding and blow molding.

Text Books :

1. Rao P.N., Manufacturing Technology – Volume I, 5/e, McGraw-Hill Education, 2018.
2. Kalpakjian S and Schmid S.R., Manufacturing Engineering and Technology, 7/e, Pearson, 2018

Reference Books:

1. Millek P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes and Systems, 4/e, John Wiley and Sons Inc, 2010.
2. Sharma P.C., A Text book of Production Technology, 8/e, S Chand Publishing, 2014.
3. Ian Gibson, David W. Rosen, Brent Stucker, Additive Manufacturing Technologies:

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			3		2			2							
CO2	3	3								3		3			
CO3			3		3			2		2					
CO4		3								1		3			
CO5	3		3		1			2							

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Year : II **Semester** : II **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20APC0302	Mechanics of Materials	3	0	0	3

Course Outcomes:
1 Apply the concepts of stress and strain to machine numbers
2 Determine, shear forces, and bending moments in beams
3 To find slope and deflection in beams, determine shear forces and bending moments in beams
4 Estimate the stresses in machine members such as shafts and springs and design
5 Estimate the stresses in thin cylinders due to internal pressure

UNIT I
Stresses and Strains: Types of stresses and strains, stress-strain relations, stress-strain diagram for ductile and other materials, axial loaded bars of uniform and varying cross section, compound bars, relation between three elastic moduli, thermal stresses. Strain energy, resilience
Principal stresses and strains: Biaxial state of stress with and without shear - Mohr's Circle and analytical methods.

UNIT II
Analysis of Beams: Types of beams and loads, shear force and bending moment diagram for cantilever, simply supported and overhanging beams for different types of loadings, point of contra flexure, relation between shearing force and bending moment.
Bending Stresses: Flexural equation, bending stress distribution and efficiency of various cross sections of beams.

UNIT III
Deflection of Beams: Differential equations of the deflection curve, Slope and deflection: using double integration method, Macaulay's method and Moment area method for simply supported, cantilever and overhanging beams. Deflection under single and several loads.

UNIT IV
Torsional and shear stresses: Theory of pure torsion, Shear Stresses: Shear stress distribution for different cross sections of beams.

UNIT V
Buckling of Columns: Analysis of columns to evaluate buckling loads with different boundary conditions, Euler's formula and its limitations, Rankine's formula.
Thin Cylinders: hoop and stresses, longitudinal, cylindrical and spherical shells subjected to internal pressure calculation of volumetric strain.

Text Books :
1. F.P. Beer, E.R. Johnston, Jr & John. T. De Wolf, Mechanics of Materials, 7/e, Tata McGraw-Hill
2. SS Rattan, Strength of materials, 3/e, Tata McGraw-Hill

Reference Books:
1. Timoshenko, Strength of Materials Part-I& II, 3/e, CBS Publishers
2. Popov, Mechanics of Solids, 2/e, New Pearson Education

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3				3				3	2					
CO2		3			3	2			3	2					
CO3	3	3								2					
CO4	3				3	2			3						
CO5		3				2									

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Course Code	MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS	L	T	P	C
20AHSMB01		3	0	0	3
	(Common to All branches of Engineering)				

Course Outcomes (CO):

CO1: Understand the fundamentals of Economics and Managerial economics viz., Demand, Production, cost, revenue and markets.
CO2: Apply the Concept of Production cost and revenues for effective Business decision
CO3: Analyze how to invest their capital and maximize returns.
CO4: Evaluate the capital budgeting techniques.
CO5: Define the concepts related to financial accounting and management and able to develop the Accounting statements and evaluate the financial performance of business entity.

UNIT - I	**Managerial Economics**

Introduction – meaning, nature, significance, functions, and advantages, ME and its role in other fields. Demand - Concept, Function, Law of Demand - Demand Elasticity- Types – Measurement. Demand Forecasting- Factors governing forecasting, Methods.

UNIT - II	**Production and Cost Analysis**

Introduction – Nature, meaning, significance, functions and advantages. Production Function– Least-cost combination– Short run and Long run Production Function- Isoquants and Is costs, MRTS - Cobb-Douglas Production Function - Laws of Returns - Internal and External Economies of scale. Cost & Break-Even Analysis - Cost concepts and Cost behavior- Break-Even Analysis (BEA) - Determination of Break-Even Point (Simple Problems)-Managerial significance and limitations of Break-Even Analysis.

UNIT - III	**Business Organizations and Markets**

Introduction – Nature, meaning, significance, functions and advantages. Forms of Business Organizations- Sole Proprietary - Partnership - Joint Stock Companies - Public Sector Enterprises. Types of Markets - Perfect and Imperfect Competition - Features of Perfect Competition Monopoly-Monopolistic Competition–Oligopoly-Price-Output Determination - Pricing Methods and Strategies.

UNIT - IV	**Capital Budgeting**

Introduction to Capital, Sources of Capital. Short-term and Long-term Capital: Working capital, types, Estimating Working capital requirements. Capital Budgeting – Features, Proposals, Time value of money. Methods and Evaluation of Projects – Pay Back Method, Accounting Rate of Return (ARR), Net Present Value (NPV), and Internal Rate Return (IRR) Method (simple problems).

UNIT - V	**Financial Accounting and Analysis**

Introduction – Nature, meaning, significance, functions and advantages. Concepts and Conventions-Double-Entry Book Keeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments). ***Financial Analysis*** **-** Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability.

Textbooks:

1. Varshney & Maheswari: Managerial Economics, Sultan Chand, 2013.
2. Aryasri: Business Economics and Financial Analysis, 4/e, MGH, 2019

Reference Books:

1. Ahuja Hl Managerial economics Schand,3/e,2013
2. S.A. Siddiqui and A.S. Siddiqui: Managerial Economics and Financial Analysis, New Age International, 2013.
3. Joseph G. Nellis and David Parker: Principles of Business Economics, Pearson, 2/e, New Delhi.
4. Domnick Salvatore: Managerial Economics in a Global Economy, Cengage,2013.

Online Learning Resources:

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https://www.slideshare.net/123ps/managerial-economics-ppt
https://www.slideshare.net/rossanz/production-and-cost-45827016
https://www.slideshare.net/darkyla/business-organizations-19917607
https://www.slideshare.net/balarajbl/market-and-classification-of-market
https://www.slideshare.net/ruchi101/capital-budgeting-ppt-59565396
https://www.slideshare.net/ashu1983/financial-accounting.

Course Title	Course Outcomes (COs)	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	**PSO1**	**PSO2**
Managerial Economics and Financial Analysis	CO1	**3**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
	CO2	**1**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	CO3	**2**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	CO4	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**
	CO5	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**

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II B.Tech **II SEM** **Branch: Common to all**

Subject Code	Subject Name	L T P	Credit: 3
20AHS9905	**Universal Human Values**	2 1 0	

Course Objectives

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

COURSE CONTENT:

UNIT – 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

- Purpose and motivation for the course, recapitulation from Universal Human Values-I
- Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
- Continuous Happiness and Prosperity- A look at basic Human Aspirations
- Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current. scenario
- Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

UNIT II: Understanding Harmony in the Human Being - Harmony in Myself!

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of 'I' and harmony in 'I'
- Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
- Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

UNIT III: **Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship**.

- Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship

- Understanding the meaning of Trust; Difference between intention and competence

- Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship

- Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals

- Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

UNIT IV: **Understanding Harmony in the Nature and Existence - Whole existence as Coexistence**

- Understanding the harmony in the Nature

- Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self-regulation in nature

- Understanding Existence as Co-existence of mutually interacting units in all- pervasive space

- Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT- V: Implications of the above Holistic Understanding of Harmony on Professional Ethics.

- Natural acceptance of human values

- Definitiveness of Ethical Human Conduct

- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order

- Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

- Case studies of typical holistic technologies, management models and production systems

- Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations

- Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions Eg. To discuss the conduct as an engineer or scientist etc.

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Course Outcomes:

On completion of this course, the students will be able to

1. Students are expected to become more aware of themselves, and their surroundings (family, society, nature)
2. They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. They would have better critical ability.
4. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5. It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

TEXT BOOKS

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93- 87034-47-1
2. R R Gaur, R Asthana, G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

REFERENCE BOOKS

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. A. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. Mohandas Karamchand Gandhi "The Story of My Experiments with Truth"
5. E. FSchumacher. "Small is Beautiful"
6. Slow is Beautiful –Cecile Andrews
7. J C Kumarappa "Economy of Permanence"
8. Pandit Sunderlal "Bharat Mein Angreji Raj"
9. Dharampal, "Rediscovering India"
10. Mohandas K. Gandhi, "Hind Swaraj or Indian Home Rule"
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland(English)
13. Gandhi - Romain Rolland (English)

Correlation of COs with the POs & PSOs for B.Tech
AK-20 Regulations
*3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated

Course Title	Course Outcomes COs	Programme Outcomes(POs)											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
Universal Human Values	CO1								3				
	CO2								3				
	CO3								3				
	CO4								3				
	CO5								3				

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B.Tech-II Year **Semester: II** **Branch : Common to EEE,ECE,CE,ME**

COURSE CODE	COURSE TITLE	L	T	P	CREDITS
20AES0506	Internet of Things Lab(IoT Lab)	0	0	3	1.5

Course outcomes: At the end of the course, students will be able to

CO1: Choose the sensors and actuators for an IoT application.
CO2: Select protocols for a specific IoT application.
CO3: Utilize the cloud platform and APIs for IoT application.
CO4: Experiment with embedded boards for creating IoT prototypes.
CO5: Design a solution for a given IoT application.

Lab Experiments:

1. Select any one development board (Eg., Arduino or Raspberry Pi) and control LED using the board.
2. Using the same board as in (1), read data from a sensor. Experiment with both analog and digital sensors.
3. Control any two actuators connected to the development board using Bluetooth.
4. Read data from sensor and send it to a requesting client. (using socket communication)
   Note: The client and server should be connected to same local area network.
5. Create any cloud platform account, explore IoT services and register a thing on the platform.
6. Push sensor data to cloud.
7. Control an actuator through cloud.
8. Access the data pushed from sensor to cloud and apply any data analytics or visualization services.
9. Create a mobile app to control an actuator.
10. Identify a problem in your local area or college which can be solved by integrating the things you learned so far and create a prototype to solve it (Mini Project).

Text Book:

1. Adrian McEwen, Hakim Cassimally - Designing the Internet of Things, Wiley Publications, 2012

Reference Books:

1. Arshdeep Bahga, Vijay Madisetti - Internet of Things: A Hands-On Approach, Universities Press, 2014.
2. The Internet of Things, Enabling technologies and use cases – Pethuru Raj, Anupama C. Raman, CRC Press.

Reference sites:
https://www.arduino.cc/
https://www.raspberrypi.org/

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1		3								2	2
CO2		2			2					2			1	1
CO3	1	1			3					3			2	1
CO4	1	3	1	1	3					1			1	1
CO5	2	1	3		2					1			2	2

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

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Year : II **Semester** : II **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20APC0326	Thermal Engineering Lab	0	0	3	1.5

Course Outcomes:

1 To student can know working of both S.I and C.I engines with the help of indicator diagrams.
2 Student can understand the fuel supply systems, cooling, lubrication and ignition systems
3 Student can understand the flame propagation inside the cylinder, stages of combustion in S.I and C.I engines
4 To familiar with indicated power, brake power and friction power and their methods of measurement
5 the working of reciprocating and rotary air compressors. Student can calculate work done by single and multistage reciprocating air compressors.

List of Experiments:

1. Valve / Port Timing Diagrams of an I.C. Engines
2. Performance Test on a 4 -Stroke Diesel Engines
3. Performance Test on 2-Stroke Petrol engine
4. Evaluation of Engine friction by conducting Morse test on 4-Stroke Multi cylinder Engine
5. Retardation and motoring test on 4- stroke engine
6. Heat Balance of an I.C. Engine.
7. Air/Fuel Ratio and Volumetric Efficiency of an I.C. Engines.
8. Performance Test on Variable Compression Ratio Engines for CI Engines
9. Performance Test on Reciprocating Air – Compressor Unit
10. Study of Boilers
11. Dismantling / Assembly of Engines to identify the parts and their position in an engine.
12. Engine Emission Measurement for SI & CI Engines.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2													
CO2						3			2						
CO3	3		2		2										
CO4		2					3								
CO5				1											

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Year : II **Semester** : II **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20APC0304	Mechanics of Materials Lab	0	0	3	1.5

Course Outcomes:

1 Analyze the strength of the beam, SSB
2 Design the various types of springs and their loads
3 Test the load and strength of bricks, cubes.
4 Define and analyze shear test, stress
5 Design the strain, stress and compression

List of Experiments:

1. Direct tension test beam
2. Bending test on
   a) Simply supported beam
   b) Cantilever beam
3. Torsion test
4. Hardness test
5. Brinells hardness test
6. Rockwell hardness test
7. Test on springs
8. Compression test on cube
9. Impact test
10. Punch shear test

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1		2			1									
CO2	1			3											
CO3			2			2									
CO4		2			3										
CO5			2			1									

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Year : II **Semester** : II **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20ASC0302	Manufacturing Process Lab	0	0	3	1.5

Course Outcomes:

1 Fabricate different types of components using various manufacturing techniques.
2 Carry out Pattern preparation and Estimate the Sand properties
3 Carry out the Welding process to join the components
4 Carry out Blanking & Piercing operation
5 Adapt material forming methods.

1. METAL CASTING

a) Gating Design and pouring time and solidification time calculations.
b) Sand Properties Testing – Exercise for Strength and Permeability.
c) Molding, Melting and Casting for ferrous/ non ferrous materials.

2. WELDING

a) Arc Welding: Lap & Butt Joint - 2 Exercises
b) Spot Welding - 1 Exercise
c) TIG Welding - 1 Exercise
d) Plasma welding and Brazing - 2 Exercises (Water Plasma Device).

3. MECHANICAL PRESS WORKING

a) Blanking & Piercing operation and study of simple, compound and progressive press tool.
b) Hydraulic Press: Deep drawing and extrusion operation.
c) Bending and other operations.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2			2		2								
CO2	2			3						2					
CO3						3									
CO4		2					2								
CO5	2				2										

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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	Total
1	Professional Core courses	20APC0327	Machine Tools	3	-	-	3	30	70	100
2	Professional Core courses	20APC0309	Kinematics of Machines	3	-	-	3	30	70	100
3	Professional Core courses	20APC0314	Fluid Mechanics & Hydraulic Machinery	3	-	-	3	30	70	100
4	Open Elective Course/Job oriented elective	20AHSMB02	Entrepreneurship Development	3	-	-	3	30	70	100
		20APE0521	Artificial Intelligence							
		20APE0417	Sensor Networks							
5	Professional Elective courses	20APE0306	Renewable Energy Technologies	3	-	-	3	30	70	100
		20APE0302	Introduction to CAD/CAM							
		20APE0303	Nano Technology							
6	Professional Core courses Lab	20APC0315	Fluid Mechanics & Hydraulic Machinery Lab	-	-	3	1.5	30	70	100
7	Professional Core courses Lab	20APC0319	Machine Tools – 1 Lab	-	-	3	1.5	30	70	100
8	Skill advanced course/ soft skill course*	20ASA0502	Soft skills	1	-	2	2	100	-	100
9	Mandatory course (AICTE suggested)	20AMC9904	Professional Ethics and Human Values	2	-	-	0	30	-	30
10	CSP	20CSP0301	Community Service Project	-	-	-	1.5	100	-	100
Total credits							**21.5**	**440**	**490**	**930**

S. No	Professional Electives	Open Electives
1	Energy Conservation and Waste Heat Recovery	Wastewater Treatment and Recycling
2	Rapid Manufacturing	Solar Energy Engineering and Technology
3	Joining Technologies for Metals	Public Speaking
4	Metal Additive Manufacturing	Sustainable Energy Technology
5	Applied Thermodynamics	Renewable Energy Systems
6	Fundamentals Of Composite and Cellular Materials	Intellectual Property
7	Finite Element Method: Variational Methods to Computer Programming	Production and Operation Management
8	Joining Technologies for Metals	Disaster Management
9	Fundamentals of Conduction and Radiation	Basic Electronics
10	Powder Metallurgy	An Introduction to Artificial Intelligence

*Student shall register any number of MOOC courses from the above lists of Professional / Open electives listed by the department as approved by the BOS. But student is required to submit the pass certificate on NPTEL platform for at least one course with in the Programme duration (Before IV-II examination notification).

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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 To 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.

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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 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

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		3			2			3		3				
CO2		3													
CO3	2		3			2			2						
CO4		3									3				
CO5	1					2			1						

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Year : III **Semester** : I **Branch of Study : ME**

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 intereference.
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.

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UNIT V

Cams:

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 Mahines, 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.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2		1		1							
CO2	3	2	2		2		1	1			2				
CO3				2	2	1	1				2				
CO4	3	2	2	2	2		1			1					
CO5			2					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'sexperiment – 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 – manomertic 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.
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.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3		1	2						2			
CO2				1								2			
CO3	3					2									
CO4		3		1	1							2			
CO5			3												

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Course Code	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
20AHSMB02		3	0	0	3
	(Common to All branches of Engineering)				

Course Outcomes (CO):

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

UNIT - I	**Introduction to Entrepreneurship**

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	**Formulation of Business Idea**

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	**Financial Aspects of Promotion**

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**

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 and Incubation**

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.

Textbooks:

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.

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.Rizwana‖ "Entrepreneurship Development: Text &Cases", Excel Books, 2011.
4. Stuart Read, Effectual "Entrepreneurship", Routledge, 2013.

Online Learning Resources:

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1. Entrepreneurship-Through-the-Lens-of-venture Capital
2. http://www.onlinevideolecture.com/?course=mba-programs&subject=entrepreneurship
3. http://nptel.ac.in/courses/122106032/Pdf/7_4.pd
4. http://freevideolectures.com/Course/3514/Economics-/-Management-/-Entrepreneurship/50

Course Title	Course Outcomes (COs)	**Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)**													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	**PSO1**	**PSO2**
Entrepreneurship Development	CO1	3	0	0	0	0	0	0	1	0	0	0	0	0	0
	CO2	0	0	3	0	0	0	0	0	0	0	1	0	0	1
	CO3	0	0	0	0	0	0	0	0	0	2	3	0	0	0
	CO4	0	0	0	0	0	3	0	0	0	1	0	0	0	1
	CO5	0	0	3	0	0	0	0	0	0	2	0	0	0	1

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Course Code	Artificial Intelligence		L	T	P	C
20APE0501			3	1	0	3
Pre-requisite	Mathematics and Programming	Semester	III-I			

Course Objectives:

- Define Artificial Intelligence and establish the cultural background for study
- Understand various learning algorithms
- Explore the searching and optimization techniques for problem solving
- Provide basic knowledge on Natural Language Processing and Robotics

Course Outcomes :

CO1: Understand the basic concepts of Artificial Intelligence
CO2: Apply searching techniques for solving a problem
CO3: Analyze the concepts of Reinforcement Learning
CO4: Develop Natural Language Interface for Machines
CO5: Understanding the concepts to design a robotics

UNIT - I 9 Hrs

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 9Hrs

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 Continues Spaces, Searching with Nondeterministic Actions, Searching with partial observations, online search agents and unknown environments.

UNIT - III 9 Hrs

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 9 Hrs

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 9 Hrs

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.

Textbooks:

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

Reference Books:

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 forthe accounting cycle: Enhancing textbook homework with artificial intelligence." Journal of Accounting Education 27.1 (2009): 30-39.

Online Learning Resources:

http://peterindia.net/AILinks.html

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2											
CO2	3	3	3	2	3								2	2
CO3	2	2	2	2	2									3
CO4		3	3		3									3
CO5	3	2	1			1		1				1	1	1

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

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B.Tech III Year V Semester **Branch of Study: CE & ME**

Course Code	Course Title	L	T	P	Credits
20APE0417	Sensor Networks	3	0	0	3

Course Outcomes: Students will be able to
CO1. Understand the concepts of Converters and Sensor data acquisition systems
CO2: Understand the concepts of Sensor Measurements in Structural Monitoring
CO3: Understand the concepts of commonly used sensing technologies and algorithms
CO4: Understand the concepts of piezoelectric transducers for assessing and monitoring infrastructures
CO5: 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-Case Study

Unit-III Commonly used sensors for civil infrastructures and their associated algorithms
Introduction, commonly used sensing technologies- Displacement-Strain-Acceleration-Environment-Prevalence of commonly used sensors in SHM systems- **Associated algorithms-** Displacement sensors-Strain gages- Accelerometers- Environmental measurements- **Examples of continuous monitoring systems**

Unit-IV Piezoelectric transducers for assessing and monitoring civil infrastructures
Introduction, Principle of piezoelectricity, Piezoelectric materials and the fabrication of piezoelectric transducers, Piezoelectric transducers for SHM applications, Bonding effects, Limitations of piezoelectric transducers, SHM techniques using piezoelectric transducers

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, Brillouin and Raman scattering distributed sensors

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

Course Title	Course Outcomes (COs)	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)													
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO 10	PO 11	PO 12	**PSO 1**	**PSO 2**
Sensor Networks	CO1	**3**				**2**								2	
	CO2	**2**		3	3									2	
	CO3	**2**		3										3	
	CO4	2			2	3								2	
	CO5	3				2								3	

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MECHANICAL ENGINEERING (ME)

Year : III **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-gasdigesters, 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. Reneweble energy resources: Tiwari and ghosal, Narosa publication.
3. Non conventional Energy Sources, Khanna Publication.

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References:

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

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2														
CO2			3		1		3								
CO3	2							3				1			
CO4				3	1		3								
CO5		2										1			

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Year : III **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

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References:

1. CAD/CAM Theory and Practice / IbrahimZeid / TMH..
2. CAD/CAM/CIM Radha Krishnan & Subramanian / New age

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3														
CO2	3	3		3				2							
CO3	2				2					2					
CO4		3													
CO5	1			1	2					1					

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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:

CO 1 To identify the essential concepts used in nanotechnology
CO 2 To identify the materials, properties
CO 3 To Derive charecterization techniques
CO 4 To Characterization of carbon allotropes, synthesis of diamond.
CO 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 crystalling diamond films, grapheme, 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 fins, 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.

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REFERENCE BOOKS:

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

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3				1										
CO2		2							2						
CO3	3	2	2		2										
CO4			1						1						
CO5	1				3										

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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 flow 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.

List of Experiments:

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. Varification 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.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3		1	2				1		2			
CO2				1	1										
CO3	3					2									
CO4		3		1	1										
CO5			3			2				1		2			

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Year : III **Semester** : I **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20APC0319	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 tapper turning on lathe machine in form tool method.
5. Job on tapper 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.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3				2									
CO2			3												
CO3	2				2			3							
CO4		3				2					3				
CO5															

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Course Code			L	T	P	C
20ASA0502	SOFT SKILLS		1	0	2	2
Pre-requisite	Communicative English	Semester	III-I			

Course Objectives:

This course is designed to:

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

Course Outcomes :

CO1: Recognize the importance of verbal and non verbal skills
CO2: Develop the interpersonal and intrapersonal skills
CO3: Apply grammatical structures to formulate sentences and correct word forms.
CO4: Create trust among people and develop employability skills
CO5: Identify and apply communication skills effectively for professional

UNIT - I 9 Hrs

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=IEOrOPVMxiM
https://www.it.iitb.ac.in/~vijaya/ssrvm/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/mcgarrit/COM220/online%20readings/sample%20critique.pdf

UNIT - II 9Hrs

Grammar: Tenses, Idioms and Phrases, One word substitutes.
Vocabulary: Public speaking - *Oral presentations*, writing skills – *Short Essay writing and E- mail writing.*

Tenses
Web links: https://www.englisch-hilfen.de/en/grammar/english_tenses.htmj; https://onlymyenglish.com/tenses/;
https://www.englishpage.com/verbpage/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 9 Hrs

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MECHANICAL ENGINEERING (ME)

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-Leasership-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		9 Hrs

Grammar: Common errors, Rearrangement of sentences.
Vocabulary: Resume writing, Pre-interview preparation , Group discussion.
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		9 Hrs

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=KIoD19uoxt8

Textbooks:

1. Robert M Sheffield, "Developing Soft Skills", Pearson, 2010.

Reference Books:

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

Online Learning Resources:

https://www.youtube.com/watch?v=DUlsNJtg2L8&list=PLLy_2iUCG87CQhELCytvXh0E_y-bOO1_q

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1										2				
CO2										2				
CO3										2		2		
CO4										2				
CO5										2		2		

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

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B.Tech **Semester:** **Branch : Common to all**
MANDATORY COURSE

Subject Code 20AMC9904	Subject Name Professional Ethics And Human Values	L 3	T 0	P 0	Credits: 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.

Syllabus

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

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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 IIIich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA
3.Engineering Ethics, Concepts Cases: Charles E Harris Jr., Michael S PritchaMichael J Rabins, 4e , Cengage learning, 2015.
4.Business Ethics concepts & Cases: Manuel G Velasquez, 6e, PHI, 2008.

Correlation of COs with the POs & PSOs for B.Tech
AK-20 Regulations
*3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated

Course Title	Course Outcomes COs	Programme Outcomes(POs)											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
Professional Ethics and Human values	CO1								3				
	CO2								3				
	CO3								3				
	CO4								3				
	CO5								3				

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Semester VI (Third year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P	C	CIE	SEE	Total
1	Professional Core courses	20APC0317	Heat Transfer	3	-	-	3	30	70	100
2	Professional Core courses	20APC0316	Design of Machine Elements	3	-	-	3	30	70	100
3	Professional Core courses	20APC0318	Dynamics of Machines	3	-	-	3	30	70	100
4	Professional Elective courses	20APE0308	Finite Element Analysis	3	-	-	3	30	70	100
		20APE0304	Applied Thermodynamics							
		20APE0305	Composite materials							
5	Professional Core courses Lab	20APC0328	CAM Lab	-	-	3	1.5	30	70	100
6	Professional Core courses Lab	20APC0329	Heat Transfer Lab	-	-	3	1.5	30	70	100
7	Professional Core courses Lab	20APC0330	Machine Tools – 2 Lab	-	-	3	1.5	30	70	100
8	Skill advanced course/ soft skill course*	20ASC0303	Crystal structure Analysis Lab	1	-	2	2	100	-	100
9	Mandatory course (AICTE)	20AMC9901	Biology for Engineers	3	-	-	-	30	-	30
			Total credits				**18.5**	**340**	**490**	**830**
Industrial/Research Internship (Mandatory) 2 Months during summer vacation										

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Year : III **Semester** : II **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20APC0317	Heat Transfer	3	0	0	3

Course Outcomes:

1 To understand the concept of modes of heat transfer and to solve problems on conduction heat transfer.
2 To understand heat transfer through extended surfaces and solve the problems in 1-D transient conduction heat transfer.
3 To understand concept of the convection heat transfer and to solve practical problems on forced and natural convection heat transfer.
4 Calculate heat transfer in boiling, condensation and understand principle behind heat exchangers and solve problems using LMTD and NTU methods.
5 Understand basic concepts of radiation heat transfer from black and gray bodies and solve problems involving radiation shields.

Unit I

Introduction: Modes and Mechanisms of Heat Transfer – Basic Laws of Heat Transfer – General Applications of Heat Transfer.
Conduction Heat Transfer: Fourier Rate Equation – General Heat Conduction Equation In Cartesian, Cylindrical and Spherical Coordinates. Simplification and Forms of the Field Equation – Steady, Unsteady and Periodic Heat Transfer – Boundary and Initial Conditions.
One Dimensional Steady State Heat Conduction: In Homogeneous Slabs, Hollow Cylinders and Spheres.

Unit II

Heat Transfer in Extended Surface (Fins) – Types, Fin Materials, Applications , efficiency, effectiveness and temperature distribution on Long Fin, Fin with Insulated Tip and Short Fin, Application to Errors in Temperature Measurement.
One Dimensional Transient Heat Conduction: In Systems with Negligible Internal Resistance – Significance of Biot and Fourier Numbers – Chart Solutions of Transient Conduction Systems – Problems on Semi-infinite Body.

Unit III

Heat Convective Transfer: Dimensional Analysis – Buckingham Π Theorem and its Application for Developing Semi – Empirical Non-Dimensional Correlations for Convective Heat Transfer – Significance of Non-Dimensional Numbers – Concepts of Continuity, Momentum and Energy Equations.
Forced Convection: External Flows: Concepts of Hydrodynamic and Thermal Boundary Layer and Use of Empirical Correlations for Convective Heat Transfer for Flow Over – Flat Plates, Cylinders and Spheres.
Free Convection: Development of Hydrodynamic and Thermal Boundary Layer along a Vertical Plate – Use of Empirical Relations for Convective Heat Transfer on Plates and Cylinders in Horizontal and Vertical Orientation.

Unit IV

Heat Transfer with Phase Change:
Boiling: Pool Boiling – Regimes, Determination of Heat Transfer Coefficient in Nucleate Boiling, Critical Heat Flux and Film Boiling.
Condensation: Filmwise and Dropwise Condensation – Nusselt's Theory of Condensation on a Vertical Plate – Film Condensation on Vertical and Horizontal Cylinders Using Empirical Correlations.

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Unit V

Radiative Heat Transfer: Emission Characteristics and Laws of Black-Body Radiation – Irradiation – Total and Monochromatic Quantities– Laws of Planck, Wien, Kirchoff, Lambert, Stefan And Boltzmann – Heat Exchange Between Two Black Bodies –Concepts of Shape Factor – Emissivity – Heat Exchange Between Gray Bodies – Radiation Shields – Electrical Analogy for Radiation Networks.

Text Books:

1. Heat and Mass Transfer, by Sachdeva, New age International.
2. Heat and Mass Transfer by Y.A Cengel, A J Ghajar, Mc Graw Hill education,2011.
3. Heat and Mass Transfer, R.K.Rajput, S.Chand& Company Ltd, 2001.

Reference Books:

1. Heat Transfer, P.K.Nag, 3/e, TMH, 2011.
2. Fundamentals of Heat and Mass Transfer, Kondandaraman, C.P., 3/e, New Age Publ.
3. Heat Transfer, Holman.J.P, 10/e, TMH, 2012.
4. Introduction to Heat Transfer, by lncropera and Dewitt, Wiley Publishers,2001.
5. Heat Transfer, M. Necati Ozisik, A Basic Approach, McGraw Hill, New York, 2005.

Note: - Heat and mass transfer data book by C.P. kothandaraman, New age publications is permitted for internal and external examinations.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		3		3		2								
CO2		3		3						2					
CO3	3		3		3		3								
CO4		3		2						3					
CO5	3			1			1			1					

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Year : III **Semester** : II **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20APC0316	Design of Machine Elements	3	0	0	3

Course Outcomes:

1 To apply design procedures using theories of failure for different elements
2 Able to design simple components under cyclic loading using Goodman's and Soderberg's criterions
3 Able to design riveted joints with different configuration, boiler shell joint design and eccentric loading design of riveted joints
4 To design cotter joint, knuckle joint and shafts
5 To design various rigid and flexible shaft couplings

UNIT I

INTRODUCTION: General considerations of design, design process. Selection of Engineering Materials - properties –Manufacturing considerations in the design. BIS codes of materials, preferred numbers and interchangeability. STRESSES IN MACHINE MEMBERS: Simple stresses – Combined stresses – Torsional and bending Stresses – impact stresses – stress -strain relation – Theories of failure – factor of safety.

UNIT II

DESIGN FOR FLUCTUATING LOADS: Stress concentration –notch sensitivity – Design for fluctuating stresses – Estimation of Endurance strength – Goodman's line – Soderberg's line. Design of components for finite and infinite life.

UNIT III

DESIGN OF RIVETED JOINTS: Types of riveted joints, design of riveted joints. Boiler shell riveting design and eccentric loading design of riveted joints. DESIGN OF BOLTED JOINTS: Forms of Screw threads. Stresses in Screw fasteners. Design of bolts with pre-stresses, Design of bolted joints under eccentric loading, Bolts of uniform strength.

UNIT IV

DESIGN OF COTTERS AND KNUCKLE JOINTS: Design of Cotter joints: spigot and socket, sleeve and cotter, jib and cotter joints- Knuckle joints DESIGN OF SHAFTS: Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined bending and axial loads.

UNIT V

DESIGN OF KEYS AND COUPLINGS: Design of Rigid couplings: Muff, Split muff and Flange couplings- Design of flexible couplings.

Text Books:

1. Machine Design, Schaum'sseries, TMH Publishers, NewDelhi, 1st edition, 2011
2. Machine Design, R.S. Kurmi and J.K. Gupta, S.Chand Publishers, NewDelhi

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Reference Books:

1. Machine Design, R.K.Jain, KhannaPublishaers,New Delhi.
2. Machine Design, SadhuSingh, KhannaPublishers, NewDelhi
3. Mechanical Engineering Design, JosephE.Shigely,TMH Publishers,NewDelhi, 9th edition, 2011 R
4. Design of Machine Elements, M.F. Spotts, PHIPublishers, NewDelhi.
5. Machine Design, Pandya and Shah, CharotarPublishers,Anand, 17th edition, 2009
6. Machine Design, R.L. Norton, Tata McGrawHillPublishers, 2nd edition, 2002
7. Machine Design by Groover – CBS Publications, 5th edition, 2012.
8. Machine Design Data Book, V B Bhandari, McGraw Hill,2014

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2		2								3					
CO3			2												
CO4					1		2			1					
CO5								1							

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Year : III **Semester** : II **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20APC0318	Dynamics of Machines	3	0	0	3

Course Outcomes:

1 To understand the application of friction in pivots, collars, clutches, brakes, and dynamometers, and also to solve the numerical problems
2 To understand gyroscopic effect on Aeroplane, ship, four wheel and two-wheel vehicles. To design a flywheel for reciprocating engine and punching press.
3 To understand the working of various types of governors and to analyze the forces acting on them. To solve numerical problems on balancing of rotating masses
4 To understand that effect of primary and secondary balancing of reciprocating masses in locomotive engines, V-engine, inline engines and Radial engines
5 To understand the concept of different types of vibratory systems and to perform simple calculations of vibration systems

UNIT I

Friction:
Types of friction, inclined plane, screw friction, screw jack, Journal bearing, concept of uniform pressure and uniform wear, pivot bearings – flat, conical and trapezoidal, flat collar bearings, friction clutches – flat, conical and centrifugal, Brakes – Block or Shoe Brake, Band Brake, Band and Block Brake, Internal Expanding Shoe Brake, Effect of Braking on vehicle, general description and method of operation of Dynamometers.

UNIT II

Gyroscope:
Effect of gyroscopic couple on the stability of moving Aeroplane, ship, motor car and motor cycle.
Fluctuation of Energy:
Turning moment diagrams for steam engine, IC Engine and multi cylinder engine, coefficient of Fluctuation of energy, coefficient of Fluctuation of speed, design of Fly wheels for reciprocating engines, design of Fly wheels for punching machines.

UNIT III

Governors:
Watt governor, dead weight governor – Porter and Proell governors. Spring loaded governors – Hartnell, Hartung and Wilson Hartnell governors. Sensitiveness, isochronism and hunting. Effort and power of a governor.
Balancing of rotating masses:
Single in single plane, multiple masses in single plane, multiple masses indifferent planes.

UNIT IV

Balancing of Reciprocating masses:
Primary and Secondary balancing of reciprocating masses. Analytical and graphical methods. Balancing of Locomotives, Effects of Partial Balancing in Locomotives, Balancing of Inline Engines, V-engines, and Radial Engines. Unbalanced forces and couples for primary and secondary balancing.

UNIT V

Vibrations:
Free Longitudinal Vibrations, Inertia Effect of the Mass of Spring, Damped Vibrations, Forced Vibrations, Forced-damped Vibrations, Transverse Vibrations of Shaft due to Single Load, uniformly distributed Load and Several Loads, Dunkerly‟s method, Raleigh‟s method, Whirling of Shafts, Free Torsional Vibrations in Single Rotor, Two-rotor and Three-rotor Systems, Inertia Effect of Mass of Shaft, Torsionally Equivalent Shaft.

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Text Books:

1. Theory of Machines, S.S. Rattan, Tata McGraw Hill.
2. Kinematics and Dynamics of Machinery R.L. Norton, Tata McGraw Hill.

Reference Books:

1. Theory of Machines, Thomas Bevan, Pearson.
2. The theory of Machines, Ballaney, Kanna Publishers
3. Theory of Machines and Mechanisms of Shigley et.al. Oxford International.
4. Theory of Machines, Kinematics and Dynamics sadhu gingh, Pearson
5. A Text Book of Theory of Machines. R. K. Bansal, Laxmi Publications
6. Theory of Mechanisms and Machines, Jagadish Lal, Metropolitan company pvt. Ltd

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3													
CO2	3		1	2		1				3					
CO3								1							
CO4	3		1		2	1									
CO5			1					1		3					

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Year : III **Semester** : II **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20APE0308	Finite Element Analysis	3	0	0	3

Course Outcomes:

CO: 1 Summarize the basics of finite element formulation.
CO: 2 Apply finite element formulations to solve one dimensional Problems.
CO: 3 Apply finite element formulations to solve two dimensional scalar Problems.
CO: 4 Apply finite element method to solve two-dimensional Vector problems.
CO: 5 Apply finite element method to solve problems on iso parametric element and dynamic Problems.

UNIT – I

INTRODUCTION

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

UNIT – II

ONE-DIMENSIONAL PROBLEMS

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices – Solution of problems from solid mechanics and heat transfer.

UNIT – III

TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems – Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.

UNIT – IV

TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations – Plate and shell elements.

UNIT – V

ISOPARAMETRIC FORMULATION

Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems – Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software

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Text Books:

1. Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2005

2. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2		3				1							
CO2	3		2		3				2						
CO3		2		3											
CO4	3								2						
CO5		2	2												

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Year : III **Semester** : II **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20APE0304	Applied Thermodynamics	3	0	0	3

Course Outcomes:

CO: 1 Explain working of IC engines with combustion process.
CO: 2 Select compressors for different applications.
CO: 3 Use T-s diagram in vapour power and gas power cycles.
CO: 4 Explain the basic principles of steam turbines.
CO: 5 Select appropriate refrigerant for different applications.

UNIT – I

IC Engines: Working and classification of IC engines, comparison of two stroke and four stroke engines, comparison of SI and CI Engines.

Testing and Performance of IC Engines: Methods of testing IC Engines, performance analysis of IC Engines.

Combustion in IC Engines: SI engine: stages of combustion, normal combustion, abnormal combustion, variables effecting delay period and knocking, pre-ignition. CI engine: stages of combustion, normal combustion, abnormal combustion, variables effecting delay period and knocking. Fuel requirements and fuel rating.

UNIT – II

Air compressors

Reciprocating Compressor: Single stage reciprocating compressors, work required, effect of clearance in compressors, volumetric efficiency, multi stage compressor, effect of inter cooling in multi stage compressors, compressor performance.

Rotary Compressor: Working principle of a rolling piston type compressor (fixed vane type), multi vane type compressors, characteristics of rotary vane type compressor, working principle of centrifugal compression and axial flow compressors, velocity triangles.

UNIT – III

Vapour Power Cycles: Vapour power cycle, simple Rankine cycle, mean temp of heat addition thermodynamic variables effecting efficiency and output of Rankine cycle

Gas power Cycle: Simple gas turbine plant, Brayton cycle, closed cycle and open cycle for gas turbines, condition for maximum pressure ratio and optimum pressure ratio, actual cycle. Methods to improve performance: regeneration, intercooling and reheating. Introduction to jet propulsion: working principle of ramjet, turbojet, turbofan, turboprop and pulse jet engines

UNIT – IV

Nozzles: Type of nozzles - air and steam nozzles. Compressible flow through nozzle- condition for maximum discharge - nozzle efficiency.

Steam Turbines: Classification of steam turbines -impulse turbine and reaction turbine -compounding in turbines - velocity diagrams in impulse and reaction turbines, efficiency, degree of reaction - governing of turbines

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UNIT – V

Refrigeration: Bell-Coleman cycle - vapour compression cycle, effect of vapour condition on COP of VCR, - vapour absorption cycle, properties of common refrigerants

Principles of Psychrometry and Air Conditioning: Psychometric terms, psychometric processes and air conditioning systems

Text Book(s)

1. Ganesan V, "Internal Combustion Engines", Tata McGraw Hill, 2017.
2. M.L.Mathur and F.S.Mehta, "Thermal Engineering", Jain brothers,2014

References:

1. Mahesh V Rathore, "Thermal Engineering", Tata McGraw Hill 2017
2. Yahya, S. M., Turbines, "Compressors and Fans", 4th edition, Tata McGraw Hill, 2010.
3. Nag P.K, "Engineering Thermodynamics", 4th edition, Tata McGraw-Hill, 2008.
4. Onkar Singh, "Thermal Turbomachines", 3rd edition, Wiley India, 2014.
5. P.L.Ballaney, "Thermal Engineering", 2nd edition, Khanna, 2005.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3				2					3					
CO2		2						1							
CO3	2				2					3					
CO4		2		1											
CO5	1				2			1		3					

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Year : III **Semester** : II **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20APE0305	Composite materials	3	0	0	3

Course Outcomes:

1 To study matrix material, reinforcements of polymer matrix composites, MMC and ceramic matrix composites.
2 To develop knowledge on manufacturing methods of composites
3 To develop knowledge on processing techniques and applications of PMCs
4 To develop knowledge on processing techniques and applications of MMCs
5 To develop knowledge on processing techniques and applications of CMCs and Carbon- carbon composites

Unit I: Introduction: Definitions, Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fibre composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites

Unit II: Manufacturing methods: Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting and prepregs. Fibre/Matrix Interface. Measurement of interface strength, Characterization of systems; carbon fibre /epoxy, glass fibre / polyester, etc.

Unit III: Processing of Polymer Matrix Composites: Thermoset matrix composites: hand layup, spray, filament winding, Pultrusion, resin transfer moulding, autoclave moulding - bag moulding, compression moulding with Bulk Moulding Compound and sheet Moulding Compound – thermoplastic matrix composites – film stacking, diaphragm forming, thermoplastic tape laying, injection moulding.

Unit IV: Processing of Metal Matrix Composites: Metallic matrices: aluminium, titanium, magnesium, copper alloys – processing of MMCs: liquid state, Solid state, fabrication techniques – diffusion bonding – powder metallurgy techniques- interfaces in MMCs – mechanical properties – machining of MMCs – Applications.

Unit V: Processing of Ceramic Matrix Composites and Carbon-carbon Composites: Processing of CMCs: cold pressing, sintering, reaction bonding, liquid infiltration, chemical reaction techniques: chemical vapour deposition, chemical vapour impregnation, mechanical properties and applications of CMCs – Carbon-carbon Composites –applications.

Text Books and Reference Books:

1. Engineering Mechanics of Composite Materials- Isaac and M Daniel, Oxford University Press, 1994
2. Mechanics of Composite Materials, R. M. Jones, Mc GrawHill Company, New York, 1975
3. Mallick, P.K. and Newman.S., Composite Materials Technology, Hanser Publishers,2003.
4. Seamour, E.B. Modern Plastics Technology, Prentice Hall,2002

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3		2		2									
CO2	3			2		2	1								
CO3	3	3					1								
CO4			3				1		3						
CO5		3	3				1		3						

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Subject Code	Subject Name	L	T	P	Credits
20APC0328	CAM Lab	0	0	3	1.5

Course Outcomes:

1 To introduce fundamentals of the analysis software, its features and applications.
2 To learn the basic element types in Finite Element analysis.
3 To understand the stress analysis on different load conditions.
4 To know the concept of discretization of continuum, Loading conditions.
5 To analyze the structure using pre-processor and postprocessor conditions.

List of Experiments:

1. Static Analysis of 2D Transmission Tower
2. Static Analysis of 2D Four bar Truss
3. Static Analysis of 3D Space Truss
4. Static Analysis of Beam with UDL, UVL and moment
5. Static Structural Analysis of a Steel Bracket using Plane stress condition
6. Analysis of Pressure vessel using Plane Strain condition
7. Static analysis of an axisymmetric pressure vessel
8. Static analysis of a curved shell due to internal pressure

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3				2				2						
CO2		3		3				3							
CO3	3				3				2						
CO4		2		3				3							
CO5		1			1				2						

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Year : III **Semester** : II **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20APC0329	Heat Transfer Lab	0	0	3	1.5

Course Outcomes:

1 Estimate heat transfer coefficients in forced and natural convection and determine the effectiveness of heat exchangers and heat pipe.
2 Perform the transient heat conduction experiment and obtain the variations of temperature along length of pin-fin.
3 To determine overall heat transfer coefficient for composite walls
4 Perform experiment to determine thermal conductivity of metal rod.
5 Perform radiations experiments and determine the surface emissivity and Stefan boltzman's constant and compare the theoretical values.

List of Experiments:

1. Heat transfer coefficient in forced convection.
2. Heat transfer coefficient in natural convection
3. Thermal conductivity of insulating powder material through Concentric Sphere apparatus.
4. Thermal conductivity of insulating material through lagged pipe apparatus
5. Overall heat transfer co-efficient through Composite Slab Apparatus
6. Thermal Conductivity of metal (conductor).
7. Heat transfer in pin-fin
8. Experiment on Transient Heat Conduction
9. Experiment on Parallel and counter flow heat exchanger.
10. Emissivity of a gray body through Emissivity apparatus.
11. Experiment on Stefan Boltzman Apparatus.
12. Experiment on Critical Heat flux apparatus.
13. Study of heat pipe and its demonstration.
14. Study of Two – Phase flow.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		3			2									
CO2		3			3				2						
CO3	2					2									
CO4		3			3				2						
CO5	1		3												

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Year : III **Semester** : II **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20APC0330	Machine Tools – 2 Lab	0	0	3	1.5

Course Outcomes:

1 Learn the Step turning and taper turning
2 Learn the thread cutting Drilling and Tapping on the lathe machine
3 The operations of Shaping and Planning and milling
4 Understand the basics of surface grinding operations.
5 To analyze the surface finish on planar machine.

List of experiments:

1. Job on counter boring on drilling machine.
2. Job on counter sinking on drilling machine.
3. Job on drilling operations.
4. Job on tapping on drilling machine.
5. Preparation of key ways using slotting machine.
6. Job on internal and external surfaces using slotting machine.
7. Study of types of abrasive tools in tools and cutter grinder.
8. Preparation of single point cutting tool in tools and cutter grinder.
9. Process parameters influence on surface finish in surface grinding.
10. Job on planner machine.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3				2									
CO2			3							2					
CO3	2				3			3							
CO4		3				2									
CO5															

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Year : III **Semester** : II **Branch of Study : ME**

Subject Code	Subject Name	L	T	P	Credits
20ASC0303	Crystal structure Analysis Lab	1	0	2	2

Course Outcomes:

1 Determination of mechanical properties of different materials.
2 Establish the constitutive relations in metals using destructive methods.
3 Understand the behavior of micro structures in specimens.
4 Familiarize with standard test specimens.
5 Prepare samples for investigating micro structure of different materials

List of experiments:

1. Preparation and study of the micro-Structure of pure metals like iron, cu and al.
2. Preparation and study of the microstructure of mild steels, low carbon steels, high–C steels.
3. Study of the micro structures of cast irons.
4. Study of the micro structures of non-ferrous alloys.
5. Study of the micro structures of heat-treated steels.
6. To find out the Hardness of various treated and untreated steels.
7. To determine the Hardenability of a given steel.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2			3							3				
CO2			3					3							
CO3	2			2						1					
CO4			3												
CO5	2			1				3							

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II & III. B.Tech **Branch: Common to ALL**

Subject Code	Subject Name	L	T	P	Credits
20AMC9901	BIOLOGY FOR ENGINEERS	3	0	0	0

Course Outcomes:

1. Explain about cells and their structure and function. Different types of cells and basics for classification of living Organisms.
2. Explain about biomolecules, their structure, function and their role in the living organisms. How biomolecules are useful in Industry.
3. Brief about human physiology.
4. Explain about genetic material, DNA, genes and RNA how they replicate, pass and preserve vital information in living Organisms.
5. Know about application of biological principles in different technologies for the production of medicines and pharmaceutical molecules through transgenic microbes, plants and animals.

Unit I: Introduction to Basic Biology (10 hrs)

Evolution: Different patterns of evolution, Darwin's theory of evolution, Cell as Basic unit of life, cell theory, Cell shapes, Cell structure, Cell cycle. Chromosomes. Prokaryotic and eukaryotic Cell. Plant Cell, Animal Cell, Plant tissues and Animal tissues, Brief introduction to five kingdoms of classification, Tissue Engineering.

Unit II: Introduction to Biomolecules (10 hrs)

Carbohydrates, lipids, proteins, Vitamins and minerals, Nucleic acids (DNA and RNA) and their types. Synthesis of Enzymes, Enzyme application in Industry. Large scale production of enzymes by Fermentation.

Unit III: Human Physiology (08 hrs)

Digestive system, Respiratory system, (aerobic and anaerobic Respiration). Respiratory organs, respiratory cycle, Central Nerves System and Excretory system.

Unit IV: Introduction to Molecular Biology and recombinant DNA Technology (08 hrs)

Prokaryotic gene and Eukaryotic gene structure. DNA replication, Transcription and Translation. DNA technology. Introduction to gene cloning.

Unit V: Application of Biology (10 hrs)

Brief introduction to industrial Production of Enzymes, Pharmaceutical and therapeutic Proteins, Vaccines and antibodies. Basics of biosensors, Properties and Classification of virus, Immune response to virus (COVID-2019), Definitions-Pandemic, Epidemic and outbreak, pandemic alert system ranges, Prevention of pandemic disease and pandemic preparation.

Text books:

1. P.K.Gupta, Cell and Molecular Biology, 5th Edition, Rastogi Publications
2. U. Satyanarayana. Biotechnology, Books & Allied Ltd 2017

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Reference Books:

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A Global Approach", Pearson Education Ltd, 2018.
2. T Johnson, Biology for Engineers, CRC press, 2011
3. J.M. Walker and E.B. Gingold, Molecular Biology and Biotechnology 2nd ed.. Panima Publications. PP 434.
4. David Hames, Instant Notes in Biochemistry –2016
5. Phil Tunner, A. Mctennan, A. Bates & M. White, Instant Notes – Molecular Biology – 2014.
6. Richard Dawkins, River Out of Eden: A Darwinian View of Life

Correlation of COs with the POs & PSOs
AK-20 Regulations
*3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated

Course Title	Course Outcomes COs	Programme Outcomes(POs) & Programme Specific Outcomes(PSOs)												
		PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Biology for Engineers	CO1	3	2										1		
	CO2	3	2										1		
	CO3	3	2										1		
	CO4	3	2										1		
	CO5	3	2										1		

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Semester VII (Fourth year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P	C	CIE	SEE	Total
1	Professional Elective courses	20APE0307	Alternative Fuels and Emission Control in Automotives	3	-	-	3	30	70	100
		20APE0311	Refrigeration & Air Conditioning							
		20APE0309	Computational Fluid Dynamics							
2	Professional Elective courses	20APE0310	Digital Manufacturing and Industry 4.0	3	-	-	3	30	70	100
		20APC0323	Operations Research							
		20APE0312	Production and Operations Management							
3	Professional Elective courses	20APE0313	Quality & Reliability Engineering	3	-	-	3	30	70	100
		20APE0314	Power Plant Engineering							
		20APE0315	Fuel cell Technologies							
4	Professional Elective courses	20APE0317	Electrical & Hybrid Vehicles	3	-	-	3	30	70	100
		20APE0301	Automobile Engineering							
		20APE0316	IC Engines & Gas Turbines							
5	Open Elective Courses/ Job oriented elective (CBCS)	20APE0119	Air Pollution and Control	3	-	-	3	30	70	100
		20AHSMB04	Intellectual Property Rights							
		20APE0117	Ground Improvement Techniques							
6	*Humanities and Social Science Elective	20AOE9901	English For Research Paper Writing	3	-	-	3	30	70	100
		20AHE9903	Professional Communication							
		20AHE9913	Effective Public Speaking Skills							
7	Skill advanced course/ soft skill course*	20AHE9902	Principles of Effective Public Speaking	1	-	2	2	100	-	100
Industrial/Research Internship 2 Months (Mandatory) after third year (to be evaluated during VII semester				-	-	-	3	100	-	100
			Total credits				**23**	**380**	**420**	**800**

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Year: IV **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
20APE0307	Alternative Fuels and Emission Control in Automotives	3	0	0	3

Course Outcomes:

CO: 1 Explain various alcohol and gaseous fuels and their use in SI and CI engines
CO: 2 Describe various vegetable and synthetic oils and their use in CI engines
CO: 3 Analyze the formation of various emissions from SI engine and control techniques
CO: 4 Analyze the formation of various emissions from CI engine and control techniques
CO: 5 Discuss various emission measuring instruments, test procedures and emission norms

Unit I:

Alcohol Fuels: Introduction to alternative fuels, important qualities of SI and CI engine fuels, rating of fuels, properties of alcohols -methanol, ethanol, alcohol-gasoline blends, reformulated gasoline for SI engines, alcohols for CI engines, surface ignition alcohol CI engine, spark-assisted Diesel engine, performance and emission characteristics of alcohol fuels.

Gaseous Fuels: Properties of hydrogen, storage methods, safety precautions, natural gas - advantages and disadvantages, biogas production and its properties, LPG and CNG - properties, advantages and disadvantages, LPG and CNG in SI and CI engines, performance and emissions characteristics of gaseous fuels.

UNIT- II

Vegetable Oils: Various vegetable oils for diesel engines, properties of vegetable oils, problems in using vegetable oils in diesel engines, methods to improve engine performance using vegetable oils – preheating, esterification, blending with good secondary fuels, performance and emission characteristics of biodiesel fuelled diesel engines.

Synthetic Oils: Introduction - di-methyl ether, di-ethyl ether, Biomass to liquid (BTL), Gas to liquid (GTL), Coal to liquid (CTL), Eco-friendly plastic fuel (EPF), Wood pyrolysis oil (WPO), Tyre pyrolysis oil (TPO) – Properties, applications, advantages and disadvantages in CI engines.

UNIT- III

Emissions From SI Engines and their Control: Emission formation in SI engines (CO, HC and NOx), effect of design and operating variables on emission formation, control techniques – thermal reactor, exhaust gas recirculation, catalytic convertors- types (two way and three way) and applications, charcoal canister control for evaporative emission, positive crankcase ventilation for blow by gas control.

UNIT- IV

Emissions from CI engines and their Control: Emission formation in CI engines (HC, CO, NOx, aldehydes, smoke and particulates), effect of design and operating variables on emission formation, control techniques – exhaust gas recirculation, selective catalytic reduction, Diesel oxidation catalytic convertor, Diesel particulate filter, NOx versus particulates – trade off.

UNIT- V

Emission Measuring Instruments and Test Procedures: Principle of operation of emission measuring instruments used in SI and CI engines, measurement of CO2 and CO by Non – dispersive infrared detector (NDIR) - hydrocarbon emission by flame ionization detector (FID), Chemiluminescent analyser for NOx, spot sampling and continuous indication type smoke meters (Bosch and Hartridge smoke meters), Euro and Bharat norms.

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Text Books:

1. S.S. Thipse, *Alternative Fuels: Concepts, Technologies and Developments*, 1st Edition, Jaico Publishing House, 2010
2. V. Ganesan, *Internal combustion engines*, 4th Edition, Tata McGraw Hill Education, 2012

Reference Books:

1. Michael F. Hordeski, *Alternative Fuels: The Future of Hydrogen*, 2nd Edition, The Fairmont Press, 2008.
2. R.K. Rajput, *A textbook of Internal Combustion Engines*, 3rd Edition, Laxmi Publications, 2016.

Web Resources:

1. https://en.wikipedia.org/wiki/European_emission_standards
2. https://en.wikipedia.org/wiki/Bharat_stage_emission_standards

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		2		2										
CO2			3		2										
CO3		3	2		1										
CO4		3	2		1										
CO5	2				3										

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Year: IV **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
20APE0311	Refrigeration & Air Conditioning	3	0	0	3

Course Outcomes:

CO: 1 Understand the basic refrigeration methods include Vapor compression refrigeration, Gas refrigeration and their applications.
CO: 2 Understand the vapor absorption refrigeration and classify the commonly used refrigerants and their environmental effects.
CO: 3 Describe components of refrigeration system and their working principles.
CO: 4 Understand properties of moist air, psychometric chart and needs of human comfort
CO: 5 Solve heating & cooling load problems under environmental and inside conditions

Unit I:
Introduction – Thermal principles, applications of Refrigeration & Airconditioning, methods of refrigeration. **Vapor compression refrigeration system-** Carnot refrigeration cycle, Wet compression & dry compression, Standard vapour-compression cycle, P-H, & T-S diagrams, effect of sub-cooling and super-heating, actual vapour-compression cycle.

Unit II:
Gas cycle refrigeration – Limitations of Carnot cycle, Bell Coleman cycle, analysis of simple aircraft refrigeration cycle.
Refrigerants: Classification of refrigerants, designation of refrigerants, properties of an ideal refrigerant, Environmental effects of CFC refrigerants, substitutes for CFC refrigerants

Unit – III
Components: Compressors – General classification – comparison, advantages and disadvantages, Evaporators – classification – working, Condensers – classification – working, Expansion devices- types –working.

Unit – IV
Vapour Absorption Refrigeration system: Introduction – Basic absorption refrigeration system, actual Ammonia absorption refrigeration system, Lithium-Bromide absorption refrigeration system, three fluid absorption refrigeration system, comparison of compression and absorption refrigeration systems
Other Refrigeration systems: Working principles of Steam jet refrigeration system, Thermoelectric refrigerator, Vortex & Pulse tube refrigerators (only theoretical concepts).

UNIT-V
Air conditioning: Psychrometric properties, Psychrometric chart, basic processes in conditioning of air, bypass factor, simple air conditioning system, human comfort and effective temperature, industrial air conditioning.

Text Books:
1. C.P.Arora , *Refrigeration and Air Conditioning*, TMH Publishers, New Delhi.
2. Barron R.F., *Cryogenic Systems*, Oxford University Press, New York.

Reference Books:
1 Dossat, *Principles of Refrigeration*, Pearson Education, New Delhi.
2 Manohar Prasad, *Refrigeration and Air Conditioning*, NAI Publishers, New Delhi.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		3												
CO2	3		2												
CO3		2			3										
CO4	3		2												
CO5			2		1		3								

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Year: IV **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
20APE0309	Computational Fluid Dynamics	3	0	0	3

Course Outcomes:

CO: 1 Apply numerical methods for solving algebraic equations
CO: 2 Solve conduction and convection problems using finite difference method
CO: 3 Solve hyperbolic and elliptic equations and understand fundamentals of fluid flow modeling
CO: 4 Understand both flow physics and mathematical properties of governing Navier-Stokes equations
CO: 5 Analyze CFD techniques using software

Unit I:

Applied Numerical Methods: Solution of a system of simultaneous Linear Algebraic Equations, iterative schemes of Matrix Inversion, Direct Methods for Matrix inversion, Direct Methods for banded matrices.

Unit II:

Finite Difference Applications in Heat conduction and Convention: Heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application in convective heat transfer, closure

Unit III:

Fluid flow modelling: Introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods, Errors and stability analysis, introduction, first order wave equation, stability of hyperbolic and elliptic equations, fundamentals of fluid flow modelling, conservative property, the upwind scheme.

Unit IV:

Governing Equations of Fluid Flow and Heat Transfer: Introduction, conservation of mass Newton's second law of motion, expanded forms of Navier-stokes equations, conservation of energy principle, and special forms of the Navier-stokes equations.

Unit V:

Simple CFD Techniques, viscous flows conservation form space marching, relocation techniques, viscous flows, conservation from space marching relovation techniques, artificial viscosity, the alternating direction implicit techniques, pressure correction technique. Computer graphic techniques used in CFD, Quasi one dimensional flow through a nozzle, turbulence models, standard and high Reynolds number models and their applications

Text Books:

1. John.Anderson, Computational Fluid Dyanamics -The basics with applications, Mc Graw Hil Publishers, New York
2. Suhas V, Patankar Hema, Numerical Heat Transfer and Fluid Flow, Shava Publishers and Mc Graw Hill, New Delhi

Reference Books:

1. Muralidharan, Computational Fluid Flow and Heat Transfer, Narosa Publications, New Delhi
2. Tapan K. Sengupta, Fundamentals of Computational Fluid Dynamics, Universities Press, New Delhi

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3	1	3											
CO2		3	2												
CO3		3		2			1								
CO4	1			2			1								
CO5	1	3			2										

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Year: IV **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
20APE0310	Digital Manufacturing and Industry 4.0	3	0	0	3

Course Outcomes:

CO: 1 Understand the Basics and applications of Digital Manufacturing and Industry 4.0.
CO: 2 Understand the role of Additive Manufacturing, Virtual prototyping and Reverse Engineering processes and their adaptability to Digital Manufacturing.
CO: 3 Understand the concepts of digital manufacturing-based product life cycle and its management.
CO: 4 Understand the concept of Industry 4.0 and allied technologies.
CO: 5 Understand the basics of Internet of things and cloud computing pertaining the fourth industrial revolution.

Unit I:

Introduction to digital manufacturing: Definition of digital manufacturing, Operation Mode and Architecture of Digital Manufacturing System, Impact on manufacturing careers, Advantages of digital manufacturing and design, Information sharing in the digital thread, Digital twins and Files format (STL, AMF, 3MF), Multiple organizations in the manufacturing process. Introduction of Industry 4.0, case study on car manufacturing by Bosch.

UNIT-II

Additive Manufacturing Processes: Additive Manufacturing processes – Engineering polymers, metals and ceramics. Stereolithography, Selective Laser Sintering, Fused Deposition Modeling, Layered object manufacturing. Electronic Materials, Bio-printing, Food Printing. Preprocessing and Post processing in AM.

Virtual Prototyping & Reverse Engineering: Virtual Prototyping, Applications, Virtual Prototyping and Virtual Manufacturing. Reverse Engineering, Application of Reverse Engineering in Digital Manufacturing. Self-Learning of Manufacturing System and Intelligent Manufacturing System

UNIT-III:

Key Technology of Digital Manufacturing: Various Digital Technologies in Product Lifecycle, Digital Equipment and Digital Processing Technology, Technology of Digital Maintenance and Diagnosis.

UNIT-IV:

Industry 4.0: Various Industrial Revolutions, Compelling Forces and Challenges for Industry 4.0, Comparison of Industry 4.0 Factory and Today's Factory, automation, data exchanges, cloud, cyber-physical systems, mobile robots, Big Data, deep machine learning, Production Systems, IoT, Challenges of implementing Industry 4.0, Impact of implementing Industry 4.0 in various sectors, Applications domains and the way forward.

UNIT –V:

Internet of Things (IoT) - IoT design methods, physical devices and enabling technologies, Industrial Internet of Things (IIoT), Smart Manufacturing.

Text Books:

1. Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited,2012.
2. Brent Stucker, David Rosen, and Ian Gibson, Additive Manufacturing Technologies, ISBN 978-1-4419-1120-9, Springer, 2010.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2				3	1									
CO2	2		1		3										
CO3	2				3										
CO4	2				3	1									
CO5	2		1		3										

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Year: IV **Semester: I** **Branch of Study: ME/CE/CIC**

Subject Code	Subject Name	L	T	P	Credits
20APC0323	Operations Research	3	0	0	3

Course Outcomes:

CO: 1 Understand Basics of operations research and solve linear programming problems
CO: 2 Solve Transportation and assignment problems
CO: 3 Solve game and replacement problems
CO: 4 Solve the sequencing related problems
CO: 5 Solve queuing problems and other relevant problems using simulation tool

Unit I:

Introduction*:* Definition, Basic OR models & Applications of OR
Linear Programming: Introduction, Formulation of Linear Programming (L P) problems, Graphical method of solving LP problem, simplex method, Artificial variable Technique, Degeneracy in L PP's, Duality, unbounded, infeasible and multiple optimum solution.

Unit II:

Transportation Models: Finding an initial feasible solution – North West Corner method, Least cost method, Vogel's Approximation Method; Finding the optimal solution using MODI method, Special cases in Transportation problems – Unbalanced Transportation problem, Degeneracy in transportation problem, multiple optimal solutions, prohibited routes.
Assignment problems: Hungarian method of Assignment problem, maximization in Assignment problem, unbalanced Assignment problem, prohibited Assignments, multiple optimum solutions

Unit III:

Game Theory: Introduction, Two-person zero sum games, Maxi-min and Mini-max principles, Principle of dominance, solution of mixed strategy problems, Graphical method for 2 x n and m x 2 games
Replacement Models: Introduction, replacement of items that deteriorate gradually ignoring change in money value, replacement of items that deteriorate considering change in money value with time, replacement of items that fail suddenly – Individual replacement policy, Group replacement policy

Unit IV:

Sequencing Models: Introduction, General Assumptions, Priority rules for job sequencing (Single machine Scheduling), Measures of Performance- Average Completion Time, Average Lateness; Processing n jobs thorough 2 machines, Processing n jobs through 3machines, Processing n jobs thorough m machines, Processing 2 jobs through m machines

Unit V:

Queuing Theory: Introduction, Single Channel – Poisson arrivals – Exponential service times with infinite population & finite population, Multi-channel – Poisson arrivals – Exponential service times with infinite population
Simulation: Introduction, Definition, Types of Simulation, Monte-Carlo Simulation, Pseudo Random Numbers, Mid-square Method of Generating Random Numbers, Application of simulation to inventory control and queuing problems.

Text Books:

1. S.D. Sarma, Operations Research, Kedarnnath, Ramnath& Co.,Meerut
2. N.D. Vohra, Quantitative Techniques in Management, TMH Publishers, New Delhi

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Reference Books:

1. V.K. Kapoor, Operations Research, S. Chand Publishers, New Delhi
2. Prem Kumar Gupta and Hira, Operations Research, S. Chand Publishers, New Delhi

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2					2								
CO2		3							1						
CO3		2									2				
CO4		2		1											
CO5		3									2				

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Year: IV **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
20APE0312	Production and Operations Management	3	0	0	3

Course Outcomes:

CO: 1 Demonstrate the operations and supply management to the sustainability of an Enterprise
CO: 2 Identify the need for forecasting and understand different forecasting methods
CO: 3 Identify various production and plant layouts
CO: 4 Examine the quality control of the production
CO: 5 Recommend the production schedule for productivity

Unit I:
Introduction: Operations Management – Definition, Objectives, Types of Production System, Difference between OM & PM, Historical Development of Operations Management, Current Issues in Operation Management, Product Design – Requirements of Good Product Design, Product Development – Approaches, Concepts in Product Development, Standardization, Simplification, Speed to Market, Introduction to Concurrent Engineering.

UNIT – II
Forecasting: Introduction, Statistical Forecasting Techniques, Moving Average, Exponential Smoothing Technique, Errors in Forecasting and Evaluation of Forecasting Techniques

UNIT – III
Value Engineering and Plant Layout: Value Engineering – Objectives, Types of Values, Function and Cost, Product Life Cycle, Steps in Value Engineering, Methodology in Value Engineering, FAST Diagramand Matrix Method. Facility Location and Layout – Factor Considerations in Plant Location, Comparative Study of Rural and Urban Sites, Methods of Selection of Plant Layout, Objectives of Good layout, Principles, Types of Layout, Line Balancing.

UNIT – IV
Aggregate Planning and MRP: Aggregate Planning – Definition, Different Strategies, Various Models of Aggregate Planning- Transportation and Graphical Models, Master scheduling, Material Requirement Planning(MRP)- Terminology, Types of Demands, Inputs to MRP, Techniques of MRP, Lot Sizing Methods, Benefits and Drawbacks of MRP, Manufacturing Resources Planning (MRP II), Just in Time (JIT) Philosophy, Kanban System, Calculation of Number of Kanbans, Pull Systems vs. Push Systems, Requirements for Implementation of JIT, JIT Production Process, Benefits of JIT.

UNIT – V
Scheduling: Policies, Types of Scheduling, Scheduling Strategies, Scheduling and Loading Guidelines, Forward and Backward Scheduling, Grant Charts, Priority Decision Rules, Flow Shop Scheduling, Job Shop Scheduling, Line of Balance.

Text Books:
1. Buffa E.S. and Sarin R.K., "Modern Production / Operations Management", 8th Edition, Wiley India Pvt. Ltd., New Delhi, 2009.
2. Joseph G. Monks, "Operations Management-Theory and Problems", 3rd Edition, McGraw Hill Education, 1987.
3. Dipak Kumar Bhattacharyya, "Production and operations Management", University press, 2012.

Reference Books:
1. James L. Riggs, Jim Rigs, "Production Systems: Planning, Analysis and Control", 4th Edition, Wave Land Press, 1992.
2. Chary S.N., "Production and Operations Management", 5th Edition, McGraw Hill Education, 2017.

3. Richard B.Chase, Ravi Shankar, Robert Jacobs F., "Operations and Supply Chain Management", 15th Edition, McGraw Hill Education, 2018

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3				1										
CO2		2													
CO3		2													
CO4	2			2											
CO5		2			1										

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Year: IV **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
20APE0313	Quality & Reliability Engineering	3	0	0	3

Course Outcomes:

CO: 1 Understand the overview of the Total Quality Management system
CO: 2 Understand concepts of customer satisfaction and employee involvement
CO: 3 Apply the appropriate tools and techniques of continuous process improvement for controlling and improving quality
CO: 4 Apply Quality Function Deployment and Bench Marking process for improving a product or process
CO: 5 Understand concept of Reliability Engineering

Unit I:
Introduction to T.Q.M.: Introduction to Quality; Evolution of and basic approach to Total Quality Management; Leadership concepts; The Seven habits of highly effective people; Role of TQM Leaders; Implementation of TQM; Quality council, quality statements

Unit II:
Customer Satisfaction: Types of Customers-Internal and External; Customer perception of quality; Feedback & brief discussion on Information Collecting Tools
Employee Involvement: Maslow's hierarchy of needs; Types of Teams, Stages of team development, Common barriers to team progress, Training; Benefits of Employee Involvement

Unit III:
Continuous Process Improvement: Introduction, Juron trilogy, Improvement strategies; P-D-S-A cycle & Problem-solving method; Basic concepts of Kaizen and Six sigma quality control, Taguchi method, Quality circles
Supplier Partnership: Introduction, Partnering, Sourcing, Supplier Selection, Supplier Rating, Relationship Development
Tools & Techniques of TQM: Pareto diagram, Cause & Effect diagram

Unit IV:
Benchmarking: Introduction, Benchmarking process
Quality Function Deployment: Benefits of QFD, House of Quality

Unit V:
Reliability Engineering: Introduction, Failures & failure modes, Causes of failures
Design for Reliability: Designing for higher Reliability, Reliability & Cost
Component Reliability: MTTF, Time dependent hazard models – Exponential Distribution
System Reliability: Systems with components- in Series, and in Parallel; Non-Series-Parallel systems
Redundancy Techniques: Introduction, Component & Unit Redundancy, Weakest link technique

Text Books:

1. Dale H. Bester field, Total Quality Management, Pearson Education, New Delhi
2. E. Balagurusamy, Reliability Engineering, TMH Publishers, New Delhi
3. M. Mahajan, Statistical Quality Control, Dhanapat Rai and Sons Publishers, New Delhi

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Reference Books:

1. Douglas C. Montgomery, Introduction to Quality Control, John Wiley and Sons Publishers, New York
2. N. Logothetis, Managing for Total Quality, From Deming to Taguchi, PHI Publishers, New Delhi
3. L.S. Srinath, Reliability Engineering, East West Press, New Delhi

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2			1											
CO2	2				2										
CO3	1				2	2									
CO4	1		2												
CO5	2			3											

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MECHANICAL ENGINEERING (ME)

Year: IV **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
20APE0314	Power Plant Engineering	3	0	0	3

Course Outcomes:

CO: 1 Understand the concepts of sources of energy, combustion of fuels and combined cycle power generation
CO: 2 Describe the idea of economics of power generation and diesel engine power plant
CO: 3 Analyse the working and layout of steam power plant
CO: 4 Describe the working principle and basic components of the gas turbine power plant
CO: 5 Compare the working principle and basic components of the hydroelectric power plant and nuclear power plant

Unit I:

Sources of Energy: Introduction, different sources of energy, types of power plants, essential requirements of a power plant.
Fuels and Combustion: Coal, fuel oil, natural and petroleum gas, industrial wastes and by-products, biomass, thermodynamic view, combustion reactions, calculation of weight of air required for combustion, heat of combustion.
Combined Cycle Power Generation: Gas turbine – Steam turbine (combined) power plant, advantages of combined cycle power generation

Unit II:

Economics of Power Generation: Terms and definitions, load duration curves, power plant economics – construction costs, Fixed cost and depreciation, fuel cost, present worth concept, incremental heat rate, input-output curves.
Diesel Engine Power Plant: Introduction, advantages and disadvantages of diesel power plant, applications of diesel power plant, general layout, essential components of diesel power plant, layout of a diesel engine power plant

Unit III:

Steam Power Plant: Introduction, classification of steam power plants, layout of a modern steam power plant, fuel handling, combustion equipment for boilers, fluidized bed combustion, advantages and disadvantages of steam power plants, efficiencies in a steam power plant – calculation of different efficiencies – simple problems

Unit IV:

Gas Turbine Power Plant: General aspects, closed cycle and open cycle plants, applications, advantages and disadvantages of a gas turbine power plant, analysis of a gas turbine power plant, gas turbine fuels, performance of gas turbine plants, components of gas turbine power plant

Unit V:

Hydro-Electric Power Plant: Introduction, advantages and disadvantages, selection of site, essential elements of hydro-electric power plant, classification of hydro-electric power plants, calculation of available hydro power.
Nuclear Power Plant: Chemical and Nuclear reactions, Nuclear Fission, chain reaction, main components of nuclear power plant, essential components of a nuclear reactor, types of reactors, power of nuclear reactor, safety measures for nuclear power plants.

Text Books:

1. P.K Nag, Power Plant Engineering, TMH Publishers, New Delhi
2. Manoj Kumar Gupta, Power Plant Engineering, PHI Publishers, New Delhi

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Reference Books:

1. R.K Rajput, Power Plant Engineering, Lakshmi Publications, Bengalore
2. G.D. Rai, Power Plant Technology, Khanna Publishers, New Delhi
3. G.R. Nagpal, Power Plant Engineering, Khanna Publishers, New Delhi

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					1	2								
CO2	3														
CO3	3				2										
CO4	3						1								
CO5	3					1									

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Year: IV **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
20APE0315	Fuel cell Technologies	3	0	0	3

Course Outcomes:

CO: 1 Understand fuel cell fundamentals
CO: 2 Understand fuel cell thermodynamics
CO: 3 Understand construction and operation of fuel cell stack and fuel cell system
CO: 4 Understand various types of fuel cell systems and components
CO: 5 Understand the fuel processing technology for fuel cell systems

Unit I:

Overview of Fuel Cells: What is a fuel cell, brief history, classification, how does it work, why do we need fuel cells, Fuel cell basic chemistry and thermodynamics, heat of reaction, theoretical electrical work and potential, theoretical fuel cell efficiency.
Fuels for Fuel Cells: Hydrogen, Hydrocarbon fuels, effect of impurities such as Carbon oxide, Sulphur and others.

Unit II:

Fuel cell electrochemistry: Electrode kinetics, types of voltage losses, polarization curve, fuel cell efficiency, Nernst equation, Tafel equation, exchange currents

Unit III:

Fuel cell process design: Main PEM fuel cell components, materials, properties and processes: membrane, electrode, gas diffusion layer, bi-polar plates
Fuel cell operating conditions: pressure, temperature, flow rates, humidity.

Unit IV:

Main components of solid-oxide fuel cells, Cell stack and design, Electrode polarization, testing of electrodes, cells and short stacks, Cell, stack and system modelling.
Advances in Fuel Cell Technology: Direct methanol fuel cell; microbial fuel cell; hydrogen generation and storage; limitations, recent advances and challenges in fuel cell research.

Unit V:

Fuel processing: Direct and in-direct internal reforming, Reformation of hydrocarbons by steam, CO2 and partial oxidation, Direct electro-catalytic oxidation of hydrocarbons, carbon decomposition, Sulphur tolerance and removal, Using renewable fuels for SOFCs

Text Books:

1. Ryan O'Hayre, Suk-Won Cha Whitney Colella , Fuel Cell Fundamentals, second edition, John Wiley & Sons, 2009
2. Franno. Barbir, PEM Fuel Cells: Theory and Practice (2nd Ed.) Elsevier/Academic Press, 013.
3. Karl Kordesch& Gunter Simader, Fuel Cells and Their Applications, VCH Publishers,2001

Reference Books:

1. Hoogers G., Fuel Cell Technology Hand Book, CRC Press, 2003.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3						1								
CO2	3														
CO3	2						1								
CO4		3													
CO5		3													

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Year: IV **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
20APE0317	Electrical & Hybrid Vehicles	3	0	0	3

Course Outcomes:

CO: 1 Understand the basics of electric and hybrid vehicles
CO: 2 Understand the concepts of drive trains for hybrid and electric vehicles
CO: 3 Understand the working of components involved in electric propulsion unit
CO: 4 Understand the energy storage options and concepts of matching the drive system of hybrid vehicles to IC engines
CO: 5 Design the battery vehicle and hybrid vehicles and to understand the energy management strategies

Unit I:

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Conventional Vehicle Drive-trains: Basics of vehicle performance, vehicle power source characterization, transmission characteristics.

Unit II:

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

Unit III:

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Unit IV:

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

Unit V:

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Text Books:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

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Reference Books:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			3												
CO2						3									
CO3	2		3												
CO4						2									
CO5			3		1										

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Year: IV **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
20APE0301	Automobile Engineering	3	0	0	3

Course Outcomes:

CO: 1 Understand the use and operation of engine components; the working of cooling and lubrication systems
CO: 2 Understand the fuel supply system of SI and CI engines of an automobile
CO: 3 Understand the working of battery, magneto and electronic ignition systems
CO: 4 Understand the working of manual transmission system, differential gear box, steering geometry and axles of an automobile
CO: 5 Understand the working of front axle, rear axle, and air suspension systems of an automobile and working of mechanical, hydraulic, pneumatic braking systems and emission standards of an automobile

Unit I:

Engine Parts: Function and constructional details of Cylinder block, Cylinder liners-wet and dry types, Piston, Connecting rods, Crankshaft, Camshaft, Air cleaner, Intake and Exhaust manifolds, Mufflers.

Cooling System: Need for cooling of automobile-Types of cooling-air cooling, water-cooling. Natural circulation (Thermo-syphon system), Forced circulation and sealed Systems. Components of water-cooling system. Water pump, fan, Radiator, Thermostats and temperature indicators. Anti-freeze mixtures.

Lubricating Systems: Need for lubrication-Functions of lubricating oil. Properties of lubricating oil, and S.A.E grading of lubricants. Lubricating systems-Petroil .Splash, Pressure feed, Wet and Dry sump, Semi pressure and pre-lubrication system

Unit II:

Fuel Supply Systems: Fuel supply system of diesel engine, fuel injection pumps, Super charging of diesel engines. Fuel supply system for petrol engines-Carburetors, Air-fuel ratios at different vehicle running conditions, Working of a simple carburetor. Various carburetor systems- Float, Starting, Idle, Low speed, High speed and acceleration systems. MPFI and EFI systems. Types of carburetors-Working and constructional details of SU, Zenith and Carter carburetors

Unit III:

Ignition-System: Electronic ignition system. Storage battery, Battery rating, Dynamo, Alternators, Cut outs, Voltage and Current regulators. Starting motors. Sparkplugs-Hot and Cold, Computer controlled coil ignition sensors

Unit IV:

Transmission System: Clutch-Principle and requirements of a clutch, types of clutches-Single plate, Multi plate and Centrifugal, Semi-centrifugal clutches**.**

Gearbox - Requirements of a gear box, Gear selecting mechanism, Types of gear boxes-Sliding mesh, Constant mesh and Synchromesh. Propeller shaft Functions and constructional details**,**

Differential: Principle of working and its construction, Front axle-stub axle-types of stub axles.

Rear axle –Semi floating, Three-quarter floating and Full floating axles. Steering-Wheel alignment. Steering geometry-Camber-Castor, Kingpin inclination, Toe in, and Toe-out. Steering linkages-Under steering and over steering. Power steering

Unit V:

Suspension: Types of suspension springs, Front axle independent suspension systems-Wishbone type. Trailing link type, Vertical link type. Rear axle suspension systems, Shock absorbers, Air suspension system

Brakes: Requirements of good braking system. Types of brakes-Mechanical, Hydraulic and pneumatic systems Emission control, environmental effects on engines, Euro Standards and Bharat Stage Emission Norms.

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Text Books

1. Kirpal Singh, AutomobileEngineeringVol.1&2, Standard Publishers, New Delhi
2. R.B. Gupta, Automobile Engineering, Satya Prakasam Publishers, New Delhi

Reference Books

1. W.H.Crowse, Automotive Mechanics, TMH Publishers, New Delhi
2. Joseph Heitner, Automotive Mechanics, EWP Publishers, New Delhi
3. Heldt, High Speed Combustion Engines, Oxford and IBH Publishers, New Delhi

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3														
CO2			3												
CO3			3												
CO4					2										
CO5				1											

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Year: IV **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
20APE0316	IC Engines & Gas Turbines	3	0	0	3

Course Outcomes:

CO: 1 Solve problems on engine performance parameters.
CO: 2 Understand the combustion process, carburetion, emissions of engines
CO: 3 Understand the working of superchargers, turbo charging and sensors
CO: 4 Understand the working of gas turbines and its performance
CO: 5 Understand the working of jet propulsion and its parameters

Unit I:

IC Engines: Introduction, Engine performance parameters, Calculation of engine power and efficiencies, Performance characteristics, Heat balance calculation, Measurement of friction power and brake power

Unit II:

Carburetion: Air-fuel mixtures and its requirements, Principle of carburetion, Working of simple carburetor, Basic principle of mechanical and electronic fuel injection

Combustion: Stages of combustion in SI engines and CI engines
Emissions: Basic categories of engine emissions, causes of HC, CO, and NOx emissions and control methods

Unit III:

Engine Electronics: Introduction, Engine management system, Position displacement and speed sensing sensors, Temperature and Intake air flow measurement

Supercharging: Introduction, advantages and limitations, types of superchargers, Turbo charging.

Unit IV:

Gas Turbines: Simple Gas Turbine, ideal cycle, essential components, open and closed cycle arrangements, requirements of working medium, applications of Gas Turbines, comparison of Gas Turbines with reciprocating engines, work output and efficiency of a simple Gas Turbine cycle, optimum pressure ratio for maximum specific output, Gas Turbines with regeneration, reheating and inter cooling

Unit V:

Jet Propulsion: Introduction to Propeller engines and Gas Turbine engines, working principle of Ramjet engine, Pulse jet engine, Turboprop engine and Turbojet engine, Thrust and thrust equation, specific thrust, parameters affecting flight performance, introduction to Rocket propulsion, classification of Rockets and principle of Rocket propulsion

Text Books

1. Ganesan, Internal Combustion Engines, TMH Publishers, New Delhi
2. V. Ganesan, Gas Turbines, TMH Publishers, New Delhi

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Reference Books

1. R.K Rajput , Thermal Engineering, Lakshmi Publications, New Delhi
2. S.L. Soma Sundaran, Gas dynamics and Jet Propulsion, NAI Publishers, New Delhi
3. P.L. Ballaney, Thermal Engineering, Khanna Publishers, New Delhi
4. Sarvanamutto and GFC Rogers, Gas Turbine Theory, Pearson Education, New Delhi

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			2		3										
CO2	1														
CO3			3		1										
CO4			3												
CO5			3		1										

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Year: IV **Semester: I** **Branch of Study: CE**

Subject Code	Subject Name	L	T	P	Credits
20APE0119	**AIR POLLUTION AND CONTROL**	3	0	0	3

COURSE OUTCOMES: On completion of the course, the students will be able to:

1. Understand the fundamentals of air pollution and effects of air pollution.
2. Understand the knowledge of air pollution, sources, types, lapse rate and decreasing measures.
3. Understand and analysis air quantity sample and monitoring of pollution.
4. Learn the design principles of particulate and gaseous control.
5. Evaluate air quantity management and analyze the causes and their effects of air pollutions.

UNIT I

INTRODUCTION: Definition - Sources and classification of Air Pollutants - Photochemical smog - Effects of air pollution on health of Human & Animals, vegetation & materials, air quality standards, Global effects of air pollution.

EFFECTS OF AIR POLLUTION: Effects of Air pollutants on man, material and vegetation: Global effects of air pollution – Green House effect, Heat Islands, Acid Rains, Ozone Holes etc.

UNIT II

THERMODYNAMIC OF AIR POLLUTION:

Meteorology and Dispersion of air pollutants: Temperature lapse rates and Stability, Wind velocity and turbulence, Wind Rose, plume behavior, Measurement of meteorological variables. Dispersion of **AIR POLLUTANTS**: Gaussian Dispersion model - Equations for the estimation of pollutant concentrations of emissions - Plume Rise –Effective stack height and mixing depths.

UNIT III

SAMPLING, ANALYSIS AND PARTICULATE POLLUTION CONTROL METHODS: Ambient air quality monitoring -High volume sampler- stack monitoring train and stack monitoring - Principles and design aspects of different types of particulate pollution control equipment– Settling chambers, Cyclone separators, Scrubbers, Filters and Electrostatic precipitators.

UNIT IV

GASEOUS POLLUTION CONTROL METHODS AND AUTOMOBILE POLLUTION: Gaseous pollutants' sampling and analysis- Types of gaseous pollution control methods – absorption, adsorption and combustion processes. Automobile pollution, sources of pollution, composition of auto exhausts, Control methods.

UNIT V

AIR QUALITY MANAGEMENT: Air Quality Management – Monitoring of SPM, SO; NO and CO Emission Standards.

TEXT BOOKS:

1. Air Quality by Thodgodish, Levis Publishers, Special India Edition, New Delhi
2. Air pollution By M.N.Rao and H.V.N.Rao – Tata Mc.Graw Hill Company.
3. Air pollution by Wark and Warner.- Harper & Row, New York.

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REFERENCS:

1. An introduction to Air pollution by R.K.Trivedy and P.K. Goel, B.S. Publications.
2. Air Pollution and Control by K.V.S.G.Murali Krishna, Kousal& Co. Publications, New Delhi.
3. Enivronmental meteorology by S.Padmanabhammurthy , I.K.Internationals Pvt Ltd,New Delhi.
4. Environmental Engineering by Peavy and Rowe, McGraw Hill Publication.
5. Air Pollution Control Engineering by N.D. Nevers, McGraw Hill Publication.
6. Air Pollution control engineering by Noel de Nevers, McGraw Hill Publication, and New
1. York.
7. Fundamentals of Air Pollution by Richard W. Boubel et al, Academic Press, New York.
8. Air Pollution: Physical and Chemical Fundamentals by John H. Seinfeld, McGraw Hill
2. bookCo. 1988.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3													
CO2	3													
CO3	3													
CO4	3													
CO5	3													

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

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Year : IV **Semester: I** **Branch of Study: B.Tech**

Subject Code: 20AHSMB04	Subject Name: INTELLECTUAL PROPERTY RIGHTS	**L T P** 3 - -	**Credits** 03

Course Outcomes

CO1: know about the concepts of intellectual property rights
CO2: Aware about the process of acquisition of trade mark rights
CO3: Understand about the law of copy rights
CO4: Acquainted with the concepts of Trade secretes
CO5: understand intellectual property laws at the international level.

UNIT-I

Introduction to Intellectual Property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT-II

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

UNIT-III

Law of Copy Rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law. Law of Patents: Foundation of patent law, patent searching process, ownership rights and transfer

UNIT-IV

Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secret elitigation. Unfair Competition: Misappropriation right of publicity, false advertising.

UNIT-V

New Development Of Intellectual Property: New developments in trade mark law; copy right law, patent law, intellectual property audits -International overview on intellectual property, international - trade mark law, copy right law, international patent law, international development in trade secrets law.

TEXT BOOKS

1. Intellectual property right, Deborah, E. Bouchoux, Cengage learning
2. Intellectual property rights: Protection and Management. India, Nityananda KV, Cengage Learning India Private Limited.

REFERENCES

1. Intellectual property right - Unleashing the knowledge economy, Prabuddhaganguli, Tata McGraw Hill Publishing Company Ltd.
2. Law relating to Intellectual Property rights. India. Ahuja VK IN: Lexis Nexis
3. Intellectual Property Rights, India. Neeraj P &Khushdeep D, PHI learning pvt limited

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	Outcomes (COs)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	**PSO1**	**PSO2**
INTELLECTUAL PROPERTY RIGHTS	CO1	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	CO2	**2**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	CO3	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	CO4	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**
	CO5	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

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Year: IV **Semester: I**

Subject Code	Subject Name	L	T	P	Credits
20APE0117	Ground Improvement Techniques	3	0	0	3

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

CO1 : Understand the grouting techniques and their applications
CO2 : Understand the densification methods used in granular soils and Cohesive soils
CO3 : Understand the ground Improvement methods used to stabilize soil
CO4 : Understand the reinforcement design principles and geosynthetic materials, functions and applications
CO5 : Identify the problems in Expansive soils

UNIT – I
GROUTING: Introduction to ground modification, need and objectives of Grouting- Grouts And Their Properties- Grouting Methods Ascending, Descending And Stage Grouting- Hydraulic Fracturing In Soils And Rocks Post Grout Test.
UNIT – II
IN-SITU DENSIFICATION OF COHESIVE AND COHESIONLESS SOILS:
In situ densification methods- in situ densification of granular soils- vibration at ground surface and at depth, impact at ground and at depth – in situ densification of cohesive soils – pre loading – vertical drains – sand drains and geo drains – stone columns.
UNIT – III STABILISATION:
Methods of Stabilization-Mechanical-Cement- Lime, Chemical Stabilization With Calcium Chloride, Sodium Silicate And Gypsum
UNIT – IV REINFORCED EARTH:
Principles – Components of Reinforced Earth – Factors Governing Design Of Reinforced Earth Walls – Design Principles Of Reinforced Earth Walls.
GEOSYNTHETICS: Geotextiles- Types, Functions and Applications – Geogrids and Geomembranes – Functions and Applications.
UNIT - V EXPANSIVE SOILS:
Problems Of Expansive Soils – Tests for Identification – Methods of Determination Of Swell Pressure. Improvement Of Expansive Soils – Foundation Techniques in Expansive Soils – Under Reamed Piles.

TEXT BOOKS:
1. Engineering Principles of Ground Modification, Haussmann M.R. (1990), McGraw-Hill International Edition.
2. Ground Improvement Techniques by Dr.P.Purushotham Raj, Laxmi Publications, New Delhi / University Science Press, New Delhi
3. Ground Improvement Techniques by NiharRanajanPatra. Vikas Publications, New Delhi

REFERENCES:
1. Ground Improvement, Blackie Academic and Professional by Moseley M.P. (1993), Boca Taton, Florida, USA.
2. Ground Control and Improvement by Xanthakos P.P, Abramson, L.W and Brucwe, D.A (1994), John Wiley and Sons, New York, USA.
3. Designing with Geosynthetics by Robert M. Koerner, Prentice Hall New Jercy, USA

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Mapping of course outcomes with program outcomes

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	3												1	1
CO2	3												1	1
CO3	3													
CO4	3												1	1
CO5	3													
CO	3												1	1

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Year: IV **Semester: I**

Subject Code	Subject Name	L	T	P	Credits
20AOE9901	**English For Research Paper Writing**	3	0	0	3

Course Outcomes:
Students will be able to:
1. Improve writing skills and level of readability.
2. Learn what to write in each section, avoiding plagiarism.
3. Understand the review of research literature
4. Apply skills in writing a Title, abstract and literature
5. Learn the skills of drafting Summations

Syllabus

Unit -1
Planning and Preparation - Word Order - Breaking up long sentences - Structuring Paragraphs and Sentences - Being Concise and Removing Redundancy - Avoiding Ambiguity and Vagueness.

Unit -2
Clarifying Who Did What - Highlighting the Findings - Hedging and Criticizing - Paraphrasing and Plagiarism - Sections of a Paper - Abstracts, Introduction.

Unit -3
Review of the Literature - Methods, Results, Discussions, Conclusions - The Final Check.

Unit – 4
Key skills for writing a title – an abstract – an introduction – review of literature

Unit:5
Key skills for writing methodology – results – discussions – conclusions.

References:
1.Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3.Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
4.Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

CO-PO MAPPING

Correlation of COs with the POs & PSOs for B.Tech
AK-20 Regulations
***3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated**

Course Title	Course Outcomes COs	Programme Outcomes(POs)											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
English for Research Writing	CO1										3		
	CO2				3								
	CO3				3								
	CO4										3		
	CO5										3		

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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Course structure for Four Year Regular B.Tech. Degree Program
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MECHANICAL ENGINEERING (ME)

IV B.Tech **Semester: I** **Branch: Common to all**

Subject Code 20AHE9903	Subject Name Professional Communication	L 3	T 0	P 0	Credits: 3

Course Objectives

1. To develop confidence in the students to use English in everyday situations.
2. To enable the students to read different discourses so that they appreciate English for science and technologies.
3. To improve familiarity with a variety of technical writings.
4. To enable the students to acquire structure and written expressions required for their profession.
5. To develop the listening skills of the students.

Syllabus:

Unit: 1- Grammar & Vocabulary

Parts of Speech - Articles - Prepositions - Subject-Verb agreement - Tenses - Active and Passive Voice - Direct & Indirect Speech - Degrees of Comparison - Punctuation -Vocabulary.

Unit: 2 - Communication Skills

Importance of Communication - Non-verbal Communication - Introduction to Kinesics, Proxemics, Chronemics - Basics of Technical Communication - Group Discussion, Interviews and Conversations.

Unit:3 – **Telephone Skills:**

Understanding Telephone Communication - Types of calls - Handling calls - Leaving a message - Making requests - Asking for and giving information - Giving Instructions - Making or changing appointments.

Unit:4 – Interpersonal Skills

Team management - Problem solving and Decision Making - Managing Time and Stress - Technology @ work - Etiquette.

Unit:5 – **Written Communication**

Email writing - Professional Letters - Letters of application, Business letters, Using Salutations, Routine letters, Request letters, Persuasive letters - Report writing - Note making - Notice, Agenda and Minutes of Meetings.

Course Outcomes:

Students will be able to:

1. Identify and apply communication skills effectively for professional success.
2. Speak clearly and concisely in formal and in informal conversations.
3. Compose and communicate the information through drafting, editing and presentation .
4. Applying interpersonal skills in appropriate manner towards the growth of best career.
5. Construct sentence structures using correct vocabulary and without any grammatical errors.

Suggested books for reading:

1. Meenakshi Raman, Sangeeta Sharma, Technical Communication – Principles and Practice, 3rd Edition, Oxford University Press, 2015.

2.Professional Communication Skills, Er A.K. Jain, Dr. Pravin S.R. Bhatia, Dr. A.M. Sheikh, S.Chand & Company Ltd, New Delhi, 2011.

3. Soft Skills for everyone, Jeff Butterfield, Cengage Learning India Private Ltd, New Delhi, 2014.

4. Basic communication Skills P. Kiranmai Dutt, Geetha Rajeevan, Cambridge University Press India Pvt. Ltd, New Delhi, 2010.

5. A Course in Communication Skils, P.Kiranmai Dutt, Geetha Rajeevan, CLN Prakash, Cambridge University Press India Pvt Ltd, New Delhi, 2013

Correlation of COs with the POs & PSOs for B.Tech
AK-20 Regulations
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Course Title	Course Outcomes COs	Programme Outcomes(POs)											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
Professional Communication	CO1										3		
	CO2										2		
	CO3										3		
	CO4						3						
	CO5										3		

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MECHANICAL ENGINEERING (ME)

IV B.Tech **Semester**-I **Branch : Common to all**

Subject Code	Subject Name	L T P	Credit: 3
20AHE9913	**Effective Public Speaking Skills**	3 0 0	

Course Objectives:

1. Gain and demonstrate the basic skills of effective oral communication, for use throughout your academic career and beyond.
2. Learn and develop the skills necessary to maximize public speaking effectiveness, including effective research and organization of information, how to make the most of presentation aids (and not become reliant on them!), and understanding the speaker-audience relationship.
3. Develop critical thinking and listening skills, enabling you to maximize your own understanding as an audience member, and offer considered and constructive critiques of others' speeches.
4. Become more confident in public speaking arenas, whether as a formal speech giver or as a participant in group settings. Improvement will be valued over perfection.

Syllabus

Unit -1 **Introduction to Public Speaking:**

Basic communication concepts - Process and models of Communication - Concepts and principles of public speaking - Steps and methods of speech preparation - Ethics in public speaking.

Unit -2 **Listening and Speech Criticism:**

Effective listening - The listening process and types of listening - Listening barriers; Identifying and improving listening styles - Evaluating speech and effective speech techniques.

Unit -3 : **Selecting Topic and Knowing your Audience**:

Identifying sources; Tools and techniques for selecting and refining speech topics; Identifying speech purposes; Central idea statement; The central idea; Audience analysis techniques.

Unit – 4: **Speaking with a Purpose:**

Efficient organizational methods - Good form in speech preparation - Guidelines for organizing components and main points in a speech - Patterns of organization - Constructing an outline of Informative, Persuasive, and Ceremonial speeches.

Unit - 5: **Delivering your speech and using Visual Aids.**

The mechanics of verbal and nonverbal communication in speech delivery - Modes of speech delivery - Speaking style and language - Effective delivery techniques by Incorporating presentation aids

Course Outcomes:

Students will be able to:

1. Apply knowledge of principles, concepts and skills learned in speech preparation.
2. Develop skills in effective listening.
3. Evaluate the delivery of speeches.
4. Develop skills in speech composition.
5. Use supporting materials and presentation aids in speech preparation.

References:

1. DeVito, J.A. (2009). The Essential Elements of Public Speaking. (3rd ed.) Boston: Pearson Education, Inc.

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MECHANICAL ENGINEERING (ME)

2. Lucas, S.E. (2009). The Art of Public Speaking. (10th ed.) New York: McGraw - Hill Co.

3. Zarefsky, D. (2011). Public Speaking: Strategies for Success. (6th ed. Boston: Pearson Education, Inc).

Correlation of COs with the POs & PSOs for B.Tech
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Course Title	Course Outcomes COs	Programme Outcomes(POs)											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
Effective Public Speaking Skills	CO1										3		
	CO2										3		
	CO3									3			
	CO4										3		
	CO5										3		

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MECHANICAL ENGINEERING (ME)

B.Tech **Branch : Common to all**

Subject Code	Subject Name	L T P	Credit: 2
20AHE9902	**Principles of Effective Public Speaking**	1 0 2	

Course Objectives:

1. Gain and demonstrate the basic skills of effective oral communication, for use throughout your academic career and beyond.
2. Learn and develop the skills necessary to maximize public speaking effectiveness, including effective research and organization of information, how to make the most of presentation aids (and not become reliant on them!), and understanding the speaker-audience relationship.
3. Develop critical thinking and listening skills, enabling you to maximize your own understanding as an audience member, and offer considered and constructive critiques of others' speeches.
4. Become more confident in public speaking arenas, whether as a formal speech giver or as a participant in group settings. Improvement will be valued over perfection.

Syllabus

Unit -1

Introduction to Public Speaking:

Basic communication concepts, processes – Models of Communication, concepts and principles of public speaking - Steps and methods of speech preparation.

Unit -2

Selecting Topic and Knowing your Audience:

Identifying sources; Tools and techniques for selecting and refining speech topics - Identifying speech purposes - Central idea statement - Audience analysis techniques.

Unit – 3

Listening with a purpose:

Effective listening, the listening process, and types of listening; Listening barriers; Identifying and improving listening styles.

Unit - 4

Speaking with a purpose:

Methods of speech preparation - Informative, persuasive, and ceremonial speeches

Unit -5

Delivering your speech and using Visual Aids:

The mechanics of verbal and nonverbal communication in speech delivery - Effective delivery techniques - Incorporating presentation aids in presentation.

Course Outcomes:

Students will be able to:

1. Apply knowledge of principles, concepts and skills learned in speech preparation.
2. Develop skills in speech composition.
3. Develop skills in effective listening.
4. Evaluate the delivery of speeches.
5. Use supporting materials and presentation aids in speech preparation.

References:

1. DeVito, J.A. (2009). The Essential Elements of Public Speaking. (3rd ed.) Boston: Pearson Education, Inc.

2. Lucas, S.E. (2009). The Art of Public Speaking. (10th ed.) New York: McGraw - Hill Co.

3. Zarefsky, D. (2011). Public Speaking: Strategies for Success. (6th ed. Boston: Pearson Education, Inc).

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Correlation of COs with the POs & PSOs for B.Tech
AK-20 Regulations
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Course Title	Course Outcomes COs	Programme Outcomes (POs)											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
Principles of Effective Public Speaking	CO1										3		
	CO2										3		
	CO3										3		
	CO4										3		
	CO5										3		

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MECHANICAL ENGINEERING (ME)
Semester VIII (Fourth year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P	C	CIE	SEE	Total
1	Major Project	20APR0301	Project work	-	-	-	9	60	140	200
2	PR	20APR0302	Internship	-	-	-	3	100	-	100
3	MOOC	OE / PE	MOOC – NPTEL (12 Week)	-	-	-	3	25	75	100
			Total credits				**15**	185	215	400