Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

DIT UNIVERSITY
Dehradun

Detailed Course Structure
of

B.Tech. – Mechanical Engineering

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

Course Structure of B.Tech. – Mechanical Engineering
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Year: 1st **Semester: I**

Course Category	Course Code	Course Title	L	T	P	Credit
UC	HS 103	Professional Communication	2	0	2	3
UC	MA 101	Engineering Mathematics-I	3	1	0	4
UC	EE 103	Basic Electrical Engineering	3	1	2	5
UC	PY102 / PY 103 / PY104	Introduction to Mechanics / Waves and Optics and Introduction to Quantum Mechanics / Introduction to Electromagnetic Theory	3	1	2	5
UC	ME 103	Engineering Graphics	0	0	3	1.5
		Total				**18.5**

Year: 1st **Semester: II**

Course Category	Course Code	Course Title	L	T	P	Credit
UC	MA 102	Engineering Mathematics - II	3	1	0	4
UC	CH 101	Engineering Chemistry	3	1	2	5
UC	ME 105	Engineering Mechanics	2	1	2	4
UC	ME 104	Workshop Practice	0	0	2	1
UC	CS 105	Programming for Problem Solving	3	0	4	5
		Total				**19**

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Year: 2nd **Semester: III**

Course Category	Course Code	Course Title	L	T	P	Credit
AC	CH201/HS244	Environmental Science / Indian Constitution	2	0	0	0
SC	MA201	Engineering Mathematics – III	3	1	0	4
DC	ME201	Basic Thermodynamics	3	1	0	4
DC	ME202	Strength of Materials	3	1	0	4
DC	ME203	Materials Engineering	3	0	2	4
DC	ME204	Manufacturing Processes	3	0	2	4
EC	EC210	Introduction to Electronics & Communication	3	0	2	4
AC	HS201	Aptitude & Soft Skills- 1	2	0	0	0
		Total	20	3	6	24

Year: 2nd **Semester: IV**

Course Category	Course Code	Course Title	L	T	P	Credit
AC	CH201/HS244	Environmental Science / Indian Constitution	2	0	0	0
DC	ME206	Theory of Machines	3	1	2	5
DC	ME207	Fluid Mechanics & Fluid Machines	3	1	2	5
DC	ME208	Applied Thermodynamics I	3	1	0	4
DC	ME209	Design of Machine Elements	3	1	2	5
DC	ME210	M/c Drawing & Solid Modelling	0	0	4	2
HE		Humanities Elective-I	2	0	0	2
AC	HS204	Aptitude & Soft Skills- 2	2	0	0	0
		Total	16	4	10	23

Humanities Elective 1

Course Code	Course Title
HS241	Education and Social Change
HS242	Introduction to Psychology
HS243	Science, Technology and Society
HS245	Ethics and Self-Awareness

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Year: 3rd **Semester: V**

Course Category	Course Code	Course Title	L	T	P	Credit
DC	ME301	Heat Transfer	3	1	2	5
	ME302	Manufacturing Technology	3	0	2	4
	ME303	Fluid Machinery- Lab Course	0	0	2	1
DE		Department Elective-1				3
		Department Elective-2				4
HE		Humanities Elective-2	2	0	0	2
PRJT	ME311	Study Project	0	0	4	2
ST	ME312	Summer Training Evaluation				0
AC	HS301	Aptitude & Soft Skills- 3	3	0	0	0
AC		Value Added Training	0	0	2	0
		Total				21

Humanities Elective 2

Course Code	Course Title
HS384	Principles of Management
HS385	Engineering Economics
HS391	Positive Psychology & Living
HS382	Literature, Language and Society

Value Added Training

Course Code	Course Title
ME331	Flexible Manufacturing System
ME332	Electro Discharge Machining
ME333	CREO Design Software
ME334	Advanced Welding
ME335	MATLAB
ME336	ANSYS

Year: 3rd **Semester: VI**

Course Category	Course Code	Course Title	L	T	P	Credit
DC	ME305	Applied Thermodynamics II	3	1	2	5
DE		Department Elective-3				4
		Department Elective-4				4
		Department Elective-5				3
		Department Elective-6				3
PRJT	ME313	Design/LAB Project – I	0	0	10	5
AC	ME314	Industrial Tour				0
AC	HS304	Aptitude & Soft Skills- 4	3	0	0	0
		Total				24

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Year: 4th **Semester: VII**

Course Category	Course Code	Course Title	L	T	P	Credit
DE		Department Elective-7				3
		Department Elective-8				3
OE		Open Elective-1	3	0	0	3
PRJT	ME401	Design/LAB Project – II	0	0	16	8
AC	HS311	Employment Enhancement Program	2	0	0	0
UC	ME381	Entrepreneurship & Start Up	2	0	2	3
		Total				20

Open Elective- 1

Course code	Course Title	L	T	P
CS481	Software Quality Engineering	3	0	0
IT353	Basics of Data Science	3	0	0
IT356	Multimedia	3	0	0
EC383	Consumer Electronics	3	0	0
EC385	Analog Electronics	3	0	0
EE481	New and Renewable Energy Sources	3	0	0
PE481	Fuel Technology	3	0	0
PE482	Health Safety and Environment in Industry	3	0	0
MA451	Statistical Techniques & their application	3	0	0
AR481	Graphics & Product Design	3	0	0

Year: 4th **Semester: VIII**

Course Category	Course Code	Course Title	L	T	P	Credit
IP/THESIS	ME403	Industrial Project/ Internship	0	0	32	16
or						
OE		Open Elective-2	3	0	0	3
		Open Elective-3	3	0	0	3
		Open Elective-4	3	0	0	3
DE		Department Elective-9				3
HE		Humanities Electives-3	2	0	0	2
		Total	13	0	2	14

Humanities Elective 3

Course Code	Course Title
HS493	Indian Culture & Tradition
HS483	Indian Philosophy
HS491	Industrial Sociology
HS485	Sustainable Development

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Department Elective 1 to 9

Course Code	Course Title	L-T-P	Credits	Pre-requisite
ME341	Energy Conservation & Management	3-0-0	3	ME201, ME208
ME342	Composite Materials	2-1-0	3	ME203, ME202
ME343	Mechatronics	3-0-0	3	EC210
ME344	Fuel Combustion and Environment	2-1-0	3	CH201
ME345	Industrial Engineering & Management	3-0-0	3	
ME346	Turbomachines	3-1-0	4	ME207
ME347	Advanced Theory of Machine	3-1-0	4	ME206
ME348	Advanced Design of Machine Elements	3-1-0	4	ME209
ME349	Automotive Electrical and Electronics	3-0-2	4	EC210
ME350	Operations Research	3-1-0	4	
ME354	Computer Aided Design	3-0-2	4	ME103, ME210
ME355	Design for Manufacturing	3-0-2	4	ME204
ME356	Automotive Fuel And Lubricants	3-0-2	4	ME201, ME207
ME358	IC Engines	3-0-2	4	ME201
ME351	Design of Heat exchangers	3-1-0	4	ME301
ME352	Tribology	3-0-2	4	ME207
ME353	Vehicle Maintenance	3-0-2	4	
ME357	Computational Fluid Dynamics	3-0-2	4	ME201, ME207, ME301
ME359	Computer Integrated Manufacturing	3-0-2	4	ME204
ME360	Power Plant Engineering	2-1-0	3	ME201, ME301
ME361	Industrial Robotics	2-0-2	3	EC210
ME362	Process Planning & Cost Estimation	3-0-0	3	ME345
ME363	Industrial Ergonomics	3-0-0	3	ME345
ME364	Renewable Energy Sources	3-0-0	3	ME201, ME301
ME365	Nuclear Power Engineering	3-0-0	3	ME201, ME301
ME366	Product Design Development	3-0-0	3	ME209
ME367	Plant Layout & Material Handling	3-0-0	3	ME349
ME441	Advanced RAC	2-1-0	3	ME305
ME442	Gas Turbine & Jet Propulsion	2-1-0	3	ME201, ME301
ME443	Design of Transmission System	2-1-0	3	ME206, ME209
ME444	Avionics	3-0-0	3	ME201, ME207
ME445	Total Quality Management	3-0-0	3	ME345
ME446	Design of Hydraulics & Pneumatics System	2-0-2	3	ME207
ME447	Mechanical Vibration	2-1-0	3	ME209
ME448	Automobile Engineering	2-0-2	3	ME305
ME449	Micro & Nano Machining	2-0-2	3	ME204
ME450	Automatic Control	2-1-0	3	MA201
ME451	Finite Element Analysis	2-0-2	3	ME202, ME203
ME452	Solar Energy Systems	2-1-0	3	ME201, ME301
ME453	Machine Tool Design	2-1-0	3	ME204, ME209
ME454	Principle of Management	3-0-0	3	
ME455	Advanced Engineering Materials	2-1-0	3	ME202, ME203
ME456	Non-Destructive Testing	2-0-2	3	ME202, ME203
ME457	Welding Technology	2-0-2	3	ME202, ME203

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Applicable from 2018-2022

Open Elective- 2, 3 and 4

Course code	Course Title	L	T	P
CS482	Human Computer Interaction	3	0	0
IT357	Internet of Things	3	0	0
IT359	Mobile Computing and Services	3	0	0
EC386	Fundamental of communication & Networks	3	0	0
EC382	Biomedical Instrumentation	3	0	0
EE485	Basic Instrumentation & Process Control	3	0	0
CE483	GIS	3	0	0
PE491	Carbon Capture and Sequestration Technology	3	0	0
MA452	Optimization Techniques	3	0	0
AR485	Art Appreciation	3	0	0
PY481	Nano scale science and technology	3	0	0

Summary of the Credit

Year	Semester	Credit
1	1	19
	2	18.5
2	3	24
	4	23
3	5	21
	6	24
4	7	20
	8	16 / 14
Total		**165.5 / 163.5**

Category wise classification of the Credit

Category	Credits	No. of Subjects
AC	0	9
DC	52	13
DE	30	9
EC	4	1
HE	6	3
IP/THESIS	16	1
OE	12	4
PRJT	15	3
SC	4	1
ST	0	1
UC	40.5	11
Grand Total	**163.5 / 165.5**	**56**

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Applicable from 2018-2022

Subject Code	HS103	Subject Title	Professional Communication						
LTP	2-0-2	Credit	3	Subject Category	UC	Year	1st	Semester	I / II

Course Outline:

Course Objective:

To develop the LSRW skills of students for effective communication, to equip the students for business environment, to prepare the students understand and present themselves effectively

Course Pre/Co- requisite (if any):

UNIT 1: Communication

Communication: Meaning, Types of Communication: General and Technical Communication. Knowledge and adoption of Non Verbal cues of communication: Kinesics, Proxemics, Chronemics, Oculesics, Haptics, Paralinguistics. Barriers to Communication, Overcoming strategies.

UNIT 2: Listening & Speaking Skills

Listening Comprehension: identifying General and Specific information, Note taking and drawing inferences. Introduction to Phonetics: Articulation of consonants and vowel sounds.

UNIT 3: Reading Skills & Technical Writing Skills

Reading Strategies and Vocabulary Building Reading Comprehension. Paragraph development. Intra office Correspondence: Notice, Agenda, Minutes and Memorandum. Technical Proposal & Report.

UNIT 4: Business Letter Writing

Business Letter Writing, Job Application Letter & Resume, Interview Skills, Impression Management, Swot Analysis (Identifying Strength & Weakness), EQ and Its Dimensions

Learning Outcome

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

CO1. Communicate smoothly

CO2. Write formal documents

CO3. Present themselves effectively

Text book [TB]:

1. Rizvi, Ashraf. Effective Technical Communication, McGraw Hill, New Delhi. 2005.
2. Raman, Meenakshi and Sangeeta Sharma,. Technical Communication: Principles and Practice, 2nd Edition. New Delhi: Oxford University Press. 2011.

Reference Books [RB]:

1. Aslam, Mohammad. Introduction to English Phonetics and Phonology Cambridge.2003.
2. Ford A, Ruther. Basic Communication Skills; Pearson Education, New Delhi.2013.
3. Gupta, Ruby. Basic Technical Communication, Cambridge University Press, New Delhi.2012.
1. Kameswari, Y. Successful Career Soft Skills and Business English, BS Publications, Hyderabad.2010.
2. Tyagi, Kavita & Padma Misra. Basic Technical Communication, PHI, New Delhi. 2011.

List of Experiments:

1. Neutralization of Mother Tongue Influence through manner of articulation, Introduction to Speech Sounds – Practicing Vowel and Consonant sounds
2. Listening (Biographies through software) & Presentation of Biographies
3. Listening & Role Play on Situational/ Telephonic Conversation (through software)
4. Picture presentation
5. Public Speaking
6. Group Discussion
7. Case Studies
8. SWOT analysis
9. Interview
10. Final evaluation

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	MA101	Subject Title	Engineering Mathematics-I						
LTP	3-1-0	Credit	4	Subject Category	UC	Year	1st	Semester	I / II

Course Outline:

Course Objective:

To introduce the fundamentals in Differential, Integral and Vector Calculus, use of tools for solving engineering problems.

Course Pre/Co- requisite (if any):

UNIT 1: Limit, Continuity and Differentiability

Review of Limit, Continuity and Differentiability; Indeterminate forms, L' Hospital's rule, Rolle's Theorem, Mean Value theorem and its applications, Successive Differentiation, Leibnitz's Theorem, Taylor's and Maclaurin's Series, Maxima and Minima, Asymptotes, Curvature, Evolutes, Involutes, Sketching of curves.

UNIT 2: Multivariable calculus (Differentiation)

Limit, Continuity, Partial Derivatives, Euler's Theorem, Total Derivatives, Taylor's series, Maxima and Minima, Method of Lagrange's multipliers.

UNIT 3: Multiple Integral

Review of indefinite and definite integrals and its application to evaluate surface area and volume of revolutions, Beta and Gamma functions and their properties, Double integral, Change of order of integration, Change of variables, triple integral, Dirichlet's integral and their applications.

UNIT 4: Vector Calculus

Scalar and Vector functions, fields, Gradient and its applications, Directional derivative, Divergence and Curl and their applications. Line integral, Surface integral, Statement of Green's Theorem, Volume integral, Statements of Stokes and Divergence Theorems and their applications.

Learning Outcome

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

CO1. Learn techniques in calculus, multivariate analysis and linear algebra.

CO2. Equip the students with standard concepts and tools for tackling advanced level of mathematics and applications.

CO3. Familiarity with fundamental tools of Differential, Integral and Vector Calculus.

Text book [TB]:

1. G. B. Thomas Jr. and R. L. Finney, Calculus and Analytic Geometry, 9th Edition, Pearson Education, 2017.
2. R. K. Jain and S. R. K. Iyenger, Advanced Engineering Mathematics, 2nd Edition, Narosa Publishing House, New Delhi, India, 2014.

Reference Books [RB]:

1. B. S. Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publication, New Delhi, India, 2012
2. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, U.K., 2006.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	EE103	Subject Title	Basic Electrical Engineering						
LTP	3-1-2	Credit	5	Subject Category	UC	Year	1st	Semester	I / II

Course Outline:

Course Objective:

- To apprise students about electric charge, current, voltage and various circuit laws involved in analysis.
- To get acquainted with the basic idea of Generation, Transmission and Distribution of Electrical energy.
- To provide the basic knowledge of operation and working of different types of electrical equipment and their applications.

Course Pre/Co- requisite (if any):

UNIT 1: D.C. Network Theory
Review of basic circuit theory concepts, Mesh and Nodal analysis, Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Star – delta transformation, Magnetic Circuits.

UNIT 2: A.C. Circuits & Measuring Instruments
Single Phase A.C.: Phasor representation of voltage and current, A.C. circuit behavior of resistance, inductance, capacitance & their combination in series and parallel, Power triangle, Power factor, Concept of series & parallel resonance.
Three Phase A.C.: Star – delta connections, Relation between line and phase quantities, three phase power and its measurement, What is 3 phase 4 wire and 3 phase 3 wire system.
Measuring Instruments: Construction and principle of voltage and current measuring instruments.

UNIT 3: Power System & Transformers
Single line diagram of simple power system.
Single phase Transformer: Principle of operation, Types of construction, Phasor diagram, Equivalent circuit, Efficiency and voltage regulation, O.C. and S.C. tests.

UNIT 4: D.C. & Synchronous Machines
D.C. Machines: Construction and working principle of d.c. generator and d.c. motor, Types of d.c. machines, E.M.F. equation, Torque equation, characteristics, Losses and efficiency, Need of starter in d.c. motors.
Synchronous Machines: Construction and Principle of operation of Alternator and Synchronous Motor.

UNIT 5: Induction Motors
Three Phase Induction Motors: Principle of operation of 3-Ø induction motor, Types of 3-Ø induction motor, Need of starters in 3-Ø induction motors, Slip – torque characteristics
Single Phase Induction Motor: Principle of operation of single phase induction motor by double revolving field theory, Methods of starting of single phase induction motor.

Learning Outcome

At the end of the course, the student will be able to:
CO1. Students will be familiar about electrical charge, current, voltage and various basic electric circuit laws.
CO2. Acquaint students about DC circuit analysis and methods
CO3. Advanced approach for solving series parallel network of resistors by star delta transformation.
CO4. Acknowledge students with the use of transformers and its working.
CO5. To build an ability amongst students regarding the functioning of DC machines and its characteristics.
CO6. Students will recognize the need for synchronous machine in our electrical systems, its basic functioning and various advantages over other types of machines.

Text book [TB]:

1. V. Del Toro. "Principles of electrical Engineering", Prentice hall International.
2. J. Nagrath, "Basic Electrical Engineering", Tata Mc Graw Hill.

Reference Books [RB]:

1. W.H. Hayt & J.E. Kemmerly, "Engineering circuit Analysis", Mc Graw Hill.

2. H. Cotton, “Advanced Electrical Technology” Wheeler Publishing.

List of Experiments:

1. Verification of Network Theorems.
2. Study of diode characteristics. Study of phenomenon of resonance in RLC series circuit.
3. Measurement of power in a three phase circuit by two wattmeter method.
4. Measurement of efficiency of a single phase transformer by load test.
5. Determination of parameters and losses in a single phase transformer by OC and SC test.
6. Study of characteristic of DC Motor.
7. Study of characteristic of AC Motor.
8. DC generator characteristics.
9. Speed control of dc shunt motor.
10. Study running and reversing of a three phase induction motor.
11. Study of a single phase energy meter.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	PY102	Subject Title	Introduction to Mechanics					
LTP	3-1-2	Credit	5	Subject Category	UC	Year	1st	Semester	I / II

COURSE OBJECTIVE: To teach students the effects of electric charges at rest and in motion. Both positive and negative charges produce force field which is called "electric field". Moving charges produce current, which gives rise to another force field called "magnetic field". The electromagnetic theory studies the behavior of the electric and magnetic fields.

Unit 1: Electrostatics in vacuum (8L)

Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction; Practical examples like Faraday's cage and coffee-ring effect; Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and its expression in terms of electric field.

Unit 2: Electrostatics in a linear dielectric medium (5L)

Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.

Unit 3: Magnetostatics (6L)

Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector potential and its solution for given current densities

Unit-4: Magnetostatics in a linear magnetic medium (4L)

Magnetization and associated bound currents; auxiliary magnetic field $\vec{H}$; Boundary conditions on $\vec{B}$ and $\vec{H}$. Solving for magnetic field due to simple magnets like a bar magnet; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

Unit- 5: Faraday's law (4L)

Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic breaking and its applications; Differential form of Faraday's law expressing curl of electric field in terms of time-derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi-static approximation; energy stored in a magnetic field.

Unit- 6: Displacement current, Magnetic field due to time-dependent electric field and Maxwell's equations (4L)

Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displace current and magnetic field arising from time-dependent electric field; calculating magnetic field due to changing electric fields in quasi-static approximation. Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Poynting vector with examples. Qualitative discussion of momentum in electromagnetic fields.

Unit- 7: Electromagnetic waves **(8L)**

The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves and examples. Momentum carried by electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

COURSE OUTCOME:

At the end of the course, the student can :

CO1. To know Newton's laws of motion, potentials, conservation of energy, momentum and angular momentum, and be able to apply them to projectiles, circular motion, and gravity

CO2. Demonstrate an understanding of intermediate mechanics topics such as co-ordinate transformations, oscillatory motion, gravitation etc.

CO3. Demonstrate rigid body and rotational dynamics using the concept of angular velocity and momentum.

CO4. Understand the concept of non-inertial frames of reference, coriolis and centripetal accelerations and their applications.

TEXT BOOKS

David Griffiths, Introduction to Electrodynamics, PHI Learning, 2012.

REFERENCE BOOKS

1. Halliday and Resnick, Physics, Wiley, 2013.
2. W. Saslow, Electricity, Magnetism and Light, Academic Press, 2002.

SR.NO.	LIST OF EXPERIMENTS (ANY TEN)
1	Identification of various electronic components.
2	Use of multimeter for testing diodes, LEDs, transistors and measurements of resistance, capacitance, inductance, dc voltage, dc current, ac voltage, ac current and frequency of ac mains.
3	Charging and discharging of capacitor through resistance and determination of time constant.
4	To determine the specific resistance of a given wire using Carey Foster's bridge.
5	To verify Stefan's law by electrical method.
6	To study the variation of magnetic field with distance along the axis of a current carrying coil and determination of radius of the coil.
7	To calibrate the given voltmeter using potentiometer.
8	To calibrate the given ammeter using potentiometer.
9	To determine the band gap of a semiconductor p-n junction.
10	To determine the resistance of a sample using four probe method.
11	To determine the band gap of semiconductor using four probe method.
12	To determine a unknown resistance using Wheatstone bridge.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	PY103	Subject Title	Waves and Optics and Introduction to Quantum Mechanics					
LTP	3-1-2	Credit	5	Subject Category	UC	Year	1st	Semester	I / II

COURSE OBJECTIVE: The objective of this course is to develop a fundamental basis of waves, optical phenomenon, concepts of quantum mechanics and semiconductor physics which the engineering students can apply to their respective area of specialization.

Unit 1: Waves **(4L)**

Mechanical and electrical simple harmonic oscillators, damped harmonic oscillator, forced mechanical and electrical oscillators, impedance, steady state motion of forced damped harmonic oscillator

Unit 2: Non-dispersive transverse and longitudinal waves **(4L)**

Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their Eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves

Unit 3: Light and Optics **(4L)**

Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them.

Unit-4: Wave Optics **(4L)**

Huygens' principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach Zehnder interferometer. Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power

Unit- 5: Lasers **(5L)**

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers (ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity

Unit- 6: Introduction to Quantum Mechanics **(5L)**

Wave nature of Particles, Time-dependent and time-independent Schrodinger equation for wave function, Born interpretation, probability current, Expectation values, Free-particle wave function and wave-packets, Uncertainty principle.

Unit- 7: Solution of Wave Equation **(5L)**

Solution of stationary-state Schrodinger equation for one dimensional problems–particle in a box, particle in attractive delta-function potential, square-well potential, linear harmonic oscillator. Scattering from a potential barrier and tunneling; related examples like alpha decay, field-ionization and scanning tunneling microscope, tunneling in semiconductor structures. Three-dimensional problems: particle in three dimensional box and related examples.

Unit- 8: Introduction to Solids and Semiconductors (8L)

Free electron theory of metals, Fermi level, density of states in 1, 2 and 3 dimensions, Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands. Types of electronic materials: metals, semiconductors, and insulators. Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p -n junction

TEXT BOOKS

1. H. J. Pain, The physics of vibrations and waves, Wiley, 2008
2. Ajoy Ghatak, Optics, McGraw Hill Education, 2017.
3. B.G. Streetman, Solid State Electronic Devices, Prentice Hall of India, 2015.
4. D. J. Griffiths, Quantum mechanics, Pearson Education, 2015.

REFERENCE BOOKS

1. E. Hecht, Optics, Pearson Education, 2008.
2. O. Svelto, Principles of Lasers, Springer Science & Business Media, 2010.
3. D. A. Neamen, Semiconductor Physics and Devices, Times Mirror High Education Group, Chicago, 2017.

COURSE OUTCOME:

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

CO1. To acquire skills allowing the student to identify and apply formulas of optics and wave physics using course literature.

CO2. To be able to identify and illustrate physical concepts and terminology used in optics and to be able to explain them in appropriate detail.

CO3. To be able to make approximate judgments about optical and other wave phenomena when necessary.

CO4. To acquire skills allowing the student to organize and plan simpler laboratory course experiments and to prepare an associated oral and written report.

CO5. To have basic knowledge of Quantum Mechanics and Semiconductors.

SR.NO.	LIST OF EXPERIMENTS
1	(a) To determine wavelength of sodium light using Newton's Rings. (b) To determine the refractive index of a liquid using Newton's Rings.
2	To determine wavelength of sodium light using Fresnel's Biprism.
3	(a) To determine wavelength of prominent lines of mercury using plane diffraction grating. (b) To determine the dispersive power of a plane transmission diffraction grating.
4	To determine the specific rotation of cane sugar solution using bi-quartz polarimeter
5	To study the diffraction pattern of Single slit and hence determine the slit width.
6	(a) To verify cosine square law (Malus Law) for plane polarized light. (b) To study the nature of polarization using a quarter wave plate.
7	To study the variation of refractive index of the material of the prism with wavelength and to verify Cauchy's dispersion formula
8	(a) To study photoelectric effect and determine the value of Planck's constant. (b) To verify inverse square law using photocell.
9	To determine the frequency of AC mains using sonometer.
10	To determine the frequency of AC mains or of an electric vibrator by Melde's experiment
11	To measure the numerical aperture (NA) of an optical fiber.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	PY104	Subject Title	Introduction to Electromagnetic Theory						
LTP	3-1-2	Credit	5	Subject Category	UC	Year	1st	Semester	I / II

Course Outline:

Course Objective:
To teach students the effects of electric charges at rest and in motion. Both positive and negative charges produce force field which is called "electric field". Moving charges produce current, which gives rise to another force field called "magnetic field". The electromagnetic theory studies the behavior of the electric and magnetic fields.

Course Pre/Co- requisite (if any):

UNIT 1: Electrostatics in vacuum
Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction; Practical examples like Faraday's cage and coffee-ring effect; Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and its expression in terms of electric field.

UNIT 2: Electrostatics in a linear dielectric medium
Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.

UNIT 3: Magnetostatics
Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector potential and its solution for given current densities.

UNIT 4: Magnetostatics in a linear magnetic medium
Magnetization and associated bound currents; auxiliary magnetic field $\vec{H}$; Boundary conditions on $\vec{B}$ and $\vec{H}$. Solving for magnetic field due to simple magnets like a bar magnet; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

UNIT 5: Faraday's law
Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic breaking and its applications; Differential form of Faraday's law expressing curl of electric field in terms of time-derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi-static approximation; energy stored in a magnetic field.

UNIT 6: Displacement current, Magnetic field due to time-dependent electric field and Maxwell's equations
Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displace current and magnetic field arising from time-dependent electric field; calculating magnetic field due to changing electric fields in quasi-static approximation. Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Poynting vector with examples. Qualitative discussion of momentum in electromagnetic fields.

UNIT 7: Electromagnetic waves
The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves and examples. Momentum carried by electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

Learning Outcome

At the end of the course, the student will be able to:
CO1. The use of Coulomb's law and Gauss' law for the electrostatic force

CO2. The relationship between electrostatic field and electrostatic potential
CO3. The use of the Lorentz force law for the magnetic force
CO4. The use of Ampere's law to calculate magnetic fields
CO5. The use of Faraday's law in induction problems
CO6. The basic laws that underlie the properties of electric circuit elements

Text book [TB]:

1. David Griffiths, Introduction to Electrodynamics, PHI Learning, 2012.

Reference Books [RB]:

1. Halliday and Resnick, Physics, Wiley, 2013.
2. W. Saslow, Electricity, Magnetism and Light, Academic Press, 2002.

List of Experiments:

1. To compare capacitances using De'Sauty's bridge.
2. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
3. To verify the Thevenin and Norton theorems.
4. To verify the Superposition, and Maximum power transfer theorems
5. To determine self-inductance of a coil by Anderson's bridge.
6. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
7. To study the response curve of a parallel LCR circuit and determine its (a) Antiresonant frequency and (b) Quality factor Q.
8. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer
9. Determine a high resistance by leakage method using Ballistic Galvanometer.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME103	Subject Title	Engineering Graphics						
LTP	0-0-3	Credit	1.5	Subject Category	UC	Year	1st	Semester	I / II

Course Outline:

Course Objective:
The objectives of this course are to enable students to acquire and use engineering graphics skills as a means of accurately and clearly communicating ideas, information and instructions for technical communication.

Course Pre/Co- requisite (if any):

Detailed Syllabus

UNIT 1: Introduction to Engineering Graphics
Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Involutes; Scales Plain, Diagonal

UNIT 2: Projection of Points and Planes
Orthographic Projections covering, Principles of Orthographic Projections, Projections of Points and lines inclined to both planes; Projections of planes inclined Planes

UNIT 3: Projection of Solids
Projections of solids in simple position, projections of solids with axes inclined to one reference plane and parallel to other. Projections of solids with axes inclined to both of the reference plane

UNIT 4: Section of Solids and Development of Surfaces
Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone, Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone

UNIT 5: Isometric Projection and Auto CAD
Isometric Projections, Freehand Sketching, Simple and compound Solids, Conversion of Isometric Views to Orthographic Views (simple machine components according to first angle projection method), Basic AutoCAD commands & its applications

Learning Outcome

At the end of the course, the student will be able to:
CO1: Be able to use Engineering Drawing Skills as a means of accurately and clearly communicating ideas, information and instructions.
CO2: Acquire requisite knowledge, techniques and attitude for advanced study of engineering drawing.
CO3: Comprehend and draw a simple engineering drawing primarily in first angle Orthographic projections.
CO4: To create section views of simple engineering objects
CO5: To understand basic AutoCAD commands and appreciate the need of AutoCAD over Manual Drafting.

Text book [TB]:

1. N. D. Bhatt and V.M. Panchal, "Engineering Drawing", Charotar Publishing House Pvt. Ltd., 53rd edition, 2016 reprint.
2. P.S. Gill, "Engineering graphics", S. K. Kataria& Sons, 13th edition, 2016

Reference Books [RB]:

1. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.
3. Narayana, K.L. & P Kannaiah (2012), Text book on Engineering Drawing, Scitech Publishers
4. D.M. Kulkarni, A.P. Rastogi, A.K. Sarkar, "Engineering Graphics with AutoCAD" , PHI Learning Pvt. Ltd., Ist edition, 2009.
5. (Corresponding set of) CAD Software Theory and User Manuals

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	MA102	Subject Title	Engineering Mathematics-II					
LTP	3-1-0	Credit	4	Subject Category	UC	Year	1st	Semester	I / II

Course Outline:

Course Objective:
The objective of the course is to introduce the fundamentals in Matrices and Linear Algebra, Solving Ordinary Differential Equations, Convergence of an Infinite Series, Laplace Transform and Fourier Series relevant to engineering applications.

Course Pre/Co- requisite (if any):

UNIT 1: Linear Algebra

Matrices, Elementary row and column operations, row reduced echelon form, rank of a matrix, invertible matrices. Consistency and solution of a system of linear equations. Linear dependence and independence of vectors, Vector space and its basis, Matrix transformation, Rank-Nullity theorem, Eigen-values and eigen-vectors, Similar matrices, Cayley–Hamilton theorem and its applications. Diagonalization of matrices.

UNIT 2: Differential Equations

Methods of solving differential equations of first order and first degree, Bernoulli equation, Wronskian, Solutions of linear differential equations of higher order with constant coefficients, Cauchy-Euler linear differential equation, Solution of second order linear differential equation with variable coefficients, Method of variation of parameters. Solution of simultaneous linear differential equations of first order.

UNIT 3: Infinite Series

Introduction to sequences and series, Convergence and divergence, Series of positive terms, Comparison test, Cauchy's integral test, D'Alembert's ratio test, Cauchy's root test, Raabe's test, Logarithmic test, Alternating series, Leibnitz test.

UNIT 4: Fourier Series

Periodic functions, Fourier series of Periodic functions, Euler's formulae, Functions having arbitrary period, Change of intervals, Even and odd functions, Half range sine and cosine series

UNIT 5: Laplace Transform

Laplace Transform, Existence theorem, Properties of Laplace transform, Laplace transform of derivatives and integrals, Laplace Transform of Periodic functions, Unit Step function and Error Function, Dirac- Delta function. Inverse Laplace transform and their properties, Convolution theorem, Applications of Laplace Transform to solve linear differential equations pertaining to engineering problems.

Learning Outcome

At the end of the course, the student will be able to:
CO1. Equip the students to deal with advanced level of mathematics and applications.
CO2. Familiarity with fundamental tools of Matrices and Linear Algebra, Ordinary Differential Equations, Infinite Series, Laplace Transforms and Fourier Series.
CO3. Use of tools to solve engineering applications.

Text book [TB]:

1. R. K. Jain and S. R. K. Iyenger, Advanced Engineering Mathematics, 2nd Edition, Narosa Publishing House, New Delhi, India, 2014.
2. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, U.K., 2006.

Reference Books [RB]:

1. B. S. Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publications, New Delhi, India, 2012.
2. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	CH101	Subject Title	Engineering Chemistry						
LTP	3-1-2	Credit	5	Subject Category	UC	Year	1st	Semester	I/II

Course Outline:

Course Objective:

The objectives of this course are to provide a summary on water chemistry, water treatment, green chemistry and synthetic chemistry. The course intends to provide an overview of the working principles, mechanism of reactions and application of the building blocks like batteries, fuel cells, polymers and an overview of surface coatings in order to protect the metal

Course Pre/Co- requisite (if any):

UNIT 1: Water Treatment and Analysis

Standards for drinking water, Water Quality parameters, Determination of alkalinity of water, Hardness of water: Units and determination. Demineralization of water.

Softening of water: Lime soda Process, Ion exchange process, Zeolite process and RO process. Internal conditioning methods: Carbonate conditioning, Phosphate conditioning, Colloidal conditioning, Calgon conditioning. Desalination of brackish water. Numerical Problems based on all these parameters.

UNIT 2: Electrochemistry & Corrosion

Electrochemical cell, Electrode potential & EMF of a Galvanic cell, Nernst Equation, Migration of ions, Transport number, Determination of Transport number by Hittorf`s method, Conductometric titrations, Types of electrode: Calomel and glass electrode, Liquid junction potential.

Corrosion and its economic aspects, Types of corrosion: Galvanic, Erosion, Crevice, Pitting, Waterline, Soil, Microbiological. Theories of corrosion: Acid, Direct Chemical attack, Electrochemical. Corrosion prevention by metallic, organic/inorganic coatings and corrosion inibitors

UNIT 3: Polymers & Biomolecules

Introduction; Classification of Polymers; Functionality; Mechanism of Polymerization; Plastics; Individual Polymers; LDPE, HDPE, PVC, Polystyrene, Bakelite, Teflon, PMMA, PET, Nylon-6, Rubbers (BUNA-S and BUNA-N); Specialty Polymers (Conducting Polymers, Silicones and Polycarbonates), Structural and functional attributes of cell and cell organelles; Biomolecules (Proteins, Carbohydrates, Lipids, Enzymes, Nucleic acids)

UNIT 4: Fuels, Battery& Lubrication

Classification of fuels, Calorific value, Cetane number, Octane number, Comparison of solid, liquid and gaseous fuel, properties of fuel, Biofuels, Power alcohol and synthetic petrol, Battery, Metal-air battery, Lithium and nickel battery. Introduction of Lubricants, Functions of Lubricants, Classification of lubricants, Mechanisms of Lubrication, Properties of Lubricants.

UNIT 5: Green Chemistry & Nano Chemistry

Emergence of green chemistry, Twelve principle of green chemistry, use of alternative feedstock (biofuels), Use of innocuous reagents, use of alternative solvents, design of safer chemicals, designing alternative reaction methodology, minimizing energy consumption. Introduction to Nano chemistry, properties of Nano materials, preparation of nanomaterial, self-assembly, Different Nano materials, Applications of Nano materials

Learning Outcome

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

CO1: To understand about the treatment of water, sewage water and hardness related calculation

CO2: An overview of surface coatings in order to protect the metal.

CO3: An ability to identify and formulate polymers and have a knowledge of various polymers like polythene, PVC, PS, Teflon, Bakelite, Nylon which have engineering applications. To gain acquaintance regarding

biomolecules and their application in Engineering. To gain acquaintance regarding biomolecules and their application in engineering.

CO4: An overview of the working principles, mechanism of reactions and application of the building blocks like batteries, fuel cells,

CO5: An ability to handle various instruments like spectroscope, flame photometer etc. Have a knowledge of synthesizing Nano materials and their applications in industry. Know the properties of Fuels and Lubricants. Have a scope in the area of Material Chemistry.

Text book [TB]:

1. Engineering Chemistry by Shikha Agarwal. Cambridge University Press Edition 2015.
2. Engineering Chemistry by S. Vairam & Suba Ramesh. Wiley India Pvt. Ltd. 2014.

Reference books [RB]:

1. Environmental Chemistry by Stanley E. Manahan. CRC Press Taylor and Francis.
2. Organic Chemistry by Morrison and Boyd. Pearson.
3. Physical Chemistry by Atkins. Oxford University Press.
4. Concise Inorganic Chemistry by J.D. Lee. Oxford University Press.
5. Basic Biotechnology by S Ignacimuthu. Tata Mcgraw-Hills
6. Spectroscopy by Silver Stein. Pearson.
7. Nano: The essentials by T. Pradeep. McGraw Hill Education.
8. Biochemistry by Stryer Lubert. Mcmillan learning. 2015.

List of Experiments:

1. Determination of alkalinity in the given water sample.
2. Estimation of temporary and permanent hardness in water sample using EDTA as standard solution.
3. To determine the percentage of available chlorine in bleaching powder.
4. To determine the chloride content in the given water sample by Mohr's method
5. Determination of iron content in the given ore by using External indicator
6. To determine the Dissolved Oxygen in a given water sample.
7. To determine the strength of unknown acid pH-metrically
8. To analyze the coal sample by proximate analysis.
9. To determine the Flash and Fire point of a fuel sample.
10. To determine the Viscosity of a lubricant by redwood viscometer.
11. To determine the rate constant and order of reaction
12. To determine the strength of a given solution conductometrically

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME105	Subject Title	Engineering Mechanics						
LTP	2-1-2	Credit	4	Subject Category	UC	Year	1st	Semester	I / II

Course Outline:

Course Objective:

The objectives of this course is to learn basics concepts of engineering mechanics and increase the ability to solve problems involving forces, loads and moments and to know their applications in allied subjects

Course Pre/Co- requisite (if any):

Detailed Syllabus

UNIT 1: Introduction to Engineering Mechanics

Basic idealizations - Particle, Continuum and Rigid body; Newton's laws of Force and its characteristics, types of forces-Gravity, Lateral and its distribution on surfaces, Classification of force systems, Principle of physical independence, superposition, transmissibility of forces, Introduction to SI units.

Couple, Moment of a couple Characteristics of couple, Moment of a force, Equivalent force - couple system; Numerical problems on moment of forces and couples, on equivalent force - couple system.

UNIT 2: Equilibrium of forces

Equilibrium of forces - Definition of Equilibrant; Conditions of static equilibrium for different force systems, Lami's theorem; Numerical problems on equilibrium of coplanar – concurrent and non-concurrent force systems

Application- Static Friction in rigid bodies in contact, Types of friction, Laws of static friction, Limiting friction, Angle of friction, angle of repose; Impending motion on horizontal and inclined planes; Numerical Problems on single and two blocks on inclined planes, ladder and wedge friction.

UNIT 3: Analysis of Plane truss and Beam

Support Reaction in beams: Types of beams, Types of Loads and Supports, statically determinate beams, Numerical problems on support reactions for statically determinate beams with Point load (Normal and inclined) and uniformly distributed and uniformly varying loads and Moments.

Plane Truss: Perfect and imperfect truss Assumptions and Analysis of Plane Truss by Method of joints and Method of section.

UNIT 4: Center of Gravity and Centroids

Introduction to the concept, Centroids of line and area, Centroids of basic geometrical figures, computing Centroids for– T, L, I, and full/quadrant circular sections.

UNIT 5: Kinetics of Particle

Newton’s law of motion; Motion of bodies in Rectangular coordinates; D’Alembert’s Principle.

Learning Outcome

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

CO1. Identify principles of mechanics to be used for solving real life engineering problems.

CO2. Apply basic Engineering concepts based on force, shape and dimension for selection of material

CO3. Comprehend the action of Forces, Moments and other loads on systems of rigid bodies.

CO4. Compute the reactive forces and the effects that develop as a result of the external loads.

CO5. Express the relationship between the motions of bodies.

Text book [TB]:

3. Engineering Mechanics by S.S. Bhavikatti, New Age International Publisher, New Delhi, 3rd edition 2009.
4. Engineering Mechanics-Statics and Dynamics by A Nielson, Tata McGraw Hill Education Private Ltd, New Delhi, 2009.

Reference Books [RB]:

1. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
2. Beer FP and Johnson ER, "Mechanics for Engineers- Dynamics and Statics"- 3rd SI Metric edition, Tata McGraw Hill. - 2008
5. Shames IH, "Engineering Mechanics – Statics & Dynamics"- PHI

List of Experiments:

1. Study of different types of beam.
2. Calculation and Verification of forces in truss elements.
3. Calculation and verification of equilibrium condition on beam model.
4. Calculation to find the redundant force in a truss.
5. Mechanical advantage over pulley arrangement.
6. Determining the coefficient of friction.
7. Optional Tensile Strength
8. Optional Hardness Measurement

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME104	Subject Title	Workshop Practice						
LTP	0-0-2	Credit	1	Subject Category	UC	Year	1st	Semester	I / II

Course Outline:

Course Objective:

Ability to prepare simple objects using machines and machine tools to make students aware of fundamental operations of manufacturing an engineering component, enhance visualization and motivate them to innovate

Course Pre/Co- requisite (if any):

UNIT 1: Machine Shop

To make a machined-component using lathe with mild steel round bar or hexagonal bar
Comprising of common turning operations with reference to drawing given in the manual.
Any one of the following jobs
Jobs: Hex Bolt, Axle for cycle wheel, Jig Bush, a typical turning specimen.

UNIT 2: Sheet metal Shop

To make a sheet metal component with galvanized iron sheet as per the drawing provided in the manual having spot welding joint.
Any one of the following jobs
Jobs: Square tray, Scoop, Funnel

Fitting Shop

To make a joint using fitting tools with mild steel flats, round bars or square bars as per the drawing provided in the manual.

UNIT 3: Welding Shop- Arc Welding

To prepare a welding joint with mild steel flat using Manual Metal Arc welding machine according to the drawing provided in the manual.
Any one of the following jobs
Jobs: Lap joint, Butt joint, Fillet/Corner joint

Gas & Spot Welding

To observe the demonstration of making a Lap joint/Butt joint with mild steel sheet using oxyacetylene flame as per the drawing provided in the manual. To perform the spot welding operation on G.I. sheet

UNIT 4: Carpentry Shop

To make a wooden joint with soft wood as per the drawing provided in the manual.
Any one of the following jobs
Jobs: T-Lap joint, Dove tail joint, Mortise & Tendon joint, Bridle joint.

UNIT 5: Foundry Shop

Introduction to foundry process like melting of metals, mould making, casting process and use of patterns to prepare of a component and significance of foundry.
Demo of mould preparation

Minor Project:

To make a minor project by the students in batches comprising the operations performed in different shops

Learning Outcome

At the end of the course, the student will be able to:
CO1: Have Capability to identify hand tools and instruments for machining and other workshop practices.
CO2: Obtain basic skills in the trades of fitting, carpentry, welding and machining
CO3: Acquire measuring skills, using standard workshop instruments & tools.
CO4: Gain eye hand co-ordination, enhance psycho motor skills and attitude.

Text book [TB]:

1. A course in Workshop Technology Vol I and Vol II by Prof. B.S. RaghuwanshDhanpat Rai & Co.(P) Ltd.

2. Elements of Workshop Technology Vol I and Vol II by S.K. Hajara Choudhury ,A.K. Hajara Choudhury & Nirjhar Roy ;Media Promoters & Publishers Pvt. Ltd, Mumbai

Reference Books [RB]:

1. WorkshopTechnology Part 1 , Part2 & Part3 by W.A.J. Chapman;CBS Publishers & Distributors, New Delhi

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	CS105	Subject Title	Programming for Problem solving						
LTP	3-0-4	Credit	5	Subject Category	UC	Year	1st	Semester	I / II

Course Outline:

Course Objective:

The objective of the course is to make the students to understand the key hardware components in a modern computer system and as to how the software is mapped to the hardware. The student shall also be able to learn make the computer programs using C language by exploring the various features of C.

Course Pre/Co- requisite (if any):

Detailed Syllabus

UNIT 1: Introduction to Computer, Programming & algorithms
Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)
Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples, From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code

UNIT 2: Arithmetic Expression, and Conditional statements, Loops
Expression:
Arithmetic, Logical , Relational expressions and precedence.
Loops & Branching: Writing and evaluation of conditionals and consequent branching, Iteration and loops.

UNIT 3: Arrays & Functions
Arrays: Arrays (1-D, 2-D), Character arrays and Strings.
Functions: functions (including using built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference.
Searching & Sorting: Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

UNIT 4: Fuels, Battery& Lubrication
Recursion:
Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc.
Structure:
Structures, Defining structures and Array of Structures.

UNIT 5: Pointers & File handling
Pointers: Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list.
File handling: different modes of opening a file in C, reading, writing from files.

Learning Outcome

At the end of the course, the student will be able to:
CO1. To formulate simple algorithms for arithmetic and logical problems.
CO2. To implement conditional branching, iteration and recursion.
CO3. To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
CO4. To use arrays, pointers and structures to formulate algorithms and programs.
CO5. To apply programming to solve matrix addition and multiplication problems and searching and sorting problems

Text book [TB]:

1. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", 2nd edition 1988, Prentice Hall of India.

List of Experiments:

1. Familiarization with programming environment.
2. Programming for Simple computational problems using arithmetic expressions.
3. Programming for Problems involving if-then-else structures.
4. Programming for Iterative problems e.g., sum of series.
5. Programming for 1-D Array manipulation.
6. Programming for Matrix problems, String operations.
7. Programming for Simple functions
8. Programming for Recursive functions.
9. Programming for Pointers and structures.
10. Programming for File operations
11. Programming for solving Numerical methods problems

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	CH201	Subject Title	Environmental Science						
LTP	2-0-0	Credit	0	Subject Category	AC	Year	2nd	Semester	3rd

Course Outline:

Course Objective:

To impart basic knowledge about the environment and its allied problems and to develop an attitude of concern for the environment. Further the course structure will create the awareness about environmental problems among students and motivate the students to participate in environment protection and environment improvement programs. The course aims to develop skills to help the concerned individuals in identifying and solving environmental problems.

Course Pre/Co- requisite (if any):

Detailed Syllabus

UNIT 1: Basics of Environment and Natural Resources

Definition and Concept of Environment, Multidisciplinary nature of environmental studies. Scope and importance of environmental studies, Need for public awareness, Environmental concerns and people. Introduction and classification of natural resources. Energy Resources, Water Resources, Land Resources, Forest Resources, Food Resources, Mineral Resources, Case studies related to over exploitation of resources and their impacts. Role of an individual in conservation of natural resources, Sustainable lifestyles.

UNIT 2: Ecosystems

Definition and concept of ecology, Structure and Function of an Ecosystem, Energy Flow in Ecosystems, Biogeochemical cycles (Nitrogen, Carbon, Phosphorus, Oxygen and Hydrological). Species interactions in ecosystems. Ecological succession and ecological pyramids. Characteristic features of grassland, pond, desert and forest ecosystems. Ecosystem services and conservation.

UNIT 3: Biodiversity and its conservation

Introduction and types of biodiversity. Bio-geographic classification of India, Value and significance of biodiversity, Biodiversity at global, national and local levels, India: A mega-diversity nation, Biodiversity hotspots, Threats to Biodiversity: Poaching and man-wildlife conflicts, IUCN Red Data Book and endangered & endemic species of India. Biodiversity conservation strategies, Institutes and organizations.

UNIT 4: Environmental Pollutions

Introduction and Definition. Causes, consequences and control measures of: Air pollution, Water pollution, Noise pollution, Nuclear pollution, Soil pollution, Thermal and Marine pollution. Solid waste management, Bio-medical waste management. Disasters and its mitigation strategies, Global warming, Climate change, Acid rain, Ozone depletion and Smog. Pollution case studies. Role of an individual in pollution prevention.

UNIT 5: Social Issues and Environment

Sustainable Development: Concept and importance, Environmental Impact Assessment (EIA), GIS, Remote sensing. Water conservation and rain water harvesting. Resettlement and rehabilitation problems, Environmental audit, eco-labeling and eco-friendly business. Environmental Legislation in India, Population explosion and its impact on environment and human health, Value Education and environmental ethics**.**

Field work

- Visit to a local area to document environmental asset: river/forest/grassland/hill/mountain
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
- Study of common flora and fauna.
- Study of a common ecosystem-pond, river, hill slopes, etc.

Learning Outcome

At the end of the course, the student will be able to:
CO1. Demonstrate depleting nature of Environmental Resources and Ecosystem concepts.
CO2. Able to identify the structure and functioning of natural ecosystems.
CO3. Establish man-wildlife harmonious relationship.
CO4. Adapt to 3R (Reuse, Recovery, Recycle).Identify the causes and control measures related to Pollutions.
CO 5. Illustrate and analyse various Case Studies related to Environmental issues and Env. Legislation.

Text book [TB]:

1. Bharucha Erach, 2004. Textbook for Environmental Studies, University Grants Commission, New Delhi.
2. Kaushik A &Kaushik C P. 2007. Perspectives in Environmental Studies, New Age International Publ.
3. S. Deswal & A. Deswal 2015. A Basic Course in Environmental Studies. Dhanpat Rai & Co.

Reference books [RB]:

1. Miller T.G. Jr. 2002. Environmental Science, Wadsworth Publishing Co. (TB).
2. De A.K. 1996. Environmental Chemistry, Wiley Eastern Ltd.
3. Sharma, P.D. 2005. Ecology and environment, Rastogi Publication.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	HS244	Subject Title	Indian Constitution						
LTP	2-0-0	Credit	0	Subject Category	AC	Year	2nd	Semester	3rd

Course Outline:

Course Objective:

To familiarize the students with the features of the Indian Constitution
To provide a knowledge of their constitutional rights

Course Pre/Co- requisite (if any):

Detailed Syllabus

UNIT 1: Introduction

Constitution- meaning of the term, basic features Indian Constitution: Sources and constitutional history. Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive, Principles of State Policy, debates on Fundamental Rights and Directive

UNIT 2: Union Government and its Administration

Structure of the Indian Union: Federalism, Centre- State relationship. President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha. Institutional Functioning: Prime Minister, Parliament and Judiciary, Power Structure in India: Caste, class and patriarchy

UNIT 3: State Government and its Administration

Governor: Role and Position, CM and Council of ministers, State Secretariat: Organization, Structure and Functions

UNIT 4: Local Administration

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

UNIT 5: Election Commission

Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women

Learning Outcome

At the end of the course, the student will be able to:
CO1. Enable the students to protect their rights

CO2. The students will be engaged in the political system of India

Text book [TB]:

1. Abbas, H., Kumar, R. & Alam, M. A. (2011) Indian Government and Politics. New Delhi: Pearson, 2011.
2. Chandhoke, N. & Priyadarshi, P. (eds.) (2009) Contemporary India: Economy, Society, Politics. New Delhi: Pearson.

Reference books [RB]:

1. Chakravarty, B. & Pandey, K. P. (2006) Indian Government and Politics. New Delhi: Sage.
2. Chandra, B., Mukherjee, A. & Mukherjee, M. (2010) India After Independence. New Delhi: Penguin.
3. Singh, M.P. & Saxena, R. (2008) Indian Politics: Contemporary Issues and Concerns. New Delhi: PHI Learning.
4. Vanaik, A. & Bhargava, R. (eds.) (2010) Understanding Contemporary India: Critical Perspectives. New Delhi: Orient Blackswan.
5. Menon, N. and Nigam, A. (2007) Power and Contestation: India Since 1989. London: Zed Book.
6. Austin, G. (1999) Indian Constitution: Corner Stone of a Nation. New Delhi: Oxford University Press.
7. Austin, G. (2004) Working of a Democratic Constitution of India. New Delhi: Oxford University Press.
8. Jayal, N. G. & Maheta, P. B. (eds.) (2010) Oxford Companion to Indian Politics. New Delhi: Oxford University Press.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	MA201	Subject Title	Engineering Mathematics-III						
LTP	3-1-0	Credit	4	Subject Category	SC	Year	2nd	Semester	3rd

Course Outline:

Course Objective:

Introduce the fundamentals in Complex variable. Solving Partial Differential Equations. Legendre polynomial of first kind with properties. Bessel function of first kind and its properties.

Course Pre/Co- requisite (if any):

Detailed Syllabus

UNIT 1: Complex variable- I

Elementary functions, limit, continuity & differentiability, Analytic Functions; Cauchy – Riemann equations, Harmonic functions, Line integral in the complex plane, Cauchy's Integral theorem, Cauchy's Integral formula for derivatives of analytic function.

UNIT 2: Complex Variables -II

Power series, Taylor's series, Laurent's series, Poles, Zeros, Singularities, Residue Theorem, Evaluation of real integrals of the type $\int_0^{2\pi} f(\cos\theta, \sin\theta)d\theta$ and $\int_{-\infty}^{\infty} f(x)dx$.

UNIT 3: Special Functions

Series solution of ODE of 2nd order with variable coefficient with special emphasis to Legendre and Bessel differential equation by Frobenious method, Legendre polynomial of first kind, Bessel function of first kind and their properties.

UNIT 4: Fourier Transform & Z-transform

Fourier integral, Fourier transform, Fourier sine and cosine transforms, Linearity, Scaling, frequency shifting and time shifting properties, Convolution theorem and its application.

Z – Transform, Properties of Z-transforms, Convolution of two sequences, Inverse Z-transform, Solution of difference equations.

UNIT 5: Partial differential equations and its Applications

Introduction to partial differential equations; Linear partial differential equations with constant coefficients of second order and their classification; Method of Separation of Variables for solving Partial Differential Equations, One-Dimensional Wave Equation, One Dimensional heat equation.

Learning Outcome

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

CO1. Familiarity with methods of solving partial differential equations.

CO2. Learn differentiation and Integration of complex functions.

CO3. Solving real integrals with complex integration.

CO4. Learn Fourier and Z-transform rules with applications.

Text book [TB]:

1. J.W. Brown & R. V. Churchill: Complex Variables & Applications, 9th edition, McGraw-Hill, 2013.
2. R. K. Jain & S. R. K. Iyenger, Advanced Engineering Mathematics, 2nd Edition, Narosa Publishing House, New Delhi, India, 2014.

Reference books [RB]:

1. B. S. Grewal, Higher Engineering Mathematics, 42th Edition, Khanna publication, New Delhi, India, 2012.
2. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, U.K., 2006.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME201	Subject Title	Basic Thermodynamics						
LTP	3-1-0	Credit	4	Subject Category	DC	Year	2nd	Semester	3rd

Course Outline:

Course Objective:

To learn about different governing laws of thermodynamics and their applications. To understand the concept of energy as low and high grade and its use in exergy analysis. To evaluate the changes in properties of pure substances in various processes.

Course Pre/Co- requisite (if any): Engineering Physics, Engineering Mathematics

Detailed Syllabus

UNIT 1: Introduction to thermodynamics

Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers

UNIT 2: First law of thermodynamics

Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy; Demonstration that energy is a property; Various modes of energy, Internal energy and Enthalpy. First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume.

UNIT 3: Pure substances

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart.

UNIT 4: Second law of thermodynamics and Entropy

Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale. Clausius inequality; Definition of entropy; Demonstration that entropy is a property; Evaluation of entropy for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of entropy from steam tables- Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles.

UNIT 5: Availability and Irreversibility

Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work, Exergy balance equation, and Exergy analysis.

Learning Outcome

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

CO1: Apply energy balance to systems and control volumes, in situations involving heat and work interactions.

CO2: Evaluate changes in thermodynamic properties of pure substances.

CO3: Evaluate the performance of energy conversion devices.

CO4: Differentiate between high grade and low grade energies.

Text book [TB]:

1. Cengel, Y.A. and Boles, M.A., "Thermodynamics: An Engineering Approach", 8th Ed 2017 Tata McGraw
2. Nag, P.K, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd. 2013

Reference books [RB]:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., Fundamentals of Thermodynamics, John Wiley& Sons.
2. Jones, J. B. and Duggan, R. E., Engineering Thermodynamics, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., Fundamentals of Engineering Thermodynamics, John Wiley and Sons.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME202	Subject Title	Strength of Materials						
LTP	3-1-0	Credit	4	Subject Category	DC	Year	2nd	Semester	3rd

Course Outline:

Course Objective:

To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.

Course Pre/Co- requisite (if any): Engineering Mechanics

Detailed Syllabus

UNIT 1: Stresses and strains

Simple stress and Strain: Hooke's law; true and engineering stress -strain curves; , axial stress in varying cross sections, volumetric strain, relation between elastic constants, thermal stress and strain.

Compound stress and strains: Introduction; state of plane stress; stress on an inclined plane; Principal stresses and Principal planes; Mohr's stress circle.

UNIT 2: Properties of Sections &Stresses in Beams

Properties of Sections: Centre of gravity and moment of inertia of commonly used cross sections (T- section, I section, Channel section and circular and triangular section).

Stresses in Beams: Shear force and bending moment diagrams, bending stresses in beams; shear stresses in beams.

Torsion of circular shaft: Torsion equation; shafts in series and parallel.

Combined Stresses: Combined bending and torsion; Combined bending and axial thrust.

UNIT 3: Deflections of Beams& Strain Energy

Deflections of Beams: Introduction; differential equation of the deflected beam; (cantilever and simply supported beams) Macaulay's method; Moment area method, Castigliano's Theorem.

Strain energy: Concept and application.

UNIT 4: Columns, Struts and springs

Column and strut: Euler's theory of buckling of column for different end conditions; limitations of Euler's Formula; Rankine's Formula.

Springs: leaf springs, close coiled and open coiled helical springs with axial load. Springs in series and parallel

UNIT 5: Thin cylinders and Shells& Theories of failure

Thin cylinders and Shells: Hoop and axial stresses strain; volumetric strain. Joint efficiency.

Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal and external pressures.

Theories of failure: Application to two dimensional (plane stress) cases.

Learning Outcome

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

CO1: Recognize various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components

CO2: The students will be able to evaluate the strain and deformation that will result due to the elastic stresses developed within the materials for simple types of loading.

CO3: Calculate the elastic deformation occurring in various simple geometries for different types of loading

CO4: Evaluate equivalent stress with consideration of failure theories

Text book [TB]:

1. Strength of Materials by R.Subramaniam, Oxford University Press, New Delhi.2007
2. Strength of Materials by B.C. Punamia, Laxmi Publications.2015

Reference books [RB]:

1. Gere J. M., Timoshenko S.P., Mechanics of materials, CBS Publication, 2nd edition, ISBN- 8123908946.
2. Popov Eger P.,"Engg. Mechanics of solids", Prentice Hall, New Delhi, 2nd edition, ISBN- 0135713560.
3. Hibbeler R.C.,"Mechanics of Materials", Prentice Hall, New Delhi, 9th edition, ISBN- 0133254429.

4. Fenner, Roger.T, "Mechanics of Solids", U.K. B.C. Publication, New Delhi
5. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGrawHill Publishing Co. Ltd., New Delhi 2005

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME203	Subject Title	Materials Engineering						
LTP	3-0-2	Credit	4	Subject Category	DC	Year	2nd	Semester	3rd

Course Outline:

Course Objective:

To study the fundamental principles underlying and connecting the structure, processing, properties, and performance of materials systems.

Course Pre/Co- requisite (if any): Engineering Mechanics

Detailed Syllabus

UNIT 1:

Crystal Structures: History Of Materials, Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress. Microstructure

UNIT 2:

Mechanical Properties measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.

UNIT 3:

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, paratactic, peritectoid and monotectic reactions.

Iron Iron-carbide phase diagram and micro-structural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

UNIT 4:

Various types of carbon steels, alloy steels and cast irons, its properties and uses. Diffusion: Introduction, diffusion mechanisms, Steady-state diffusion, factors that influence diffusion.

Heat Treatment: Various types of heat treatment such as Annealing, Normalizing, Quenching, Tempering and Case hardening. Time Temperature Transformation (TTT) diagrams.

UNIT 5:

Ceramics: Structure, types, properties and applications of ceramics. Rubber, Plastics: Various types of polymers/plastics and its applications. Mechanical behavior of plastics. Future of plastics. Other materials: Brief description of other material such as optical and thermal materials, concrete, Composite Materials and its uses. Brief introduction to Smart materials & Nano-materials and their potential applications.

Learning Outcome

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

CO1: Will apply knowledge of mathematics, science and engineering to materials.

CO2: Will design and conduct experiments to analyze and interpret material testing data.

CO3: Be able to design a process, identify microstructure, on engineering needs.

CO4: Learn to identify, formulate, and solve engineering problems.

CO5: Learn to use the experimental, analytical, statistical, and computational tools for engineering practice in the materials discipline.

Text book [TB]:

1. W.D. Callister, Jr, -"Material Science & Engineering" Addition-Wesley Publication, 7th edition, 2007.
2. Er. R. K. Rajput, "Material Science, 3rd edition, Katson Books.

Reference books [RB]:

1. Van Vlack, "Elements of Material Science & Engineering", 6th edition, John Wiley & Sons, 2010.
2. V. Raghvan "Material Science", 5th edition, Prentice Hall, 2005.

List of Experiments:

1. Making a plastic mould for small metallic specimen.
2. Specimen preparation for micro structural examination-cutting, grinding, polishing, etching.
3. Grain size determination of a given specimen.

4. Comparative study of microstructures of different given specimens (mild steel, gray cast iron, brass, copper etc.)
5. Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after.
6. Material identification of, say, 50 common items kept in a box.
7. Study of corrosion and its effects.
8. Study of microstructure of welded component and HAZ. Macro and Micro Examination.
9. Suitable experiment on Magnetic/ Electrical/ Electronic materials.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME204	Subject Title	Manufacturing Processes						
LTP	3-0-2	Credit	4	Subject Category	DC	Year	2nd	Semester	3rd

Course Outline:

Course Objective:
This course will give an introduction to concepts and technologies of the principal manufacturing processes utilized by industry – Primrary, Secondary & Tertiary from a designer's viewpoint

Course Pre/Co- requisite (if any): Engineering Mechanics

Detailed Syllabus

UNIT 1: Conventional Manufacturing Process
Classification of Manufacturing Processes, Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses

UNIT 2:Forming Process
Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending).
Presses and their classification Compound vs. Progressive die, Forging equipment and methods: hand, drop and die forging.

UNIT 3: Metal cutting
Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.

UNIT 4: Joining/fastening processes
Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Arc welding: Power sources and consumables. TIG & MIG processes and their parameters, Resistance welding-spot, seam projection friction welding etc. Defects in welds and their remedies, HAZ Adhesive bonding. Powder Metallurgy Introduction

UNIT 5: Unconventional Machining Processes
Study of Machining processes, Process parameters and relations: EDM, ECM, LBM, EBM, PAM, Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining. Additive manufacturing: Rapid prototyping and Rapid tooling.

Learning Outcome

At the end of the course, the student will be able to:
CO1: Define casting processes and suggest manufacturing sequence for simple product shapes
CO2: Guide on process sequence of sheet metal operations like Draw, Punch, Bend etc
CO3: Define type, material and geometry of cutting tools.
CO4: Suggest different welding / joining process.
CO5: Discuss modern manufacturing processes like EDM, ECM, USM, LBM etc.

Text book [TB]:

1. S. Kalpakjian and S. Schemid (2001), Manufacturing, Engineering and Technology, Addison Wesley
2. A. Ghosh and A. K. Malik (2010) Manufacturing Science, East West Press Private Limited New Delhi

Reference books [RB]:

1. MP Groover, "Fundamentals of Modern Manufacturig", John Wiley & Sons 2002
2. PN Rao, "Manufacturing Technology", Tata Mcgraw Hill, 2017

List of Experiments:

1. To perform experiment on punching, blanking and drawing operation on sheet metal.
2. Study of Composite Material.
3. To prepare a sheet metal product (square container).
4. Pipe bending Operation.
5. Experiment based upon rolling and extrusion operation.
6. Study of Jigs and fixtures.
7. To study and observe various stages of casting through demonstration of Sand Casting Process.
8. To make an S-hook from a given round rod, by following hand forging operation.
9. To make a Square rod from a given round rod, by following hand forging operation.
10. To prepare a sand mold, using the given single piece pattern.
11. To prepare a sand mold, using the given Split-piece pattern.
12. Compression strength test for moulding sand.
13. Permeability test
14. Sieve analysis to find grain fineness number of base sand.
15. To visit an industry for study and observation of Modern casting processes like investment casting, centrifugal casting, die casting, evaporative pattern casting.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	EC210	Subject Title	Introduction to Electronics & Communication						
LTP	3-0-2	Credit	4	Subject Category	EC	Year	2nd	Semester	3rd

Course Outline:

Course Objective:

To understand basics of semiconductors, rectifying action of a diode, regulated power supplies circuits, transistor, fundamentals of logic gates and basics of signals and Systems, Instrumentation.

Course Pre/Co- requisite (if any): EE103- Basic Electrical Engineering

Detailed Syllabus

UNIT 1: Fundamental of Semiconductors

Energy bands in semiconductors, intrinsic and extrinsic semiconductors, Fermi Level in Intrinsic and Extrinsic semiconductor, Carrier transport in semiconductors: diffusion current, drift current, mobility, Hall Effect and resistivity. Generation and recombination of carriers

UNIT 2: Application of Low Power and High Power Diodes

Diode Circuits: Construction, Junction diode characteristics, Half and full wave rectifiers - Expression for efficiency and ripple factor - Bridge rectifier - π Filter circuits, Clipper, Clamper and multipliers using diodes, Zener Diode Characteristics - Regulated power supply using Zener diode.

UNIT 3: Transistor Fundamentals

Transistor circuits: Characteristics of a transistor in CB, CE and CC modes - Relatively merits - Biasing of Transistors- Load Line and operating point concept (both AC and DC). Construction and working of JFET and MOSFET.

UNIT 4: Digital Fundamentals and Introduction to Signals

Basic logic gates: AND, OR, and NOT – implementation of all gates using Universal gates, Number Systems conversions, Boolean algebra, K-map (upto 4 variables). Source of Information, Types of Signals.

UNIT 5: Basics of Communications & Instrumentation

Communication Systems, Communication Channels, Need of modulation, Types of modulations (Wave shapes and final expression only), Study of Piezoelectric, PMMC, LVDT and Strain Gauge transducers and their classifications and display device (7 segment) only.

Learning Outcome

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

CO1. To get acquaints student with fundamental knowledge of semiconductor devices their characteristics and modelling in different applications.

CO2. Students will be able to design and analyze electronic circuits

Text book [TB]:

1. Electronics Devices and Circuits, Millman and Halkias, Tata McGraw Hill, 4th ed.
2. Electronic Devices and Circuit Theory, Robert L. Boylestad, Prentice Hall Higher Edu. 2000.

Reference books [RB]:

1. Digital Design, Morris Mano, PHI
2. Modern Digital & Analog Communications, B. P. Lathi, OUP
3. Electronics Communication Systems, John Kennedy, Tata McGraw Hill, 4th ed.
4. Electronic Instrumentation - H. S. Kalsi

List of Experiments:

1. To identify and Study of the various components (resistor, capacitor, inductor, ICs, LED, potentiometer etc.) and electronic devices (CRO, Function Generator, Multimeter, Power Supply etc.) with their specification.

2. To study the V-I characteristics of PN Junction diode.
3. To study the V-I characteristics of Zener diode.
4. To find the efficiency of rectifiers and ripple factor of capacitive and non-capacitive half wave rectifier.
5. To find the efficiency of rectifiers and ripple factor of capacitive and non-capacitive full wave rectifier.
6. To Study and verify clipper and clamper with biased circuits.
7. To find the characteristics of CB amplifiers.
8. To find the characteristics of CE amplifiers.
9. Determine the characteristics of FET.
10. To find out the power energy of various periodic and non-periodic signals.

List of two value added Experiments

1. To study the waveforms of AM
2. To study the waveforms of FM

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	HS201	Subject Title	Aptitude and Soft Skills I						
LTP	2 0 0	Credit	0	Subject Category	AC	Year	II	Semester	III

Course Outline: This is a module having basics of aptitude coupled with Soft Skills to help students set the tone for aptitude training to create readiness for campus placement and various competitive exams for Government & non-corporate set-ups. The various tools used in the classes will help them rediscover & reinvent themselves.

Course Objective:

1. Prepare students for becoming confident and corporate-culture fit
2. Get them equipped with the aptitude tools to handle workplace stressors and manage time properly
3. Help them improve their interpersonal skills

Course Pre/Co- requisite (if any): Basic understanding of elementary Mathematics and Logical reasoning and basic understanding of Soft Skills.

Detailed Syllabus

UNIT 1: QUANTITATIVE APTITUDE **05 hours**

Simplification:Duplex method for finding square; Vedic mathematics tricks for multiplication of 2, 3, 4 digit numbers; BODMAS application, Finding square roots and cube roots; Introduction to Surds and Indices.
AgesProblems based on ages solving with algebraic equations; Concept of hence time and past time.
Averages**:** Basic Concepts; Weighted Average; Basic understanding of mean, median and mode; Application of average on ages, speed time distance and series.

UNIT 2: VERBAL APTITUDE **05 hours**

Sentences- Types of sentences, Parts of Speech**-** application based approach.
Vocabulary: Understanding word structure, common roots, prefixes, suffixes, Mnemonic method.
Speed Reading**:** Easy to medium passages-techniques and practical applications, Idioms and phrases.
Activities-Words from Dictionary, Newspaper and other sources (theme based).

UNIT 3: LOGICAL REASONING **06 hours**

Clock and Calendar, Cubes – Structure of cube, cutting rules, cutting the painted cube into identical cubelets and Dice reasoning – rule detection, pattern completion, image analysis.
Missing Number, Mathematical operation, Inequality, Number puzzles.

UNIT 4: SELF-ANALYSIS & INTERPERSONAL SKILLS05 hours

MBTI and other personality tests, strategies to develop interpersonal skills.
Suggested Activities & Games: (i) I Am (ii) Flip (iii) A Letter to Yourself, (iv) Card Pieces, (v) Blindfold Game, (vi) Crazy Comic.

UNIT 5: PRESENTATION SKILLS **05 hours**

Principles of Effective Presentations, Do's and Don'ts of Formal Presentations, How to prepare for a formal presentation, Presentation Exercises a) Welcome speech, c) Farewell Speech, d) Vote of thanks etc.
Suggested Activities & Games: (i) Stand Up for Fillers, (ii) Mimes, (iii) Short Speech Challenge.

Learning Outcome

1: Get to know more about their personality and gain people skills.

2: Be able to deliver presentations more confidently.
3: Will have a firm base ready for the upcoming years for the aptitude part.

Text book [TB]:

1. Quantitative Aptitude :How to prepare for Quantitative Aptitude, Arun Sharma, McGraw Hill, 8th edition, 2018.
2. Logical Reasoning **:** A Modern Approach to Logical Reasoning-R.S. Aggarwal, S Chand Publishing; 2nd Colour edition-2018.
3. Verbal Aptitude : English is Easy- Chetanand Singh, BSC Publication-2018.
4. Soft Skills- The Power of Now- Eckhart Tolle, Yogi Impressions Books Pvt. Ltd.-2010.

Reference books [RB]:

1. Quantitative Aptitude:Quantitative Aptitude for Competitive Examinations- R.S. Agarwal S. Chand Publications-2018.
   Quantitative Aptitude: Quantitative Aptitude- Saurabh Rawat and Anushree Sah Rawat Savera Publishing House, 1st edition-2016.
2. Logical Reasoning: Logical Reasoning and Data Interpretation for the CAT - Nishit K Sinha; Pearson India; 5th edition-2016.
   Logical Reasoning: Wiley's Verbal Ability and Reasoning - P A ANAND,Wiley -2016.
3. Verbal Aptitude: Fun with grammar- Suzanne W. Woodward Pearson Education ESL-1996.
4. Soft Skills- The Greatness Guide – Robin Sharma, Jaico Publishing House- 2006.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME206	Subject Title	Theory Of Machines						
LTP	3-1-2	Credit	5	Subject Category	DC	Year	2nd	Semester	4th

Course Outline:

Course Objective:

To learn about mechanisms, links and machines, motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link. To understand the kinematics of gear trains. To find the power transmission through gears, belts and pulleys, frictional torque in braking systems. To know the balancing of machines and gyroscopic effect in airplanes, four wheelers and ships.

Course Pre/Co- requisite (if any): Engineering Mechanics

Detailed Syllabus

UNIT 1:

Mechanisms and Machines: Link, kinematic pairs, degrees of freedom, kinematic chain, mobility of mechanism. Inversions of four bar chain and single slider crank chain.

Velocity and acceleration analysis of mechanisms (graphical method): Velocity and acceleration analysis of four bar mechanism, slider crank mechanism by vector polygons. Concept of coriolis component of acceleration.

UNIT 2:

Cams: Types of cams, Types of followers, displacement curves for cam profiles, Follower motions including SHM, uniform velocity.

Gears: Gear terminology, law of gearing, comparison of involute and cycloidal teeth. Simple gear trains, Compound gear and Epicyclic gear trains

UNIT 3:

Static and Dynamic force Analysis: Static Force Analysis; Free Body Diagram. Force analysis of four bar Mechanism and Slider-Crank Mechanism., Turning moment Diagram Concepts and application of Flywheel

Belt drives: Flat Belt Drives, Ratio of Belt Tensions. Power transmission, Centrifugal effect, initial tension Brakes: Types and their function, Resisting torque

UNIT 4:

Vibration: Free and forced vibration of single degree of freedom systems, effect of damping;

Balancing: Balancing of rotating masses in same plane and in different planes. Balancing of reciprocating masses

UNIT 5:

Governors Porter Governor; Hartnell Governors; Controlling Force; Stability; Sensitiveness

Gyroscope: Function of gyroscope, gyroscopic couple; Effect of gyroscopic couple on ship and airplane.

Learning Outcome

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

CO1: To understand different mechanisms and the balancing of machines to reduce undesirable stresses in machine parts

CO2: To know design of gears and pulleys for power transmission

CO3: To reduce the vibrations and undesirable noise in machine parts

CO4: Understanding the effect of gyroscopic couple in aeroplanes and ships

Text book [TB]:

1. S.S. Ratan, Theory of Machines, 4th edition, MGH, Education Publisher , 2009
2. R.S. Khurmi and J K Gupta , Theory of Machines, S Chand publication, 2005

Reference books [RB]:

1. Thomas Beven, Theory of Machines, 3rd edition, CBS Publishers and Distributors, 2005
2. Robert L Norton Kinematics and Dynamaics of Machinery, Tata McGraw Hill, 2009
3. Ghosh A and Mallick A K , Theory of Mechanism and Machines, East West Pvt. Ltd, New Delhi,1988.

List of Experiments:

1. To study the Different types of kinematic links, kinematic pairs and inversions of mechanisms.

2. To study different types of Gears and Gear trains.
3. To study different types of Cams and followers.
4. To perform the experiments of static and dynamic balancing on a shaft.
5. To perform the experiment on a governor and to plot the graph between “r” and “f”.
6. To perform the experiment on the Gyroscope & prove the law of gyroscope.
7. To perform an experiment on cam dynamics apparatus.
8. To calculate the frequency of a free vibrating spring.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME207	Subject Title	Fluid Mechanics & Fluid Machines						
LTP	3-1-2	Credit	5	Subject Category	DC	Year	2nd	Semester	4th

Course Outline:

Course Objective:

The students completing this course are expected to understand the properties of fluids, its kinematic and dynamic behavior through various laws of fluids like continuity, Euler's, Bernoulli's equations, energy and momentum equations. Further, the student shall be able to understand the theory of boundary layer, working and performance characteristics of various hydraulic machines like pumps and turbines.

Course Pre/Co- requisite (if any): Engineering Mathematics

Detailed Syllabus

UNIT 1: Introduction to Fluid Mechanics

Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension

Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications, Archimedes principle, buoyancy

UNIT 2: Laminar flow and boundry layer

Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli-

Darcy Weisbach equation, friction factor, Moody's diagram, concept of boundary layer – measures of boundary layer thickness

UNIT 3: Dimension analysis

Need for dimensional analysis – methods of dimension analysis – Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model analysis.

UNIT 4: Hydraulic Pumps

Euler's equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles. Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps- Reciprocating pump – working principle

UNIT 5: Hydraulic Turbines

Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities, performance curves for turbines –governing of turbines.

Learning Outcome

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

CO 1. Identify principles of fluid mechanics to be used for real life engineering problems.

CO 2. They will be able to understand the principle of floatation of objects in fluid

CO 3. Understand the working of different pumps and their components.

CO 4. Know the working of different turbines and their components

CO 5. Knowledge of dimension analysis and formation of correlations

Text book [TB]:

1. Bansal, R.K., "FLUID MECHANICS AND HYDRAULIC MACHINES", LAXMI PUBLICATIONS (P) LTD, 9th edition, New Delhi, 2014.

Reference books [RB]:

1. Rajput, R.K., "Text Book of Fluid Mechanics", S.Chand Publication, 4th edition, New Delhi, 2013.
2. Modi P.N and Seth S. M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi.

List of Experiments:

1. Verification of Bernoulli's Theorem.
2. To calibrate an orifice meter and determination of the co-efficient of discharge.

3. To calibrate a venture-meter and determination of the co-efficient of discharge.
4. Determination of coefficient of discharge for rectangular notch.
5. Determination of coefficient of discharge for triangular notch.
6. Determination of coefficient of discharge for trapezoidal notch.
7. To study the transition from laminar to turbulent flown in a circular pipe.
8. Determination of friction factor in pipe flow.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME208	Subject Title	Applied Thermodynamics I						
LTP	3-1-0	Credit	4	Subject Category	DC	Year	2nd	Semester	4th

Course Outline:

Course Objective:

To learn about first law for fuels and combustion, gas and vapor cycles and their first law and second law efficiencies. To understand gas dynamics of air flow and steam flow through nozzles. Understand the concepts of steam turbines and reciprocating compressors.

Course Pre/Co- requisite (if any): Basic Thermodynamics

Detailed Syllabus

UNIT 1: Introduction

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables.

UNIT 2: Gas and Vapor power cycles

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Super-critical Rankine cycle, Gas power cycles- Air standard Otto, Diesel and Dual cycles-Air standard Brayton cycle, effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles- Vapor compression refrigeration cycles

UNIT 3: Flow through nozzles

Basics of compressible flow, Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam through nozzle, super saturation- compressible flow in diffusers, efficiency of nozzle and diffuser.

UNIT 4: Reciprocating Compressors

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.

UNIT 5: Steam turbines and Condensers

Analysis of steam turbines, velocity, and pressure compounding of steam turbines, steam condenser, condenser efficiency, and thermodynamic analysis.

Learning Outcome

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

CO1: After completing this course, the students will get a good understanding of various practical power cycles.

CO2: They will be able to analyze energy conversion in various thermal devices such as combustors, nozzles, diffusers, steam turbines and reciprocating compressors.

Text book [TB]:

1. Cengel, Y.A. and Boles, M.A., "Thermodynamics: An Engineering Approach", 3rd Ed., Tata McGraw-Hill.
2. Nag, P.K, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.

Reference books [RB]:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., Fundamentals of Thermodynamics, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., Engineering Thermodynamics, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., Fundamentals of Engineering Thermodynamics, John Wiley and Sons.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME209	Subject Title	Design Of Machine Elements						
LTP	3-1-2	Credit	5	Subject Category	DC	Year	2nd	Semester	4th

Course Outline:

Course Objective:

This course provides an introduction to the students to have an overview of design methodologies employed for design of various machine components. Student will also learn to appreciate nature and applicability of empirical design principles, based on tests and safety considerations

Course Pre/Co- requisite (if any): Strength of Materials, Theory of Machines

Detailed Syllabus

UNIT 1:

Introduction: Definition, Methods, standards in design & selection of preferred size. Limits, fits and tolerances. Introduction Stress Concentration, Fatigue loads and Failure BIS system of designation of steels.

Design against static load: Modes of failure, Factor of safety, theories of failure, Simple & Compound stresses in machine elements. Fatigue failure, endurance limit, design for finite & infinite life, Soderberg & Goodman criteria, Modified Goodman criteria, S-N curve

Design of shafts under static and fatigue loadings.

UNIT 2:

Design of Joints: Welded joint, Riveted joints, threaded fasteners, Bolted/Screwed Joints. Pre-loaded bolts

Shaft, keys & coupling.

UNIT 3:

Mechanical springs: Design of Helical and leaf springs, Stress analysis in springs, Design against static & fatigue loading.

UNIT 4:

Design of transmission elements Basics of Spur Gear: Terminology, Classification, System of gear teeth, contact ratio, Interference, Backlash, Selection of gear materials, Design considerations. For gear pairs: spur, helical & bevel

UNIT 5:

Analysis and design of sliding and rolling contact bearings systems, Sommerfeld Nos, Boyd Raimondi Charts

Simple analysis and application of Power Screws:

CASE STUDY: Engineering Of Typ 800 /1000 cc Vehicle Clutch, Brake, Gear Box and Differential systems

Learning Outcome

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

CO1: Develop fundamental understanding of Machine Design in an engineering perspective and know how to integrate it with other subjects in engineering practice.

CO2: Know how to analyse, evaluate and recommend materials on the basis of given problem statement

CO3: Understand the influence of manufacturing processes in the design of machine element

CO4: Understand safety, reliability concepts in design of machine elements in static & dynamic Loading conditions

CO5: Develop ability to analyze, M/c Elements, Gears, springs, Bolted & Riveted Joints, Bearings.

Text book [TB]:

1. Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill Intern; 2011.
2. V. B. Bhandari, Design of Machine Elements, McGraw-Hill, Inc., 2005.

List of Experiments:

1. Design & drawing of a cotter joint.
2. Design & drawing of a knuckle joints.
3. Design & drawing of a simple screw jack.
4. Design of shaft for different loading conditions.
5. Design & drawing of rigid coupling (flanged type).

6. Design & drawing of Flexible coupling.
7. Design & drawing of key and spline.
8. Design & drawing of a leaf spring for an automobile.
9. Design & drawing of a helical spring for a given application.
10. Design and drawing of spur gear. (Involute tooth profile, interference, Pressure angle etc.)

Note -

1. Students are advised to use design data book.
2. Drawing shall be made wherever necessary on A4/A3 size drawing sheets

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME210	Subject Title	Machine Drawing And Solid Modeling						
LTP	0-0-4	Credit	2	Subject Category	DC	Year	2nd	Semester	4th

Course Outline:

Course Objective:

The objective of this course is to use engineering graphic skills as a means of communicating technical ideas, information and instructions. Use of Sectional views, Part sectioning, Assembly drawings and Layouts forms a part of this learning. Student uses manual drafting and design software for this communication.

Course Pre/Co- requisite (if any): Engineering Graphics

Detailed Syllabus

UNIT 1:

Introduction to Engineering Drawing, Classification of Engineering Drawings, Machine Drawing and representation of materials, Conventional representation of materials and common machine components. Representation of geometrical and dimensional tolerance and surface roughness symbols. Fundamental concepts of G and H, No-go and Go gauges.

UNIT 2:

Representation of welded joints. Projections, Sectional views and sectioning of parts and assemblies.

UNIT 3:

Engineering Graphics Software, Co-ordinate Systems, Drafting and Modelling, Evolution of geometric modeling, Advantages of solid modeling, Definition, Advantages and disadvantages of wireframe models, Solid Representation, Boundary Representation (B-rep), Constructive Solid Geometry (CSG).

Computer aided Drafting: Generation of points,lines, curves, polygons, dimensioning, utilitycommands etc.

Solid modeling: Use of modeling software, Part model, Assembly.

UNIT 4:

Drawing of Machine Elements and simple parts: Views of any three sets of the following machine elements and parts;

a) Popular forms of Screw threads, bolts, nuts, stud bolts.
b) Keys, cotter joints and knuckle joint.
c) Shaft coupling, spigot and socket pipe joint.
d) Journal, pivot and collar and foot step bearings.
e) Rivet joints for plates

UNIT 5:

Assembly Drawings: Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions; (any one)

a) Engine parts – connecting rod, piston assembly.
b) Other machine parts - Screws jacks, Machine Vices, Plummer block, Tailstock.
c) Valves: Steam stop valve, spring loaded safety valve, feed check valve and air cock

Learning Outcome

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

CO 1. Understand Part and Assembly Drawing Concepts, Engineering Drawing and its classification

CO 2. Representation of manufacturing symbols, materials etc

CO 3. Be able to specify dimensions, and dimensional tolerances. Surface fisnish etc

CO4. Develop Drafting and Modeling skills using design software.

Text book [TB]:

1. Bhatt.N.D. and Panchal.V.M. Machine Drawing, Charotar Publishing House Pvt. Ltd. Anand (Gujrat), 388001, 49thEdition, 2014.
2. Dhawan R.K, A Textbook of Machine Drawing, S. Chand Publishing, New Delhi-110055.

3. Narayana.K.L, Kannaiah P. & Reddy K. Venkata,Machine Drawing, New Age International (P) Ltd. Publishers, NewDelhi-110002,4thEdition,2012.

Reference books [RB]:

1. Sidheswar. N, Kannaiah. P, & Sastry V.V.S.,Machine Drawing, McGraw-Hill Education (India) PrivateLimited,NewDelhi-110016,2001
2. Pohit. Goutam&Ghosh. Goutam,Machine Drawing with AutoCAD, Pearson Education, Delhi.
3. John. K.C, A Textbook of Machine Drawing,PHI Learning, Delhi.
4. Gill P.S, A Textbook of Machine Drawing, S. K. Kataria & Sons Publishers, New Delhi-110002, 18th Edition,2013

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Humanities Electives I

Subject Code	HS241	Subject Title	Education and Social Change						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	II	Semester	IV

Course Objective

- To define the various types of education policies
- To understand the role in striving for social change.
- To overview on education and its implications on social changes to the students.

Unit 1 **6 Hrs**

General introduction to the place of learning in society. Learning, education and training.
Changing meanings of education across time and society. A brief historical perspective on education in India.

Unit 2 **6 Hrs**

Social-political arithmetic as a spurious way of understanding education and social change.
Structural functionalist perspectives and structural-conflict perspectives on education

Unit 3 **7 Hrs**

Class, conflict, legitimation processes, reproduction of society. Anarchist perspectives. "New" Sociology of Education. Symbolic interactionist perspectives on education. Resistances to schooling. Critical theory and education.

Unit 4 **7 Hrs**

Neo-Weberian perspectives on education. Status politics and education. Caste, class, gender and education in India. Indian thinkers on education. Current debates on the place of education in India.

LEARNING OUTCOME:

- The students will understand how theeducation system assesses the importance of education in society.
- The students will be able to take a significant action in area of education to maintain social change
- The student will be able to participate in the changes required in society.
- Education will be used as a tool to implement adequate changes in society.

TEXT BOOKS

1. Desai, A.R. (2005), *Social Background of Indian Nationalism,* Popular Prakashan.
2. Giddens, A (2009), *Sociology*, Polity, 6th ed.

REFERENCE BOOKS

- Guha, Ramachandra (2007), *India after Gandhi,* Pan Macmillan.
- Sharma R.S. (1965), *Indian Feudalism,* Macmillan.
- Deshpande, Satish (2002), *Contemporary India: A Sociological View,* Viking.
- Gadgil, Madhav & Ramachandra Guha(1993), *This Fissured Land: An Ecological History of India,* OU Press.
- Haralambos M, RM Heald, M Holborn (2000), *Sociology*, Collins.
- Mohanty, M (ed.) (2004), *Class, Caste & Gender- Volume 5,* Sage.
- Dhanagare, D.N., *Themes and Perspectives in Indian Sociology,* Rawat

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Humanities Electives I

Subject Code	HS242	Subject Title	Introduction to Psychology						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	II	Semester	IV

Course Objective

- To understand the basic psychological processes and their applications in everyday life.

Unit 1Introduction **5Hrs.**

Psychology as a science, perspective, origin and development of Psychology, Psychology in India, Methods: experimental and case study.

Unit 2 Cognitive Processes-Perception **7Hrs.**

Nature of perception, laws of perceptual organization, learning, conditioning observational learning, memory processing, information processing model, techniques for improving memory

Unit 3 Motivation and Emotion **7Hrs.**

Motives: Biogenic and Sociogenic; Emotion: Nature of Emotions, key Emotion

Unit 4 Personality and Intelligence-Personality **7Hrs.**

Nature and Theories; Intelligence: Nature and Theories

Course Outcome:

- The students will develop an understanding of the various psychological processes to maintain their daily activities
- The students will understand themselves better.
- The students will be better equipped for life.
- The Students will be able to demonstrate critical and creative thinking and scientific approach to understand human behaviour.

Text Books:

1. Baron, R.A. and Misra, G., Psychology (Indian Subcontinent Edition). Person Education Ltd. (2014)
2. Chndha, N.K. & Seth, S., The Psychological Realm: An Introduction. Pinnacle Learning, New Delhi. (2014)

REFERENCE BOOKS:

- Ciccarelli, S.K. & Meyer, G.E., Psychology (South Asian Edition). New Delhi: Tata Mc Graw Hill. (2008)
- Glassman, W.F., Approaches to Psychology (3rd Ed.) Buckingham: Open University Press. (2000)
- Passer, M.W., Smith, R.E., Holt, N. and Bremmer, A., Psychology: The Science of Minand Behaviour, McGraw-Hill Education, UK. (2008)

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Humanities Electives I

Subject Code	HS243	Subject Title	Science, Technology & Society						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	II	Semester	IV

Course Objective

To increase the basic understanding of students towards science and technology, and basic implications of science & technology on social development**.**

Unit 1 **5Hrs.**

Introduction of society, Sociological imagination, the two revolutions and their socio-economic technological and scientific implications; Social significance of science and technology, ideas beyond technology.

Unit 2 **5Hrs.**

Perspectives on relations between science and technology; Sociological perspective on scientific knowledge: Karl Marx, Emile Durkheim and Karl Mannhen's Sociology of knowledge; Merton's approach to science and technology.

Unit 3 **7Hrs.**

Ethos of science, Matthew effect in science,Thomas theorem and Mathew effect; Thomas Kunn's notions paradigm and paradigm-based science, Scientific community and growth of scientific knowledge.

Unit 4 **9Hrs.**

Science in India: science and technology policies in India, Scientific communities and their linkages, national and international Science, Ethics in science & engineering, environment and science and technology

COURSE OUTCOME:

- Enable students to examine the role of science and technology in social and economic development.
- The students will understand perspectives on relations between science and technology.
- The student will be able to understand the scientific temper & its social significance.
- The student will be able to understand and implement technological policies for the betterment of society.

TEXT BOOKS

1. Federic A. Lyman: Opening Engineering Students Mind to Idea to Ideas Beyond Technology. IEEE Technology and Society Magazine, Fall, pp.16-23. (2002)
2. John Theodore Rivers: Technology and the use of Nature. Technology in Society, 25(3), August, pp.403-416 (2003).

REFERENCE BOOKS

- Ronald R. Kline: Using History & Sociology to Tech Engineering Ethics. IEEE Technology and Society Magazine, Winter, pp.13-20 (2002).
- V.V. Krishna: A portrait of the scientific community in India: Historical Growth and Contemporary Problems, Gaillard et al. (eds). Scientific Communities in the Developing World, Sage (1997

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Humanities Electives I

Subject Code	HS245	Subject Title	Ethics & Self Awareness						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	II	Semester	IV

Course Objective

- To introduce the concepts pertaining to ethical and moral reasoning and action
- To develop self – awareness

Unit 1 Introduction **4Hrs.**

Definition of Ethics; Approaches to Ethics: Psychological, Philosophical, Social.

Unit 2 Psycho-social theories of moral development **4Hrs.**

View of Kohlberg,Morality and Ideology, Culture and Morality, Morality in everyday context

Unit 3 **8Hrs.**

Ethical Concerns: Work Ethics and Work Values, Business Ethics, Human values in organizations, Self-Awareness: Self Concept: Johari Window, Self and Culture, Self-Knowledge, Self-Esteem

Unit 4 **11Hrs.**

Perceived Self-control, Self-serving bias, Self-presentation, Self-growth: Transactional Analysis and Life Scripts. Self-Development: Character strengths and virtues, Emotional intelligence, Social intelligence, Positive cognitive states and processes (Self-efficacy, Empathy, Gratitude, Compassion, and Forgiveness).

COURSE OUTCOME

- Students will develop an understanding of the ethical values and their application in daily activities
- Students will learn business ethics and work ethically in every sphere.
- Students will understand themselves better and develop healthy interpersonal relationships.
- Students will be able to develop themselves into wholesome personalities.

TEXT BOOKS

1. Leary M.R., "The Curse of Self: Self-awareness, Egotism and the Quality of Human Life", Oxford University Press. 2004
2. Louis P. P., "The Moral Life: An Introductory Reader in Ethics and Literature", Oxford University Press. 2007

REFERENCE BOOKS

- Corey, G., Schneider Corey, M., & Callanan, P., "Issues and Ethics in the Helping Professions", Brooks/Cole. 2011
- Snyder, C.R., Lopez, Shane, J., & Pedrotti, J.T., "Positive Psychology" Sage, 2nd edition. 2011

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	HS204	Subject Title	Aptitude and Soft Skills II						
LTP	2 0 0	Credit	0	Subject Category	AC	Year	II	Semester	IV

Course Outline: This module is focused on providing students more hands-on practice on aptitude problems and prepare a stronger fundamental base for Aptitude and Soft Skills III and IV. Employability skills will help students improve their employability.

Course Objective:

1. Prepare a ground for the students to be ready in Quantitative, Logical Aptitude and Verbal Aptitude
2. Prepare them for becoming confident and corporate-culture fit as present-day workplace requires professionals who are not only well qualified and competent but also possess Soft Skills like interpersonal skills and good presentation skills

Course Pre/Co-requisite (if any): Basic understanding of simplification and calculation tricks, non-verbal pattern completion LR, covered in Aptitude and Soft Skills I.

Detailed Syllabus

UNIT 1: QUANTITATIVE APTITUDE **06 hours**

Basic algebraic equations (linear equations in one variable), polynomials and Algebraic Inequalities; logarithm. Quadratic Equations (concept of determinant, real, non-real, rational and conjugate roots); Geometry and Mensuration; Heights and Distances.

UNIT 2: VERBAL APTITUDE **04 hours**

Figures of speech; Determiners.

Creative Writing: Essay, Report Writing, Article, Letters, E-mail, difference between formal and informal tone, appropriate use of transition words, creating a signature, understanding different situations and the responses they require (situation- based writing), Proper use of connectors.

UNIT 3: LOGICAL REASONING **05 hours**

Input Output – Sequential output tracing of logical operations applied on machine input, Ranking and Order- Test - Ordering of measurable attributes like height / weight / performances, etc.

Eligibility test, Logical sequences and series, Completion of incomplete pattern, Odd figures or Odd man out, Analogies, Coding Decoding basics.

UNIT 4: LEADERSHIP & TEAM BUILDING SKILLS **05 hours**

Importance, How to develop Leadership Skills? Best Leadership & Team Building Examples.

Suggested Activities & Exercises: (i) Leadership Pizza, (ii) Minefield, (iii) Leaders You Admire.

UNIT 5: EMPLOYABILITY SKILLS & CV WRITING **06 hours** What Skills Do Employers Expect From Graduates? CV vs. Resume, CV writing Do's & Don'ts, Tips with Best Examples/ Samples, Feedback Sharing & Error Analysis.

Suggested Activities & Exercises: (i) Relevant Videos on 'Employability', (ii) Group Discussions on Newspaper Articles, (iii) Sample correction, (iv) writing exercise.

Learning Outcome

1: Develop Leadership & Team Building Skills.

2: Receive hands-on guidance to develop an effective CV.

3: The students would be able to understand the basic trends of questions asked in the aptitude part of placements.

Text book [TB]:

1. Quantitative Aptitude:How to prepare for Quantitative Aptitude, Arun Sharma, McGraw Hill, 8th edition-2018.
2. Logical Reasoning: A Modern Approach to Verbal & Non-Verbal Reasoning by R.S.Aggarwal, S Chand Publishing; 2nd Colour edition-2018.
3. Verbal Aptitude: English is Easy- Chetanand Singh, BSC Publication-2018

Reference books [RB]:

1. Quantitative Aptitude: Quantitative Aptitude for Competitive Examinations- R.S. Agarwal S. Chand Publications-2018.
   Quantitative Aptitude: Quantitative Aptitude- Saurabh Rawat and Anushree Sah Rawat Savera Publishing House, 1st edition-2016.
2. Logical Reasoning: Analytical & Logical Reasoning by Peeyush Bhardwaj-Arihant Publications; 4th edition-2015.
   Logical Reasoning: Analytical Reasoning by M.K.Pandey BSC publishing; 3rd edition . -2009.
3. Verbal Aptitude: Oxford Guide to English Grammar- John Eastwood, Oxford University Press-2003.
4. Soft Skills: Talk like Ted – Carmine Gallo, St. Martin's Press.
   Soft Skills: No Excuses – Dr Wayne Dyer, Hay House Inc.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME301	Subject Title	HEAT TRANSFER						
LTP	3 1 2	Credit	5	Subject Category	DC	Year	3rd	Semester	V

Course Outline:

Course Objective: To build a solid foundation in heat transfer exposing students to its three basic modes of conduction, convection and radiation. Introduction to governing equations with solution of practical problems using empirical correlations.

Course Pre/Co- requisite (if any): Basic Thermodynamics, Engineering Mathematics

Detailed Syllabus

UNIT 1: INTRODUCTION TO HEAT TRANSFER

Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness.

UNIT 2: FINS & TRANSIENT CONDUCTION

Heat transfer through fins of uniform cross-section, lumped system approximation and Biot number-approximate solution to unsteady conduction heat transfer by the use of Heissler charts.

UNIT 3: CONVECTIVE HEAT TRANSFER

Heat convection, basic equations, boundary layers, Forced convection, external and internal flows, Natural convective heat transfer, Dimensionless parameters for forced and free convection heat transfer, Correlations for forced and free convection, Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

UNIT 4: BOILING, CONDENSATION &HEAT EXCHANGERS

Boiling and condensation heat transfer, pool boiling curve, types of heat exchangers, analysis and design of heat exchangers using both LMTD and ε-NTU methods.

UNIT 5: RADIATION HEAT TRANSFER

Basic radiation concepts, definitions of radiative properties, radiation laws, black and gray body radiation, shape factor, black-body radiation exchange, radiation exchange between non-blackbodies in an enclosure, Infinite parallel Planes, radiation shields.

Learning Outcome

After completing the course, the students will be able to

CO1:Formulate and analyze a heat transfer problem involving any of the three modes of heat transfer.
CO2:Analyze heat transfer through fins and unsteady state heat conduction problems.
CO3:Analyze convective heat transfer cases using exact, approximate, and empirical methods.
CO4:Design heat exchange devices and understand boiling and condensation heat transfer.
CO5:Analyze radiative heat exchange between black and gray surfaces

Text book [TB]:

1. Cengel, Y.A. and Ghajar, A.J. “Heat and Mass Transfer”, Tata McGraw Hill Co.Ltd, 4th, edition, 2013.
2. Incropera, F.P., “Fundamentals of Heat & Mass Transfer”, Wiley Publication, 6th edition, 2013.

Reference books [RB]:

1. Kreith, F. and Bohn, M.S., “Principles of Heat Transfer”, Brooks/Cole, 6th edition, 2006.
2. Holman, J.P., “Heat Transfer”, TataMcGraw-Hill Publishing Company Limited, 6th edition, 2008.
3. Thirumaleswar, M., “Fundamentals of Heat and Mass Transfer”, Pearson Education, 1st edition, 2013.
4. Bejan, A., “Heat Transfer John Wiley”, 1993.
5. Massoud K., “Principles of Heat Transfer”, John Wiley, 2002

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME302	Subject Title	MANUFACTURING TECHNOLOGY						
LTP	3 0 2	Credit	4	Subject Category	DC	Year	3rd	Semester	V

Course Outline:

Course Objective: Introduce student to (mechanical) measurement techniques so as to appreciate relationship between process and system in manufacturing domain for identifying techniques for quality assurance of process.

Course Pre/Co- requisite (if any): Manufacturing Process

Detailed Syllabus

UNIT 1: METROLOGY

Introduction: measurement and measuring instruments, calibration, standards of measurements, statistical analysis of errors.

Dimensions, form and surface measurements, Limits, fits and tolerances; linear and angular measurements; comparators; Answering Gauge Design; Metrology in tool wear and part quality including surface integrity, alignment and testing methods; tolerance analysis in manufacturing and assembly.

UNIT 2: MEASUREMENTS (Lab Based Teaching)

Strain measurement: Sensors, Transducers & Strain Gauges, working, circuits, rosettes, calibration. Force and Torque Measurement: Load cells, elastic transducers.

Vibration Measurement: vibration pickups, decibel meters, vibrometers accelerometers.

UNIT 3: PRESSURE AND TEMPERATURE MEASUREMENT

Pressure Measurement: Introduction; Pressure standards and methods of pressure measurement; Manometers; Elastic pressure transducers; Calibration of pressure measuring instruments.

Temperature Measurement: Introduction; Temperature and Temperature Scales; Methods of temperature Measurement; Expansion thermometers; Filled System thermometers; Electrical temperature measuring instrument; Pyrometers; Calibration of temperature measuring instruments.

UNIT 4: OPTIMIZATION METHODS IN MANUFACTURING

Linear programming, objective function and constraints, graphical method, Simplex and duplex algorithms, transportation, assignment.

UNIT 5: PROJECT MANAGEMENT & INVENTORY CONTROL TECHNIQUES

Network models: Shortest route, minimal spanning tree, maximum flow model- Project networks: CPM and PERT, critical path scheduling; Forecasting models, Economic Order Quantity practical inventory control models.

Learning Outcome

At the end of the course the student can:

CO1:Identify measuring process, appropriate measuring tools for various manufacturing /shapes/ processes

CO2:Relate metrology parameters in manufacturing processes to dimensional accuracy, tolerances of products

CO3:Attain a hands on approach to practical measurements related to sensor based technology

CO4:Relate to overall optimization in manufacturing domain; relationship between processes and system

CO5:Identify techniques for the quality assurance of products in terms of process & resource management.

Text book [TB]:

1. R.K. Rajput, “Mechanical Measurements & Instruments 4th edition, 2014
2. Doeblin, “Measurement Systems”, 6th edition, 2012

3. Kalpakjian and Schmid, Manufacturing processes for engineering materials -Pearson India, 2014.

Reference books [RB]:

1. Taha H. A., Operations Research, 6th Edition, Prentice Hall of India, 2003.
2. Shenoy G.V. and Shrivastava U.K., Operations Research for Management, Wiley Eastern, 1994.
3. JK Sharma Operation Research: Theory and Application, 5th ed 2013
4. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", 5th edition, 2003
5. A.K. Sawhney and P. Sawhney, "Mechanical Measurements and Instrumentation", 12th edition, 2001

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME303	Subject Title	FLUID MACHINERY- LAB COURSE						
LTP	0 0 2	Credit	1	Subject Category	DC	Year	3rd	Semester	V

Course Outline:

Course Objective: The students completing this course are expected to understand the working and performance characteristics of various hydraulic machines like pumps and turbines.

Course Pre/Co- requisite (if any): Fluid Mechanics and Fluid Machines

Detailed Syllabus

LIST OF EXPERIMENTS:

1. To determine the coefficient of impact jet vane combination by comparing the actual force with the theoretical force for stationary vanes of different shapes.
2. To find out Pelton wheel turbine efficiency by comparing the fluid energy to Mechanical energy.
3. To find out the performance of Francis turbine.
4. To study the performance of reciprocating pump.
5. To study the performance of centrifugal pump.
6. Study through visit of any pumping station/plant.
7. Study through visit of any hydraulic power plant.

Learning Outcome

At the end of the course the student can:

CO1: Understand the working of different pumps and their components.
CO2: Know the working of different turbines and their components.
CO3: Practical understanding of selection of various fluid components for any applications.

Text book [TB]:

1. White, F.M., "Fluid Mechanics", McGraw Hill Pvt. Ltd., 7th edition, 2011.
2. Bansal R. K., "A Text Book of Fluid Mechanics and Hydraulic Machine", Lakshmi Publications, New Delhi, 2010.

Reference books [RB]:

1. Munson, "Fundamentals of Fluid Mechanics", Willey India Pvt Ltd, New Delhi, 6th edition, 2010.
2. Duglas, J. "Fluid Mechanics", Pearson Ltd, 14th edition, New Delhi, 2013.
3. Modi P.N and Seth S. M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi.2006
4. Rajput, R. K., "Text Book of Fluid Mechanics", S. Chand Publication, 4th edition, New Delhi, 2013

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME341	Subject Title	Energy Conservation And Management						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: This course will give an understanding of the energy data from industries and carry out energy audit for energy savings

Course Pre/Co- requisite (if any): Basic Thermodynamics, Applied Thermodynamics I

Detailed Syllabus

UNIT 1:

Introduction to energy & power scenario of world, National Energy consumption data, and environmental aspects associated with energy utilization; Energy Auditing- need, types, methodology and barriers, role of energy managers, instruments of energy auditing.

UNIT 2:

Components of EB billing, HT and LT supply, transformers, cable sizing; Concept of capacitors, power factor improvement, harmonics; Electric motors- motor efficiency computation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting.

UNIT 3:

Thermal systems, Boilers, Furnaces and Thermic Fluid heaters- efficiency computation and energy conservation measures; Steam distribution and usage, steam traps, condensate recovery, flash steam utilization; Insulation & Refractories.

UNIT 4:

Energy conservation in major utilities; pumps, fans, blowers, compressed air systems, Refrigeration& Air Conditioning systems, Cooling Towers, DG sets.

UNIT 5:

Energy Economics- discount period, payback period, internal rate of return, net present value; Life Cycle costing- ESCO concept.

Learning Outcome

After completing this course,

CO1: Student will be able to perform of energy auditing for the energy consumption of industries.

CO2: Students will understand Industrial terminology of energy managements

CO3: Students will understand major utility of energy conservation in industry.

Text book [TB]:

1. Witte L. C, Schmidt P.S. and Brown D.R., Industrial Energy Management and Utilization, Hemisphere Publ., Washington, 1988.
2. Hemant Pathak , A Hand Book of Energy Conservation and Management, Createspace Independent Pub, 30-Nov-2013

Reference books [RB]:

1. Callaghn P.W., Design and Management for Energy Conservation, Pergamon Press, Oxford, 1981.
2. Murphy W.R. and McKay G., Energy Management, Butterworths, London, 1987.
3. Energy Manager Training Manual, Bureau of Energy Efficiency (BEE) under Ministry of Power, GOI, 2004 (available at www.energymanager training.com).

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME342	Subject Title	Composite Materials						
LTP	2 1 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To enable the students, know and understand the mechanical behavior of composite materials

Course Pre/Co- requisite (if any): Strength of Materials, Materials Engineering

Detailed Syllabus

UNIT 1:

Definition and applications of composite materials, classifications, Fibers- glass, carbon, ceramic and aramid fibers. Matrices- polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. Fillers and whiskers. Advantages and limitations of composites

UNIT 2:

Mechanical behaviour of composite materials, surface treatment of fibers, thermosets matrix materials, Thermoplastics and other matrix materials, Manufacturing of thermoset composites, bag moulding, compression moulding, pultrusion, filament welding, other manufacturing processes

UNIT 3:

Composite mechanics Terminology, Behaviour of unidirectional composites, Behaviour of short fiber composites Analysis of orthotropic ply. Hook's Law for orthotropic lamina, Relation between Engg. constants and Elements of matrices for orthotropic ply, Transformation of Engg. constants, Failure in isotropic materials

UNIT 4:

Analysis of laminated composites, symmetric laminates, angle ply laminates, cross ply laminates, laminate, evaluation of lamina properties, determination of stress and strain in laminate, maximum stress and strain criteria, von Mises Yield criterion for isotropic materials, .

UNIT 5:

Residual stresses during curing, prediction of laminate failure, thermal analysis of composite laminates. Analysis of laminated plates - equilibrium equations of motion, static bending analysis, buckling analysis, free vibrations, natural frequencies.

Learning Outcome

At the end of the course the student can:

CO1:Have an overview of the mechanical behaviour and application of composite materials.

CO2:Get an overview of the methods of manufacturing composite materials

CO3: students will understand various mechanics of composite materials.

Text book [TB]:

1. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.
2. Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill, 1998.

Reference books [RB]:

1. F. L. Matthews, Rees D. Rawlings , Composite Materials: Engineering and Science Woodhead Publishing, 1999 - Composite materials.
2. Autar K. Kaw**,**Mechanics of Composite Materials,CRC Press, 30-May-1997

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME343	Subject Title	Mechatronics						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To impart knowledge of integration of electronics engineering, electrical engineering, and control engineering with mechanical engineering system design and to give awareness of various interdisciplinary technology such as MEMS and PLC and their applications in mechanical devices.

Course Pre/Co- requisite (if any): Intro. Electronics and Communication

Detailed Syllabus

UNIT 1:

Mechatronics: Definition of Mechatronics Systems, Multidisciplinary Scenario, A leading edge technology, Systems, Measurement system, Control system, Sequential controller, Microprocessor based controller, Signal conditioning, digital to analogue convertor, and analogue to digital convertor, Mechatronics application.

UNIT 2:

Sensors and transducers: Performance terminology, Classification, Displacement, Position and proximity sensors, Velocity, Motion, Force, Fluid pressure. Temperature sensors. Strain gauge, Bimetallic sensor, Pneumatics sensors. Selection of sensors.

UNIT 3:

Actuation System- Overview of Mechanical actuations, pneumatics and hydraulic actuations system, electrical actuations system.

Microprocessor and Microcontrollers- concept, architecture and instruction sets. Difference between microcontroller and microprocessor.

Digital logic – Number system, logic gates, flip flops, multiplexers.

UNIT 4:

Programmable logic controller(PLC): introduction, architecture of PLC, fundamental of ladder programming, timers, internal relay and counters, shift registers, master jumps, selection of PLC. Ladder programming of two and three cylinders sequencing..

UNIT 5:

Micro-electro mechanical system (MEMS) – introduction, Basic block diagram, Materials used in MEMS, Micro sensors, Micro actuators. Application, Advantages.

Micro-fabrication techniques. Bulk Micro Machining, Surface Micromachining, and LIGA Process: Lithography, etching, Micro-joining etc.

Learning Outcome

Upon completion of this course, students will be able to:

CO1: Get an overview of mechatronics applications and the use of micro-sensors and microprocessors.

CO2: Understand the principle of automation with the help of electrical drives and actuators.

CO3: Understand the working and development of micro-sensors, actuators and their applications in various fields.

CO4: Understand the working and development of PLC and their industrial application.

Text book [TB]:

1. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall.Sixth Edition.2019
2. Tilak Thakur, Mechatronics, oxford higher education university press.2016.

Reference books [RB]

1. NItaigour premchand mahalik, Mechatronics principles. Concepts and applications.MeGrwa Hill Education pvt ltd. 2016
2. A Textbook of Mechatronics, R. K. Rajput, S. Chand & Company Private Limited 2010.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME344	Subject Title	Fuel Combustion And Environment (FCE)						
LTP	2 1 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To provide an overview of fuels and their distillation, imparting the knowledge about the kinetics of combustion etc.

Course Pre/Co- requisite (if any): Basic Thermodynamics

Detailed Syllabus

UNIT 1: SOLID FUELS

Solid Fuels: Wood charcoal, Origin of Coal-Composition of coal, properties of different grades of coal-preparation and storage of coal-coal washing – Briquetting, Detailed classification Conventional and Unconventional, Coal – Carburization, Gasification and liquefaction – Petroleum based fuels.

UNIT 2: LIQUID AND GASEOUS FUELS

Liquid coals: Origin of petroleum Fuels-Production –Composition-Petroleum, Alcohol shale oil, Synthetic fuels - Storage and handling of liquid fuels.

Classification of Gaseous fuels- Composition and Properties, Gas Calorimeter. Rich and Lean Gas - Wobbe Index - Natural Gas - Dry and Wet Natural Gas -Stripped NG - Foul and Sweet NG - LPG - LNG - CNG - Methane - Producer Gas -Gasifiers - Water Gas – Town Gas - Coal Gasification, Coal Gas – Blast Furnace Gas Alcohols and Biogas.

UNIT 3: COMBUSTION

Principles of combustion: Chemical composition – Flue gas analysis, dew point of products – Combustion stoichiometry, Chemical kinetics – Rate of reaction, Reaction order, First, second reactions, Complex reactions – chain reactions.

Thermodynamics of combustion: Enthalpy of formation – Heating value of fuel, Adiabatic flame Temperature, Flame stability, burning velocity of fuels – Measurement of burning velocity, factors affecting the burning velocity, Combustion of fuel.

UNIT 4: FUEL ANALYSIS

Characteristics of Fuels – Determination of Properties of Fuels - Fuels Analysis - Proximate and Ultimate Analysis - Moisture Determination – Calorific Value -Gross and Net Calorific Values - Calorimetry - DuLong's Formula for CV Estimation -Flue Gas Analysis - Orsat Apparatus - Fuel and Ash Storage and Handling – Spontaneous Ignition Temperatures.

UNIT 5:

Pulverized fuel furnaces-fixed, Entrained and Fluidized Bed Systems, Environmental considerations: Air pollution – Effects on Environment, Human Health etc., Principal pollutants and Methods of Emission control.

Learning Outcome

After completing this course, the students would be able to-

CO1: Understand about the origin and formation of different kind of fuels.
CO2: Understand the importance of different type of fuels available.
CO3: Come out with some basic understanding of flame and flame kinetics.
CO4: Differentiate among the various aspects of the fuel and fuel components.
CO5: Get the idea about the reduction of pollution using different methods

Text book [TB]:

1. Samir Sarkar, "Fuels and Combustion, Edition 3, Universal Press"2010
2. Obrert Edward, I.C Engines and Air pollution, Harper and Row publishers. 2000.

Reference books [RB]:

1. Blokh AG, Heat Transfer in Steam Boiler Furnace, Hemisphere Publishing, 2000.
2. NPTEL

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME345	Subject Title	Industrial Engineering & Management						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: This course introduces the students to have an overview of industrial engineering and management. Student will learn about production and its relation with productivity, selection of plant location and layout. Student will also learn about inspection, quality control and basics of managements.

Course Pre/Co- requisite (if any): Manufacturing Technology

Detailed Syllabus

UNIT 1: Production, Productivity and work study

Definition of production, Types of production systems, Definition of productivity, Application and advantages of productivity, Improvement tools, Reasons for increase and decreases in productivity.

Introduction of work study, Importance and advantages of work study, Work study procedure.

UNIT 2: Location Selection and Plant Layout

Nature of location decision, Importance of plant location, Dynamic nature of plant location, Choice of site for selection, State regulations on location, Government policies on decentralization, Industrial estates, Economic survey of site selection.

Principles of plant layout and its types, Factors affecting layout, Flow pattern and factors governing flow pattern, Travel chart, Analytical tools of plant layout.

UNIT 3: Production Planning and Control

Definition of production planning and control (P.P.C), Functions and objectives of P.P.C, Product design and development including standardization and simplification, Sales forecasting and its different techniques, Sequencing, Loading and scheduling, Techniques and their selection, Line of balance, Assembly line balancing, Dispatching, and Progress control.

UNIT 4: Inspection and Statistical Quality Control

Inspection– functions, Types, Objectives and benefits, Quality control– principles, Concepts of quality circles, Total quality management, Quality assurance, Quality audit, ISO, and Six sigma. SQC concept, Variable and attributes, Normal distribution curves and its property charts for variable and attributes and their applications and interpretation (analysis) process capability, Acceptance sampling, Sampling plans, OC curves and AOQ curves.

UNIT 5: Basics of Management

Definition of management, Functions of management– Planning, Organizing, Staffing, Directing, Co-ordination, Controlling, Motivating, Communication, Decision making. Principles of management, Administration and management, Nature of management, Levels of management, Managerial skills, Managerial roles, Styles of management. Forms of organization– Line, Staff, Line-staff, Forms of ownership – Partnership, Joint stock, Cooperative society, Govt. sector etc.

Learning Outcome

After completing this course, the students can:

CO1: Develop fundamental concepts of industrial engineering and management.

CO2: To familiarize the students with production, productivity and principles of work-study.

CO3: To enable the students understand the selection of plant location and layout.

CO4: To provide students an insight into the concepts of production planning and control.

CO5: To enable the students understand the inspection and statistical quality control.

Text book [TB]:

1. Riggs, “Production System, Planning, Analysis and Control”, Wiley, 3rd ed. 1991.

2. Mahajan, “Industrial Engineering and Production Management”, Dhanpat Rai & Co., 2005.
3. Martand Telsang, “Industrial Engineering and Production Management”, S Chand & company, 2nd ed. 2006.

Reference Books[RB]:

1. Banga and Sharma, “Industrial Engineering and Production Management”, Khanna publishers.
2. Shankar, “Industrial Engineering and Management”, Galgotia Publications Pvt. Ltd, 1st ed. 2000 (Reprint 2006).
3. Khanna, “Industrial Engineering and Management”, Dhanpat Rai Publications, 17th edition 2010.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME346	Subject Title	Turbomachines						
LTP	3 1 0	Credit	4	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To enable the students, know the operation of turbomachines for compressible and incompressible fluids. To introduce students to fans, turbines, pumps etc.

Course Pre/Co- requisite (if any): Fluid Mechanics and Fluid Machines

Detailed Syllabus

UNIT 1: Energy Transfer

Definition and classification of Turbomachines, Specific work - T-s and H -s diagram -Equation of energy transfer - Losses - Various efficiencies - Effect of reheat - Preheat.

Aero–Foil section - Cascading of compressor and Turbine blades - Energy Transfer in terms of lift and drag co-efficient for compressor and turbine blades - Variation of lift -Deflection and stagnation pressure loss with incidence.

UNIT 2: Fans, Blowers and Compressors

Centrifugal fans - Blowers and Compressors - construction details - Inducers - Backward and Radial blades - Diffuser - volute casing stage work - Stage pressure rise - Stage pressure co-efficient - Stage efficiency - Degree of reaction - Various slip factors H-S diagram for centrifugal compressor.

Axial flow Fans and Compressors - Stage velocity triangles - Blade loading and flow coefficient -Static pressure rise - H-S diagram - Degree of reaction - Work done factors -Free and Forced Vortex flow performance - Stalling and Surging.

UNIT 3: Steam and Gas Turbines

Axial turbine stages - Stage velocity triangle - Work - Single stage Impulse Turbine -Speed ratio maximum utilization factor - Multistage velocity compounded impulse - Multi stage pressure compounded impulse - reaction stages - Degree of reaction - Zero reaction stages - Fifty percent reaction stages - Hundred percent reaction - Negative reaction -Free and Forced vortex flow.

Inward flow radial turbine stages - IFR Turbine - T-s diagram - and degree of reaction -Steam turbine governing – Features of Steam turbine and Gas turbine.

UNIT 4: Hydraulic Pumps

Centrifugal pumps – Work done - Head developed - Pump output and Efficiencies -priming - minimum starting speed - performance of multistage pumps - Cavitation -methods of prevention - Pump characteristics.

Axial flow pumps – Characteristics - Constructional details - Non-dimensional parameters– Efficiencies - Vibration and Noise in hydraulic pumps.

UNIT 5:Hydraulic Turbines

Classification of hydraulic turbines - Pelton wheel - Francis turbine - Kaplan and Propeller turbines - Velocity triangles - Specific speed - Theory of draft tube - Governing- Performance characteristics - Selection of turbines.

Learning Outcome

At the end of the course the student can:

CO1: Have thorough understanding of velocity triangles, thermodynamic plots and losses in turbo-machinery.

CO2: Solve analytical problems in turbo-machines for both compressible and incompressible fluid flows

CO3: Demonstrate the knowledge of working, stages, performance characteristics, governing and selection of turbo-machinery.

Text book [TB]:

1. S.M. Yahya, (2002), Turbine, Fans and Compressors, TMH, 2002.
2. Douglas J.F., Gasiorek, J.M and Swaffield J.A. , Fluid Mechanics, Addison – Weisly.1999

Reference books [RB]:

1. Dixon, S.L, , 'Fluid Mechanics and Thermodynamics of Turbomachinery', Pergamon Publishers 1999
2. Kadambi and Prasad, (1997), Energy conversion Vol. III – Turbomachines, Wiley Eastern.
3. A.H. Church and Jagadish Lal, (2000), Centrifugal Pumps and Blowers; Metropolitan Book Co, Pvt. Ltd.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME347	Subject Title	Advanced Theory Of Machine						
LTP	3 1 0	Credit	4	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: This course will develop competency in understanding of theory of gears and gear train, applications of mechanisms and synthesis of the mechanism.

Course Pre/Co- requisite (if any): Theory of Machine

Detailed Syllabus

UNIT 1: Gears

Classification, Spur gear: definition, terminology, fundamentals, interference and under cutting, Force analysis and Friction in gears. Helical gears: nomenclature, center distance, virtual number of teeth. Spiral Gear terminology and Efficiency.

Bevel Gear & Worm and worm wheel: terminology, geometrical relationships, tooth forces, torque transmitted.

UNIT 2: Gear Trains

Components of EB billing, HT and LT supply, transformers, cable sizing; Concept of capacitors, power factor improvement, harmonics; Electric motors- motor efficiency computation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting.

UNIT 3: Cam and Follower

Types of cams and followers, analysis of standard motions to the follower, Determination of cam profiles for different follower motions, analysis of circular arc and tangent cams with flat face follower. Methods of control: pressure angle, radius of curvature and undercutting. Jump phenomenon of Eccentric cams.

UNIT 4: Study and Synthesis of Mechanisms

Steps in synthesis process: Type, number and dimensional synthesis. Tasks of Kinematic synthesis: Path, function and motion generation (Body guidance). Precision Positions, Chebychev spacing, Mechanical and structural errors. Graphical synthesis: Two and three position synthesis using relative pole method and inversion method for single slider crank and four bar mechanism. Freudenstein's equation for four bar Mechanism, Three position function generation using the equation. Straight line mechanisms. Indicator mechanisms

Learning Outcome

After completing this course, the student will be able to:

CO1: Understand the gear theory that will be the prerequisite for gear and gear box design.

CO2: Analyze synthesis and working principle of various mechanisms.

CO3: Understand design of mechanism and cam profile.

Text book [TB]:

1. S.S.Ratan, Theory of Machines, Third Edition, McGraw Hill Education (India) Pvt. Ltd. New Delhi.2017
2. Beven T, Theory of Machines, Third Edition, Longman Publication. 2009

Reference books:

1. A.G. Ambekar, Mechanism and Machine Theory, PHI Learning Pvt. Ltd., 19-Jul-2007
2. N.K. Meheta, Machine Tool Design, Tata McGraw Hill Publication, 1984
3. J.J.Uicker, G.R.Pennock, J.E.Shigley, Theory of Machines and Mechanisms, Third Edition, International Student Edition, OXFORD.2006

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME348	Subject Title	Advanced Design Of Machine Elements						
LTP	3 1 0	Credit	4	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: This course introduces the students to have an overview of design methodologies employed for design of various machine components. Student will also learn to appreciate nature and applicability of empirical design principles, based on tests and safety considerations

Course Pre/Co- requisite (if any): Design of Machine Elements

Detailed Syllabus

UNIT 1:

Helical Gear: Terminology, Proportions, Beam strength and wear strength of helical gear, herringbone gear, crossed helical gear, Design of helical gears.

Bevel Gear: Terminology, Proportions, Beam strength and wear strength of Bevel Gear, Design of Bevel Gear.

Worm Gear: Types of worm, Terminology, Gear tooth proportions, Efficiency of worm gear, Heat dissipation in worm gearing, Strength and wear tooth load for worm gear, Design of worm gear.

UNIT 2:

Multi speed Gearbox: Introduction, Drawing & Design Procedure of Spur & Helical gear boxes (2-Stage).

Introduction to Commercial gearbox, Bevel gear box, Worm gear box and other Automobile Gear Boxes.

UNIT 3:

Sliding Contact Bearing Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants, Hydrodynamic journal bearing, Heat generation, Design of journal bearing, Thrust bearing-pivot and collar bearing, Hydrodynamic thrust bearing, Hydrostatic Journal Bearing.

UNIT 4:

Brakes: Types of Brakes, Design of Shoe Brake, Design of Disc Brake.

Clutches: Introduction of Clutch, Types of Clutch, Design Consideration-Uniform pressure and Uniform wear Theory, Torque and Power rating.

UNIT 5:

Belt Drives: Introduction, Types of Belt Drives, Slip, Law of Belting, Belt Joints, Analysis of Open belt and Cross belt, Condition for Maximum Power.

V-Belts- Tension Relation, Selection of V-Belts.

Chain Drives: Types of Chain drives, chain drive geometry, Design of Chains, Polygon effect, Power rating.

Learning Outcome

After completing this course, the students can:

CO1:Develop fundamental understanding of Machine Design in an engineering perspective and know how to integrate it with other subjects in engineering practice.

CO2:Know how to analyze, evaluate and recommend materials on the basis of given problem statement.

CO3:Understand the influence of manufacturing processes in the design of machine elements

CO4:Understand safety, reliability concepts in design of machine elements in static & dynamic Loading conditions

CO5:Develop ability to analyze, M/c Elements, Gears, Springs, Bolted & Riveted Joints, Bearings.

Text book [TB]:

1. Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill Intern; 2011.
2. V. B. Bhandari, Design of Machine Elements, McGraw-Hill, Inc., 2005.

Reference books [RB]:

1. Kamaraju Ramakrishna, Design of Machine Element, Oxford University Press, 2017
2. Spotts, Design of Machine Elements, Pearson Education India, 2004.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME349	Subject Title	Automotive Electrical & Electronics						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: This course provides an understanding of application of electrical and electronic system in automobile vehicle.

Course Pre/Co- requisite (if any): Basic Automobile Engineering

Detailed Syllabus

UNIT 1: Batteries and Accessories

Principle and construction of lead acid battery, characteristics of battery, rating capacity and efficiency of batteries, various tests on batteries, maintenance and charging. Lighting system: insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods – Horn, wiper system and trafficar.

UNIT 2: Starting and Charging System

Starting System: Condition at starting, behavior of starter during starting, series motor and its characteristics, principle and construction of starter motor, working of different starter drive units, Starter motor requirements, care and maintenances of starter motor, Drive mechanisms, starter switches.

Charging System: Generation of direct current, shunt generator characteristics, armature reaction, third brush regulation, cut out. Voltage and current regulators, compensated voltage regulator, alternators principle and constructional aspects and bridge rectifiers, new developments

UNIT 3: Fundamentals of Automotive Electronics

Current trends in automotive electronic engine management system, electromagnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, on board diagnostic system, security and warning system.

UNIT 4: Sensors and Actuators

Types of sensors: sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors, relay.

UNIT 5:Safety and Security Systems

Keyless entry system, Antilock braking system, Air bag restraint system, Adaptive cruise control system, Voice warning system, Seat belt system, antitheft system.

Learning Outcome

At the end of the course the student can:

CO1: Understand the basic auto electrical systems.

CO2: Understand the layout of wiring and connections of electrical systems in automobiles.

CO3: Understand the working of different electrical components used in automobiles.

Text book [TB]:

1. Bechhold “Understanding Automotive Electronics”, SAE, 1998.
2. Kholi.P.L. “Automotive Electrical Equipment”, Tata McGraw-Hill Co., Ltd., New Delhi, 1975.

Reference books [RB]:

1. Crouse, W.H. “Automobile Electrical Equipment”, McGraw-Hill Book Co., Inc., New York, 3rd edition, 1986.
2. Robert Bosch “Automotive Hand Book”, SAE (5th Edition), 2000.
3. Willium B. Ribbens, Understanding Automotive Electronics, Willium B. Ribbens,-Sixth edition Elsevier Science 2003

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME350	Subject Title	Operations Research						
LTP	3 1 0	Credit	4	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To provide students the knowledge of optimization techniques and approaches about networking, inventory, queuing, decision and replacement models.

Course Pre/Co- requisite (if any): Manufacturing Technology

Detailed Syllabus

UNIT 1: Linear Models

Introduction to Operations Research – Linear Programming - Mathematical Formulation –Graphical method – Simplex method – Duality – Two – Phase Simplex method –Transportation problems – Northwest Corner method – Vogel's Approximation method –MODI method – Assignment problems – Applications.

UNIT 2: Sequencing and Networks

Sequencing –Problem with N jobs and 2 machines - 3 machines and 'M' machines. Network models – Basic Concepts – Construction of Networks – Project Network – CPM and PERT - Critical Path Scheduling – Crashing of Network.

UNIT 3: Inventory Models

Inventory models – Various Costs and Concepts–EOQ–Deterministic inventory models –Production models – Stochastic Inventory models – Buffer stock

UNIT 4: Queuing Models

Queuing models – Poisson arrivals and Exponential service times – Single channel models and Multi-channel models.

UNIT 5: Decision Models

Decision models – Game theory – Two-person zero sum game – Graphic solution - Property of dominance – Algebraic solution

Learning Outcome

At the end of the course the student can:

CO1:Apply operations research techniques like L.P.P, scheduling and sequencing in industrial optimization problems.

CO2:Solve transportation problems using various OR methods and illustrate the use of OR tools in a wide range of applications in industries.

CO3:Analyze various OR models like Inventory, Queing, Replacement, Simulation, Decision etc and apply them for optimization.

Text book [TB]:

1. Hira D S and Gupta P K, (2007), Operations Research, S.Chand & Sons.
2. Hamdy Taha, (2009), Operations Research: An Introduction, Pearson Education Inc.

References [RB]:

1. Panneerselvan. R. (2006), Operation Research, Prentice Hall of India Pvt Ltd
2. Kanti Swarup, Gupta P.K., and Manmohan, (2004), Operations Research, S.Chand & sons.
3. P.Chattopadhyay Boiler Operation Engineering: Questions and Answers 3rd Edition Tata McGraw Hill.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Humanities Electives II

Subject Code	HS384	Subject Title	Principles of Management						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	III	Semester	V

Course Objective

- The objective of this course is to familiarize B.Tech. Students with the roles, responsibilities, and skills required of modern managers.
- This course will be present the concepts of management as it applies to current thinking in the workplace.

Unit 1 Overview of management **5 Hrs.**

Definition-Management-Role of managers-Organization and the internal and environmental factors –Trends and Challenges of Management in India.
Directing – delegation –span of control– communication, Controlling

Unit 2 Management Information **4 Hrs.**

Introduction to functional areas of management, Operations management, Human resources management, Marketing management, Financial management

Unit 3 Planning Approach to Organizational Analysis **10 Hrs.**

Design of organization structure; job design and enrichment; job evaluation and merit rating

Unit 4 Motivation and Productivity **7 Hrs.**

Theories of motivation, Leadership styles and Managerial grid. Co-ordination, monitoring and control in organizations. Techniques of control; Few Cases on current management issues in India

COURSE OUTCOME:

- To present the topics in management, management theories, while at the same time focusing on practical applications in the real world especially for engineers.
- Evaluate the global context for taking managerial actions of planning, organizing and controlling.
- Assess global situation, including opportunities and threats that will impact management of an organization.
- Integrate management principles into management practices.

TEXT BOOKS:

1. Schermerhorn, Management and Organisational Behaviour essentials, Wiley India
2. Koontz: Essentials of Management, PHI Learning.
3. Hirschey: Managerial Economics, Cengage Learning.
4. A V Rau: Management Science, BSP, Hyderabad
5. Mote, l Paul and Gupta: Managerial Economics Concepts & Cases, TMH, New Delhi.
6. Stephan R Robbins Fundamental of Management, Pearson

REFERENCE BOOKS

- Koontz, H., and Weihrich, H., Essentials of Management: An International Perspective, 8th ed., McGraw Hill, 2009.
- Hicks, Management: Concepts and Applications, Cengage Learning, 2007.
- Mahadevan, B., Operations Management, Theory and Practice, Pearson Education Asia, 2009
- Kotler, P., Keller, K.L, Koshy, A., and Jha, M., Marketing Management, 13th ed., 2009.
- Khan, M.Y., and Jain, P.K., Financial Management, Tata-Mcgraw Hill, 2008.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Humanities Electives II

Subject Code	HS391	Subject Title	Positive Psychology & Living						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	III	Semester	V

Course Objective

- To increase awareness for relevance of positive emotions at workplace.
- To equip students with psychological skills to maximize happiness and virtues like compassion, love and wisdom through experiential, workshop based and interactive activities along with assigned lectures and reading

Unit 1 What is positive psychology? 7Hrs.

Introducing Positive Psychology: Definition, goals, assumptions, key concepts and relationships with health psychology, developmental psychology, social psychology and psychology of religion, Meaning and measure of Happiness: Hedonic and Eudemonic perspective, Yogic notion of bliss

Unit 2 Positive Emotions, Cognitive states and Well-being 9Hrs.

What are positive emotions? The broaden and build theory, relevance of positive emotional states for physical, social & psychological resources, Positive emotions and well-being: Happiness and positive behavior, positive emotions and success, resilience, Self-efficacy, Optimism, Hope, Wisdom, Mindfulness and flourishing

Unit 3 How to enhance well-being? 5Hrs.

Use of postures, breathing practices, Sounds, dietary consumption

Unit 4 Positive Psychology at work place 5Hrs.

Maximizing achievement, conflict resolution, gratitude, positive leadership

COURSE OUTCOME:

- Students learn about modern psychological knowledge of happiness.
- Students acquire skills to cultivate positive emotions.
- Measure and build individual, workplace and educational flourishing; plan, implement and assess positive psychology.
- Students will gain an understanding of what contributes to well-being and how to build the enabling conditions of a life worth living.

TEXT BOOK:

Snyder (2011). Positive Psychology: The Scientific and Practical Explorations of Human Strengths. New Delhi: Sage.

REFERENCE BOOKS:

1. Carr, A. (2004). Positive Psychology: The science of happiness and human strength.UK: Routledge.
2. Peterson, C. (2006). A Primer in Positive Psychology. New York: Oxford University Press.
3. Seligman, M.E.P. (2002). Authentic Happiness: Using the New Positive Psychology to Realize YourPotential for Lasting Fulfillment. New York: Free Press/Simon and Schuster.
4. Snyder, C.R., &Lopez,S.J.(2007). Positive psychology: The scientific and practical explorations of human strengths. Thousand Oaks, CA: Sage.
5. Snyder, C. R., & Lopez, S. (Eds.). (2002). Handbook of positive psychology. New York: Oxford University Press.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Humanities Electives II

Subject Code	HS385	Subject Title	Engineering Economics						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	III	Semester	V

Course Objective:

- To provide the basic overview of economics in engineering perspectives.
- To increase the understanding of students to solve the engineering problems through economic theories.
- To increase the understanding of students to use economics theories in project investment of industries

Unit 1 General Overview of Economics 6Hrs.

Nature and Scope of Economics in engineering perspective; **Theory of Demand Analysis:** Meaning and Types, Law of demand, Exceptions to the Law of Demand, Elasticity of Demand; **Theory of Supply Analysis:** Law of Supply and Elasticity of Supply; Mathematical Explanation on cost, revenue and profit function

Unit 2 Production Function and Its Applications 6Hrs.

Production Function: Short-run and long-run Production Function; **Mathematical Explanation:** Laws of Returns to Scale & Law of Diminishing Returns Scale; **Concept of Cost and Its Types:** Total cost, fixed cost, variable cost, average variable cost, average fixed cost, marginal cost, explicit and implicit cost; **Break-Even-Analysis:** Importance and graphical presentation, mathematical problems

Unit 3 Time Value of Money and Project Evaluation 8Hrs.

Time Value of Money: Simple and Compound, Uniform Series Compound Interest Formula, Present Worth Analysis, Future Worth Analysis, Future Value through Annuity, Rate of Return Analysis, Cash flow diagrams; **Depreciation**: Introduction, Straight Line and Declining Balance Method of Depreciation; **Project Evaluation Techniques:** Present Worth Method, Future Worth Method, Annual Worth Method; Benefit Cost Analysis: Conventional and Modified B/C Ratio with PW method

Unit 4 Banking and Finance 6 Hrs.

Banking Sector: Functions of the Commercial Bank and Central Bank, Financial Institutions; **Financial Market:** Money Market and Capital Market; **Monetary and Fiscal Policy:** Objectives, Instruments, Tools in Indian Economy; **Inflation:**Causes, Effects and Methods to Control it, Measurement of Inflation- Consumer Price Index and Whole Price Index; Deflation and Stagflation; **Business Cycles:** Various phases, Control and Measurement, Impact on business cycles on economic activities

COURSE OUTCOME

- Students will be able to apply economic principles and calculations to solve engineering projects.
- To students will be efficient to get the idea of production activities and its applications in industries.
- Students will be competent to estimate the present and future value of money on their various investment plans.
- Develop the ability to account for time value of money using engineering economy factors and formulas, as well as the implications and importance of considering taxes, depreciation, and inflation.

TEXT BOOKS TEXT BOOKS

1. Pravin Kumar (2015). Fundamental of Engineering Economics. Raj Kamal Press, New Delhi.
2. Riggs J.L., Dedworth, Bedworth D.B., and Randhawa, S.U. (1996). Engineering Economics. McGraw Hill International, New Delhi
3. PanneerSelvam R. (2001). Engineering Economics. Prentice Hall of India Ltd, New Delhi.

REFERENCE BOOK

- L.M. Bhole (2007). Financial Institutions and Markets. Tata McGraw Hill, New Delhi.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Humanities Electives II

Subject Code	HS382	Subject Title	Literature, Language & Society						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	III	Semester	V

Course Objective

- The focus of the programme is on the interaction between literature & Society, and Literature and visual culture
- To discuss how Literature reacts to major changes in society

Unit 1 **4Hrs.**

Nature and Functions of Literature, Literature and Society with special reference to Indian Literature and Indian Society, Literary Forms, Poetry, Drama, Fiction, Essay, Autobiography

Unit 2 **7Hrs.**

Approaches to the Study of Literature, Reader response to the study of Literature, Interpretation, Appreciation, Evaluation, Special problems in understanding Modern Literature.

Unit 3 **9Hrs.**

Social dimension of language. problems of multilingual communities, dominance and conflict, shift and attrition, language and the state, language and nation, Indian multilingualism, language variation, language and identity, linguistic prejudice and inequality, standardization, linguistic determinism, critical discourse analysis, and methodological issues.

Unit 4 TEXT **6 Hrs.**

Jerome K Jerome: Three Men on a Bummel (selection), Martin Amis: Last Days of Muhammad Atta, Li Ho: A Girl Comb her hair, R.K. Narayan: Malgudi Days (selection)

COURSE OUTCOME

- Students will read critically from a variety of genres, specifically poetry, drama, non fiction, and fiction.
- Students will read literature more carefully and meaningfully, practicing close-reading skills.
- Students will understand the relation between historical and cultural contexts.
- The students will develop a critical understanding of how literature can both uphold and resist existing structures of power.

TEXT BOOKS

1. Jerome K Jerome: Three Men on a Bummel (selection), Arrow smith Publications
2. R.K. Narayan: Malgudi Days (selection), I*ndian Thought Publications*

REFERENCE BOOKS

- Martin Montgomery, An Introduction to Language and Society (Studies in Culture and Communication)Routledge; 2 edition (December 22, 1995)
- Robe Pope, *An Introduction to Language Literature and Culture*.Routledge, 2005

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	HS301	Subject Title	APTITUDE & SOFT SKILLS III					
LTP	3 0 0	Credit	0	Subject Category	AC	Year	III	Semester	V

Course Outline: The first step of an intensive two step placement training module equips the students to successfully handle the placement program of any on-campus/off-campus company. It not only provides career guidance about the selection process but also helps students in profile building; self-introduction and proactive internship search techniques.

Course Objective:

1. Interpret the questions of aptitude building objectively and prepare for various competitive examinations
2. Understand the optimized approach of dealing with placement questions
3. Learn ways of representing themselves effectively in formal settings

Course Pre / Co-requisite (if any): Understanding of writing concepts, general intelligence of LR, algebra concepts and equation formation, time management and presentation skills covered in Aptitude and Soft Skills I and II.

Detailed Syllabus

UNIT 1 - QUANTITATIVE APTITUDE **11 HOURS**

Number System **03 hours**

Types of numbers; Factors; Divisibility test; Place and face Value; Base system; Remainder theorem; digits at the unit places and finding last two digits in a given expression; Calculating number of zeroes, Finding maximum power of any prime number or any composite number in any factorial, HCF and LCM.

Fractions–Types of fractions; Conversion of terminating and non-terminating types of decimal into fraction; Subtraction, addition and multiplication of terminating and non-terminating decimals.

Percentage **02 hours**

Basic concepts; Conversion from fraction to percentage; Application of percentage in – Expenditure, Cost, Consumption problems; Population increase or decrease problems; Production, Manpower and Working hour problems; successive increment or decrement; Comparison of salary or numbers; Percentage change in area or volume, etc.

Ratio and Proportion **02 hours**

Ratio, Proportion and Variation:Ratio- Introduction; Types of ratios; Comparison of Ratios; Concept of duplicate, triplicate, sub-duplicate and sub-triplicate ratios.

Proportion and variation – Concept of direct, inverse, continuous and mean proportions.

Profit and Loss **02 hours**

Introduction; Concept of single, double and triple discount and marked price.

Simple / Compound Interest **02 hours**

Simple Interest and compound Interest: Basic concept of Principal, Time, Amount and Rate of Interest; Concept of Lent money.

UNIT 2- VERBAL APTITUDE **09 HOURS**

Tenses **02 hours**

Understanding and aligning them with the various question types.

Subject – Verb Agreement **02 hours**

Subject-Verb Agreement: Rules and Applications; commonly confused words-II; Gerunds, Active and Passive voice.

Question Types **03 hours** Introduction to Question types-I: Fill in the blanks, One word Substitution, Spellings, understanding the right word choice, concept of para jumbles and para completion, reading comprehension, verbal analogies, odd man out, phrases and idioms.

Introduction to Question types-II: Error identification, Homophones, Usage of the various figures of speech, commonly confused words and phrases, techniques for tackling synonyms and antonyms.

Reading Comprehensions **02 hours** Reading Comprehension: Basics of Comprehensions, different tones of comprehensions, cracking question types like contextual vocabulary, fill in the blanks, true/false questions, reference to context, summary and title of the passage, paraphrasing the text.

UNIT 3- LOGICAL REASONING **10 HOURS**

Coding Decoding and Sequences **02 hours**
Coding Decoding, Cryptarithmetic, Sequence and Series - Finding the missing term/wrong term in the logical sequence of letter/number/word/alphanumeric, Continuous pattern series.

Verbal Analogies and Odd man out **02 hours**
Verbal Analogy based on various parameters - Antonym / synonym relationship, Quantity and unit, Individual and Group, Product and Raw material, cause and Effect etc.
Odd man out based on several kind of relationship – Relationship based on meaning, functional relationship, even- odd or prime-composite, divisibility rule, etc.

Blood Relation and Direction Sense **02 hours** Blood Relation- Indicating form / puzzle form / coding form, Direction Sense, Direction puzzles.

Seating Arrangements **02 hours** Seating Arrangements – Linear / Circular / Distribution / comparison/ Floor and box arrangement /Quant based arrangements/ etc.

Critical Reasoning– I **02 hours**
Statement and assumptions, course of action, statement and conclusion, probably true/false.

UNIT 4- NON VERBAL COMMUNICATION **04 HOURS**

Types of Non Verbal Communication, Body Language-Exercises and Activities, Error Analysis & Feedback Sharing.
Suggested Activities & Exercises: (i) Communication Origami, (ii) Power of body language, (iii) Draw it.

UNIT 5- ONLINE PROFILING & SOCIAL MEDIA ETHICS **05 HOURS**

Social Media ethics and etiquette, Do's & Don'ts, LinkedIn Profile Development, Example Sharing, Feedback Sharing & Error Analysis.
Suggested Activities & Exercises: (i) Online Portfolio Creation, (ii) Fun Social Media Projects,
(iii) LinkedIn profile development project with feedback sharing and error analysis

LEARNING OUTCOME:

By the end of this semester, students will be able to perceive and analyse the requirements of placement trends as detailed information about the selection process would be provided by career guidance. They will be more confident and will be able to develop a professional profile, both online and offline.

Text book [TB]:

5. Quantitative Ability:How to prepare for Quantitative Aptitude, Arun Sharma, McGraw Hill, 8th edition-2018.
6. Logical Reasoning**:** A Modern Approach to Logical Reasoning-R.S. Aggarwal S Chand Publishing; 2nd Colour edition-2018.
7. Verbal Aptitude: English is Easy- Chetanand Singh, BSC Publication-2018.
8. Soft Skills: The Definitive Book of Body Language by Barbara and Allan Pease; RHUS; 1 edition-2006.

Reference books [RB]:

5. QA :Quantitative Aptitude for Competitive Examinations- R.S. Agarwal S. Chand Publications-2017.
   QA: Quantitative Aptitude- Saurabh Rawat and Anushree Sah Rawat, Savera Publishing House, 1st Edition-2016.
6. LR: Logical Reasoning and Data Interpretation for the CAT - Nishit K Sinha, Pearson India; 5th edition-2016.
   LR: Wiley's Verbal Ability and Reasoning - P A ANAND,Wiley-2016.
7. VA : Oxford Guide to English Grammar- John Eastwood, Oxford University Press-2003.
   VA: Fun with grammar- Suzanne W. Woodward Pearson Education ESL-1996
8. Soft Skills :How to Talk to Anyone by Leil Lowndes Harper Element; New edition-2015.
   Soft Skills: Crucial Conversations: Tools for Talking When Stakes Are High by Kerry Patterson, Joseph Grenny, Ron McMillan, and Al Switzler; Brilliance Audio; Abridged, Updated edition-2013.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME305	Subject Title	Applied Thermodynamics-II						
LTP	3 1 2	Credit	5	Subject Category	DC	Year	3rd	Semester	VI

Course Outline:

Course Objective: -

- To impart the theory and practical knowledge of SI and CI Engines.
- To impart the fundamental knowledge of Refrigeration and Air-conditioning systems and their practical applications.

Course Pre/Co- requisite (if any): Applied Thermodynamics I

Detailed Syllabus

UNIT 1: S.I. Engines

Introduction to I.C Engines, classification, fuels, important qualities, and rating of SI engine fuels, Carburetion, Mixture requirements, Carburetor- types, theory of carburetor, MPFI, Combustion in SI engine, Flame speed, Ignition delay, abnormal combustion and it's control. Ignition systems, Ignition timing, and spark plug.

UNIT 2: C.I. Engines

Important qualities of CI engine fuels, fuel injection, types of injection systems, Fuel pumps, Fuel injectors, Injection timings, Combustion in CI engines, Ignition delay, Knock and its control, Scavenging in 2 Stroke engines.
Testing and Performance: Performance parameters, Basic measurements, Testing of SI and CI engines, Heat balance sheet.

UNIT 3: Air Refrigeration Systems

Introduction, Principles, and methods of refrigeration, reverse Carnot cycle, unit of refrigeration, coefficient of performance (COP), Air refrigeration system: Classification, Bell Coleman cycle, Open and closed air refrigeration cycles, Simple, Boot-strap, reduced ambient and regenerative cooling systems, Dry air rated temperature (D.A.R.T).
Refrigerants: classification and desirable properties.

UNIT 4: Vapour Compression and Vapour Absorption Refrigeration System

Vapour compression cycle, p-h and T-s diagrams, deviations from theoretical cycle, Effects of sub-cooling and superheating, condenser and evaporator pressure on system performance, Multi-stage Vapour compression system, Removal of flash gas, multiple expansion and compression with flash inter cooling. Vapour absorption system: aqua-ammonia and Lithium bromide absorption systems.

UNIT 5: Psychrometry and Air-conditioning

Psychrometry: Psychrometric properties and their definitions, psychrometric processes, sensible heat factor (SHF), apparatus dew point (ADP), bypass factor of coil, Air washer, cooling tower.
Air-conditioning: Requirements of comfort air conditioning, human comfort, Sensible and Latent heat loads; estimation of cooling load of air-conditioning apparatus.

Learning Outcome

At the end of the course the student can:
CO1:To understand the S.I. Engines construction and working.
CO2:To understand the C.I. Engines construction, working, and performance of IC Engines.
CO3:To understand the working of Air refrigeration systems.
CO4:To understand the working of Vapour compression and Vapour absorption refrigeration systems.
CO5:To understand the working and design of Air-conditioning systems.

Text book [TB]:

1. Ganesan V., "Internal Combustion Engines," McGraw-Hill Education (India) Private Limited, 4th Edition, 2012.
2. Arora, C.P., "Refrigeration & Air-Conditioning," McGraw-Hill Education (India) Private Limited, 3rd Edition, 2008.

Reference books [RB]:

1. Mathur M.L. and Sharma R.P.," A Course in International Combustion Engines," Dhanpat Rai & Sons, 2014.
2. Colin R. Ferguson, Allan Thomson Kirkpatrick, "Internal combustion engines: Applied Thermosciences" John Wiley & Sons, 2nd edition, 2000.
3. Arora, S.C. and Domkundwar, S. "Refrigeration & Air-Conditioning," Dhanpat Rai & Co. (P) Ltd., 2013.
4. Roy J. Dossat. "Refrigeration & Air-Conditioning," Pearson Education India, 4th edition, 2002.
5. Stoecker, W., Jones, J., "Refrigeration & Air-Conditioning," McGraw-Hill Education, 2nd edition, 1983.
6. ASHRAE Handbook, 2018.

List of Experiments:

1. Performance Analysis of Four stroke S.I. Engine and determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
2. Determination of Indicated H.P. of I.C. Engine by Morse Test.
3. Performance Analysis of Four stroke C.I. Engine and determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
4. Experiment on single stage vapour compression refrigeration test ring and calculation of various performance parameters.
5. Experiment on two stage vapour compression refrigeration test ring and calculation of various performance parameters.
6. Experiment on air-conditioning test rig and calculation of various performance parameters.
7. Experiment on cooling tower and calculation of various performance parameters.
8. Study of different components of vapour compression refrigeration system.
9. Visit of a central air conditioning plant.
10. Visit of cold storage plant.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME351	Subject Title	Design Of Heat Exchangers						
LTP	3 1 0	Credit	4	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To impart knowledge of various types of heat exchangers, their construction, design and performance behavior.

Course Pre/Co- requisite (if any): Heat Transfer

Detailed Syllabus

UNIT 1: Basic Design Methods of Heat Exchangers

Introduction, Arrangement of Flow Path in Heat Exchangers, Basic Equations in Design, Overall Heat Transfer Coefficient, LMTD Method for Heat Exchanger Analysis, Parallel and Counter Flow Heat Exchanges, Multipass and Cross Flow Heat Exchangers, The ε-NTU Method for Heat Exchanger Analysis, Heat Exchangers Design Calculations and Methodology.

UNIT 2: Forced Convection Correlations for the Single Phase Heat Exchangers

Hydrodynamically Developed and Thermally Developing Laminar Flow in Smooth Ducts, Annular, Turbulent Forced Convection, Turbulent Flow in Smooth Ducts, Heat Transfer from Smooth-Tube Bundles, Heat Transfer in Helical Coils and Spirals, Nusselt Numbers of Helical and Spiral Coils, Heat Transfer in 90° and 180° Bends.

UNIT 3: Pressure Drop and Fouling Factor in Heat Exchanger

Tube-Side Pressure Drop in Circular and non-circular Cross Sectional Tubes, Pressure Drop in Tube Bundles in Cross flow, Pressure Drop in Helical and Spiral Coils, Heat Transfer and Pumping Power Relationship.

Effect of Fouling on Heat Transfer, Effect of Fouling on Pressure Drop, Categories of fouling, Design of Heat Exchangers Subject to Fouling, Fouling Resistance, Cleanliness Factor.

UNIT 4: Double Pipe Heat Exchangers and Shell-and-Tube Heat Exchangers

Double-Pipe Heat Exchangers: Thermal and Hydraulic Design of Annulus and Tubes, Finned inner tubes.

Shell-and-Tube Heat Exchangers: Baffle Type and Geometry, Shell-Side Heat Transfer and Pressure Drop, Shell-Side Heat Transfer Coefficient, Shell-Side Pressure Drop, Tube-Side Pressure Drop

UNIT 5: Design of Phase Change and Compact Heat Exchangers.

Shell and Tube Condenser, Evaporators for Refrigeration and Air-Conditioning, Steam Turbine Exhaust Condenser, Air-Cooled Condensers.

Compact Heat Exchanger; Heat Transfer and Pressure Drop, Heat Transfer Enhancement, Plate-Fin and Tube-Fin Heat Exchangers. Performance evaluation.

Learning Outcome

At the end of the course the student can:

CO1: Understand the basic design methods for sizing and rating heat exchangers.

CO2: Understand able to apply single phase forced convection correlations in designing of heat exchangers.

CO3: Understand able to apply concept of pumping power and fouling factor in designing of heat exchangers

CO4: Understand and able to design double pipe and shell & tube heat exchangers.

CO5: Able to design phase change and compact heat exchangers and also understand its performance evaluation.

Text book [TB]:

1. Kakac, S. and Liu H. “Heat Exchangers: Selection, Rating and Thermal Design”, CRC Press, 2nd edition, 2002
2. Arthur P. Fraas ,Heat Exchanger Design,John Wiley & Sons, 20-Mar-1989

REFERENCES [RB]:

1. Shah, R. K. and Sekulic, D. P., “Fundamentals of Heat Exchanger Design”, John Wiley & Sons, Inc., 2003.
2. Webb, R.L., and Kim, N.H., “Principles of Enhanced Heat Transfer”, Taylor and Francis, 2005.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME352	Subject Title	Tribology						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective:

- To know about properties of lubricants, modes of lubrication, additives etc.
- To select suitable/proper grade lubricant for specific application.
- To select suitable material combination for tribological contact.
- To apply the basic theories of friction, wear and lubrications about frictional behavior commonly encountered sliding surfaces.

Course Pre/Co- requisite (if any): Fluid Mechanics and Fluid Machines, Design of Machine Elements

Detailed Syllabus

UNIT 1: Introduction

Tribology definition. Tribology in design- bearing material its properties and construction Tribological charecteristics of oil seals and gasket. Tribology in industry (Maintenance).

Lubrication-Definition, basic modes of lubrication, properties of lubricants, additives, EP lubricants, Recycling of used oil, oil conservation. Bearing Terminology-Types of Sliding contact, rolling contact bearings. Comparison between sliding and rolling contact bearing. (Theoretical treatment only).

UNIT 2: Friction and wear

Introduction, laws of friction, Friction classification, causes of friction. Theories of dry friction. Friction measurement. Stick-slip motion and friction instabilities.

Wear-classification, wear between solids, wear between solid and liquids, factors affecting wear. Theories of wear. Wear measurement. Controlling friction.

UNIT 3: Hydrodynamic lubrication

Theory of hydrodynamic lubrication, mechanism of pressure development in oil film. Two dimensional Reynold's equation and its limitations, Petroff`s equation. Designing journal Bearing. Hydrodynamic thrust bearing-Introduction, types. Flat plate thrust bearing-Pressure equation, load, centre of pressure.

UNIT 4: Hydrostatic lubrication and Gas (Air) lubrication

Hydrostatic lubrication-Basic concept, advantages, limitations, viscous flow, load carrying capacity, flow requirement of hydrostatic step bearing, energy losses, design concepts of stepped bearing. Squeeze film lubrication- Basic concept, circular and rectangular plate approaching a plane.

Gas(air) lubricated bearings-Introduction, advantages, disadvantages, applications of tilting pad bearing, hydrostatic and hydrodynamic bearing with air lubrication.

UNIT 5: Tribological Aspects

Lubrication in rolling, forging, drawing and extrusion. Theory of tyre road interaction, road grip. Surface engineering for wear and corrosion resistance-diffusion, plating and coating methods.

Learning Outcome:

CO1: Student develops confidence in him/her to fulfill course objectives.

CO2: Term work includes simple case study/assignment/seminar/visit and in-semester theory examination as a part of learning process encourages students.

CO3:He/she proves himself/herself to be excellent practical engineer in any tribological industry.

Text book [TB]:

1. Bharat Bhushan, — Principles and Applications of Tribology, 2nd Edition, Wiley India 2006.
2. Halling J., —Principles of Tribology‖, McMillan Press Ltd.2010

References [RB]:

1. Cameron A., —Basic Lubrication Theory‖, Wiley Eastern Ltd.2012
2. Mujumdar B. C., —Introduction to Tribology and Bearings‖, S. Chand and Company Ltd. New Delhi.2010
3. Fuller D. D., —Theory and Practice of Lubrication for Engineers‖, John Wiley and Sons.2016
4. Bhushan B. and Gupta B. K., — Handbook of Tribology: Material, Coatings and SurfaceTreatments‖, McGraw Hill Ltd.2015
5. Davis J., —Surface engineering for Corrosion and Wear Resistance‖, Woodhead Publishing, 2001.
6. Tadausz Burakowski, —Surface Engineering of Metals: Principles, Equipments andTechnologies‖, Taylor and Francis.2010

List of Experiments:

1. Experiment to study the pressure distribution in a journal bearing setup.
2. Experiment for Viscosity measurements of lubricating oil and other parameters.
3. Experiment for Topography of engineering surfaces and its description using optical methods.
4. Experiment for Wear measurements using Tribometer.
5. Measurement of surface roughness.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME353	Subject Title	Vehicle Maintenance						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To make the student understand the need for vehicle maintenance and its importance and to familiarize the maintenance procedure for various components of an automobile.

Course Pre/Co- requisite (if any): Basic Automobile Engineering

Detailed Syllabus

UNIT 1: Inspection Schedule and Maintenance of Records

Need for maintenance, types of maintenance: preventive and breakdown maintenance, requirements of maintenance, preparation of check lists. Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance: General safety, tool safety.

UNIT 2: Vehicle Maintenance Tools and Equipments

Figs and Specifications of standard tools; non Standard tools; denting tools; painting equipment; testing equipment; Service station equipment; Hydraulic lift; Tyre changer; Tyre inflation gauge; Car Washer; Air Compressor; Spark Plug Cleaner and Tester; brake and transmission bleeding equipment; Grease Guns;
Hydraulic Hoist; Analyzers: CO; HC; NOx; smoke meter: Engine analyzer: Petrol and Diesel; Ignition timing light; Wheel Balancer; Wheel aligner; Headlight aligner; Cylinder boring and honing; crankshaft grinder; Brake lathe m/c; ridge cutter and boring m/c; Trolley Jacks; Engine lifting cranes

UNIT 3:Engine Tuning

Procedure for carburetor based S.I Engine tuning; use of compression gauge; vacuum gauge; engine analyzer; exhaust analyzer; battery tester S.G tester; adjustment of spark plugs electrodes; Cam-dwell angle; valve tappet clearance; CB point; carburetor cleaning; air filter cleaning; replacement of engine oil and filter; ignition timing setting by timing light; tightening head bolts. Tyre inflation pressure; checking fuel consumption; MPFI and CRDI Engines: Study of tools needed to service the system: assembly line diagnostic link (ALDL) connector; ALDL read out scan tool; test light; ohmmeter; digital volt meter; jumper wires; vacuum gauge; Tachometer; computerized automotive maintenance system. Knowledge of diagnostic codes; service engine soon (SES) light; ECM; CALPAK. Study of important components : name; location and functions : TPS; IAC valve; ECM; MAP sensor; engine coolant temp sensor; IAT sensor; VSS; camshaft and Crankshaft – position sensor; start signal; PSP switch; Oxygen sensor; Fuel Vapor Canister; Catalytic Converter; Particulate filter; Troubles and diagnosis MPFI engines.

UNIT 4: Engine Maintenance

Tools used for engine disassembly, dismantling of engine components: cylinder head, valve train, cylinder block, connecting rod, piston and crankshaft assembly; cleaning and inspection of engine components, reconditioning of components. Cooling system: water pump, radiator, thermostat. Lubrication system maintenance, Anticorrosion and anti-freeze additives

UNIT 5: Chassis Maintenance

Servicing and maintenance of clutch, gear box, universal joints, propeller shaft, differential system. Service and maintenance of brake – disc and drum brakes, steering wheel and suspension systems, wheel alignment, and vehicle body maintenance

Learning Outcome

After completing this course

CO1:The students can Inspect and diagnose the problems occurring in the various components of the vehicle.

CO2: Student will get the industrial knowledge about the basic terminology and application.

CO3:students will understands the maintenance issue related to engine and chassis.

Text book [TB]:

1. Shrivastava, Sushil Kumar., "Industrial Maintenance Management", S Chand & Company Ltd., 2005
2. Knott and Phil Knott, "An Introductory Guide to Motor Vehicle Maintenance: Light Vehicles", EMS publishing, 2010

REFERENCES [RB]:

1. Kholi.P.L. "Automotive Chassis and Body", Tata McGraw-Hill Co., Ltd., New Delhi, 1975.
2. Tim Giles, "Automotive service: Inspection, maintenance and repair", 3rd edition, 2007
3. Service manuals of various OEMs

List of Experiments:

1. Study of Automobile Repair Shop with the help of Layout.
2. Study and Preparation of Workshop Statements.
3. Experimental Study about Tools and instruments used in the maintenance shop.
4. Experiment to perform tuning of automobile multi cylinder engine.
5. Study and diagnosis of ignition, starting and charging system.
6. Study and diagnosis of Automobile fuel systems, filters & air cleaners
7. Wheel Balancing and adjustment of head light.
8. Adjustment of pedal play in clutch brake, hand brake and steering wheel and Braking system troubleshooting.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME354	Subject Title	Computer Aided Design (CAD)						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To provide an overview of how computers can be utilized in mechanical component design.

Course Pre/Co- requisite (if any): Machine Drawing and Solid Modeling

Detailed Syllabus

UNIT 1:

Fundamentals of CAD: Introduction, Reasons for implementing a CAD system, Computer Aided Process application, conventional design vs CAD.

Computer graphics:

Graphics input devices-cursor control devices, digitizers, scanners and touch panels.

Graphics display devices: CRT, Color CRT monitors, DVST, Flat panel display, graphics output devices.

UNIT 2:

Line Drawing algorithms: Bresenham's line drawing and Mid-Point

Circle algorithms.

Geometric Modeling of Curves Types of mathematical representation of curves, wire frame models, wireframe entities, and parametric representation of synthetic curves- her mite cubic splines, Bezier curves, B-splines rational curves.

UNIT 3:

Introduction to Geometric Modeling of Surfaces and Solids Surface entities utilized in CAD.

Solid modeling, Solid Representation, Boundary Representation (B-rep), Constructive Solid Geometry (CSG).

Graphics Standards: PHIGS, IGES, PDES. Standards in CAD.

UNIT 4:

Transformations (2D)

Transformations in CAD modeling software.

UNIT 5:

Finite Element Methods: Introduction and Application of FEM, Stiffness Matrix/ Displacement Matrix, One/Two Dimensional bar & beam element (as spring system) analysis

Learning Outcome

After completing this course, the students can:

CO1: Appreciate the importance of Computers in Product Design and Development Process.
CO2: Understand the prevalent display technologies.
CO3: Understand the modeling of CAD geometric elements.
CO4: Can use CAD software for modeling mechanical components
CO5: Students will be able to design and conceive new concepts of the state of art

Text book [TB]:

1. Ibrahim Zeid, Mastering CAD CAM, Tata McGraw Hill Publishing Co. 2007.
2. C. McMohan and J. Browne, CAD/CAM Principles, II edition, Pearson Education, 1999.

REFERENCES [RB]:

1. W. M. Neumann and R.F. Sproul, Principles of Computer Graphics, McGraw Hill, 1989.
2. D. Hearn and M.P> Baker, Computer Graphics, Prentice Hall Inc., 1992

LIST OF EXPERIMENTS:

1. Introduction to CAD, CAE and Creo; Concepts: - Modelling, Parametric, Associative, Feature and Graphic User Interface of Creo Parametric, Sketcher, line center line and rectangle. (Practice module 1 and 2)
2. Circle: using centre and point, concentric circles, 3 point circle, 3 tangents circle, Ellipse: axis end ellipse, center and axis, Arc: 3-point/Tangent end, center and ends, 3 tangents, concentric, conic (Practice module 3)
3. Dimensioning the sketch: Normal dimensions, reference dimensions, perimeter and baseline dimensions Fillets & trim: Circular and elliptical, Chamfer: chamfer and chamfer trim Spline, Point, Coordinate system, text, Palette (practice module 4)
4. Part Modelling: Part mode, setting units, Creating reference sketch, Extrude: Blind, side1, side2, symmetric, to next, through next, to selected (Practice module 5 & 6)
5. Revolve: selecting axis, thin features, Sweep: Selecting profile and path, free and merge ends, thin protrusion, surface sweep, Helical Sweep: defining path and profile, Draft: selecting draft surface, hinges, pull direction, draft angle. split draft, draft sides independently, first side only, second side only, Hole: placement of hole, sketched holes, standard holes (practice module 7 & 8)
6. Rounds: Sets, transitions, Chamfer: chamfer sets, transitions and corner chamfer (Practice module 9 & 10)
7. Datum planes: normal to plane, parallel, offset, tangent constraint, Datum axis: normal, through constraint, Datum Points: on a plane or face, offset to face, intersection of three faces, centre of curve edge, Datum curves: through points, by sketching (practice module 11 & 12)
8. Shell: surface selection, Patterns, Ribs and introduction to assembly design (Practice module 13)

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME355	Subject Title	Design For Manufacturing						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective To provide the basic knowledge and understanding of the concept & role of Design in manufacturing.

Course Pre/Co- requisite (if any): Manufacturing Process, Industrial Engineering and Management

Detailed Syllabus

UNIT 1: Introduction

Concepts of DFM, Role of DFM, Material and Process Selection

UNIT 2: Components Design

Design for Quality, Design for Assembly, Design for Cost, Design for Performance, Design for Biocompatibility, Design for Ergonomics, Design for Recycling and other factors.

UNIT 3: Methods of Material Selection

Material Selection on the basis of Engineering Properties, Material Selection on the basis of material performance indices, Material Selection on the basis of charts, Evaluation of single and multi-attribute utilities

UNIT 4: Design Rules

Design rules for material and process, Part geometry and tolerances, Shape factor, Prototyping, Computer aided Material, Functional Modelling, Mathematical optimization, Formation of objective, Constraint functions, factorial analysis.

UNIT 5: Case Studies

Case studies on product design. Case study on manufacturing design. Case study on design of assembly.

Learning Outcome:

After completing this course, the students can:

CO1: Design different components/parts for manufacturing.
CO2: Identify application of different materials.
CO3: Apply proper rules and criteria for designing of a component.
CO4: Design components for industrial applications

Text book [TB]:

1. Design for Assembly Automation and Product Design by G. Boothroyd, Marcel Dekker.2010
2. Engineering Design and Design for Manufacture and Structural Approach by Dickson, John. R, and Corroda Poly 2016

References [RB]:

1. Material Selection in Mechanical Design by Michael Ashby.2006
2. Design for Manufacture handbook, McGraw Hill by Bralla 1999.

List of Experiments:

1. Case Studies

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME356	Subject Title	Automotive Fuel and Lubricants (AFL)						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To provide an overview of fuels/lubricants and their distillation, discussing various parts of automobile which are involved in the use of lubrication.

Course Pre/Co- requisite (if any): Basic Thermodynamics, Fluid Mechanics

Detailed Syllabus

UNIT 1:

Structure of petroleum, refining process, Fuels, thermal cracking and catalytic cracking, Polymerization, alkylation, isomerization, blending, Products of refining process, manufacturing of lubricating oil base stocks, Lubricating finished automotive lubricants.

UNIT 2:

Engine friction-introduction, Total engine friction and effects of engine variables on friction, Hydrodynamic lubrication, Elasto-hydrodynamic lubrication and boundary lubrication, Bearing lubrication and functions of lubrication system, Properties of lubricants.

UNIT 3:

Specific requirements of automotive lubricants, oxidation deterioration, Degradation of lubricants and Additives, Additive mechanism and synthetic lubricants, Classification of lubricating oils, Tests on lubricants, Grease, classification and properties, Tests used in grease

UNIT 4:

Thermos-chemistry of fuels, Properties and testing of fuels, Relative density, calorific value, flash point and fire point, distillation, Vapor pressure, spontaneous ignition temperature, viscosity and pour point, Flammability, ignitability, diesel index, API index, Aniline point, carbon residue, copper strip corrosion.

UNIT 5:

SI engines-flame propagation and mechanism of combustion, Normal combustion, knocking, octane rating and fuel requirements, CI engines- mechanism of combustion, diesel knock, Cetane rating and fuel requirements, Additive mechanism, requirements of an additive, Petrol fuel additives and diesel fuel additives-specifications of fuels

Learning Outcome

After completing this course, the students would be able to-

CO1: Understand about the origin and formation of different kind of fuels/lubricants.

CO2: Understand the different methods of separation of lubricants from crude oil.

CO3: Come out with some basic understanding of journal bearings.

CO4: Understand about the various properties of the lubricants used in the daily use vehicles.

CO5: Get the basic idea about the chemistry behind the formation of the lubricants.

Text book [TB]:

1. Ganeshan. V., “Internal Combustion Engineering”, Tata McGraw-Hill Publishing Co., New Delhi, 2003.
2. Mathur M.L., Sharma R.P., “A course in Internal Combustion Engines”, Dhanpatrai Publication, 2003
3. Obert E.F., “Internal Combustion Engineering and Air Pollution”, International book co., 1988.

References [RB]:

1. NPTEL
2. Brame, J.S.S. & King J.G., “Fuel Solids, Liquids, Gaseous”, Edward Arnold, 1961
3. Francis W, “Fuels and Fuel Technology, Vol 1 & 2, Pergamon, 1965
4. Hobson G.D. & Pohl, “Modern Petroleum Technology”, 1974
5. Raymond C. Gunther, “Lubrication”, Chilton Book Co., 1971.

List of Experiments:

1. Abel's Flash point apparatus
2. Aniline point temperature calculation
3. ASTM distillation apparatus for the calculation of condensate of fuel sample
4. Bomb Calorimeter apparatus for the calculation of HCV and LCV
5. Carbon Residue calculation for a given sample
6. Cleveland Flash point and Fire point apparatus
7. Calculation of drop melting point temperature
8. Pensky Martin apparatus for the flash and fire point temperature calculation
9. Redwood viscometer-I for the calculation of viscosity of a fuel sample.
10. Redwood viscometer-II for the calculation of viscosity of a fuel sample.
11. Saybolt viscometer for the calculation of viscosity of a given sample.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME357	Subject Title	Computational Fluid Dynamics						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To provide the students with sufficient background to understand the mathematical representation of the governing equations of fluid flow and heat transfer. To enable the students to solve one and two-dimensional ordinary and partial differential equations using traditional CFD tools.

Course Pre/Co- requisite (if any): Basic Thermodynamics, Fluid Mechanics, Engineering Mathematics

Detailed Syllabus

UNIT 1: Introduction and Governing Equations

Introduction- Impact and applications of CFD in diverse fields - Governing equations of fluid dynamics – Continuity - Momentum and energy - Generic integral form for governing equations - Initial and Boundary conditions - Governing equations for boundary layers - Classification of partial differential equations – Hyperbolic - Parabolic - Elliptic and Mixed types - Applications and relevance.

UNIT 2: Discretization

Basic aspects of discretization - Discretization techniques – Finite difference - Finite volume and Finite Element Method– Comparison of discretization by the three methods -Introduction to Finite differences - Transient one-dimensional and two-dimensional conduction – Explicit - Implicit - Crank-Nicolson - ADI scheme – Stability criterion.

Difference equations - Numerical errors - Grid independence test - Optimum step size.

UNIT 3: Grid Generation

Grid generation – General transformation of the equations - Form of the governing equations suitable for CFD – Boundary fitted co-ordinate systems – Elliptic grid generation - Adaptive grids – Modern developments in grid generation.

UNIT 4: Convection – Diffusion

Steady one-dimensional convection and diffusion - Central difference, upwind, quick, exponential, false diffusion, hybrid and power law schemes. Transient one-dimensional heat conduction equation.

UNIT 5:Calculation of Flow Field

Representation of the pressure - Gradient term and continuity equation – Staggered grid -Momentum equations - Pressure and velocity corrections - Pressure Correction equation -Numerical procedure for SIMPLE algorithm - Boundary conditions for the pressure correction method. Stream function – Vorticity method - Discussion of case studies.

Learning Outcome

After completing this course, the students can:

CO1:Possess the knowledge of CFD techniques, basic aspects of discretization and grid generation.
CO2:Solve fluid flow fields using CFD methods.
CO3:Model fluid flow problems and heat transfer.
CO4: Apply explicit, implicit and semi-implicit methods of finite differencing.

Text book [TB]:

1. K.A. Hoffman, (2000), Computational Fluid Dynamics for Engineering, Vol I – III Engineering Education System, Austin, Texas.
2. H. Versteeg (Author), W. Malalasekera, An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Second Edition. 2006

References [RB]:

1. J.D. Anderson, Jr., (2000), Computational Fluid Dynamics – The basics with applications, McGraw-Hill, Incs.
2. K. Muralidhar, T. Sundarajan, (2001), Computatioanl Fluid Flow and Heat Transfer, Narosa Publishing House, New Delhi.2010
3. S.V. Patankar, (1999), Numerical Heat Transfer and Fluid Flow, Hemisphere, New York.
4. V.V. Ranade, (2002), Computational Flow Modeling for Chemical Reactor Engineering, Academic Press

List of Experiments:

1. Diffusion/Conduction Problem
2. Convection-Diffusion Problem
3. Pressure-Velocity Coupling Problem
4. Unsteady flow
5. Complex geometry and boundary conditions problem
6. Turbulence Flow Simulation
7. Calculate the velocity at 0.005m from inlet- Without using Turbulence model.
8. Calculate the velocity at different points 0.0, 0.01, 0.03, 0.05, 0.07, 0.09 &0.1m from inlet- Using k-ε Turbulence model.
9. Calculate the velocity at different points0.0, 0.01, 0.03, 0.05, 0.07, 0.09&0.1m from inlet- Using k-ω Turbulence model.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME358	Subject Title	IC Engines						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: This course provides a basic skill for understanding of construction of automobile engines working principle and performance under various conditions.

Course Pre/Co- requisite (if any): Basic Thermodynamics

Detailed Syllabus

UNIT 1: Fuel Supply Systems for SI Engine:

Engine classification, Ideal air standard cycles & actual air standard cycles analysis, Valve timing diagram, Air fuel ratio requirements of SI engines, Requirements of an automotive carburetor; Working of a simple fixed venture carburetor, Fuel feed systems, MPFI systems for petrol.

UNIT 2: Fuel Supply Systems for CI Engine:

Diesel fuel injection systems, Air and solid injection, Jerk pumps, distributor pumps, Unit injector, Fuel injector - pintle and multi-hole nozzles, CRDI systems for diesel, Fuel injection computation.

Emissions from Internal Combustion Engine and its Control

Spark Ignition and Compression Ignition Engine Emissions, Effect of emissions on Human Health and Environment, Control of engine emissions - Catalytic Converter, EURO and BHARAT norms.

UNIT 3:Combustion, Supercharging and Turbocharging:

Introduction to combustion in SI and diesel engines and stages of combustion. Knock in SI and CI engines. Effect of engine variables and knock. Combustion chambers for SI and CI engines. Importance of Swirl, squish and turbulence. Factors controlling combustion chamber design

Supercharging and Turbocharging: Necessity and limitation, Different methods of turbocharging.

UNIT 4: Cooling and Lubrication System:

Need for cooling, types of cooling systems- air and liquid cooling systems. Thermosyphon and forced circulation and pressurized cooling systems. Properties of coolants. Requirements of lubrication systems. Types-mist, pressure feed, dry and wet sump systems. Properties of lubricants.

UNIT 5: Engine Testing and Performance Characteristics:

Dynamometers, indicated thermal, brake thermal and volumetric efficiencies. Measurement of friction, Cylinder pressure measurement. Engine performance curves, Engine testing standards. Variables affecting engine performance. Methods to improve engine performance. Heat balance sheet.

Non-Conventional Internal Combustion Engines

Stratified Charged Engine, Wankel Engine, Free Piston Engine, Stirling Engine, Variable Compression Ratio Engine, Dual Fuel Engines, Multi Fuel Engines

Learning Outcome

After completing this course, the students can:

CO1: Understand the basic working principles of engines, its Construction and Operation.

CO2: Understand phenomena of Combustion and Design of Combustion Chambers.

CO3: Conduct Engine Testing and Performance and understand Performance characteristics.

Text book [TB]:

1. V. Ganesan, “Internal Combustion Engines”, Tata Mc Graw Hill Publishers, 4th Edition.2016
2. M.L. Mathur & R. P. Sharma,” A Course in International Combustion Engines”, Dhanpat Rai & Sons. 4th Edition, 2005.

References [RB]:

1. Colin R. Ferguson, Allan Thomson Kirkpatrick, “Internal combustion engines” John Wiley & Sons, 2nd edition, 2000.
2. Automotive Engines by E. H. Ellinger, Prentice Hall Publishers, 1992.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

List of Experiments:

1. Study & experiment on 2- Stroke diesel and diesel engine.
2. Study & experiment on 4- Stroke petrol and diesel engine.
3. Performance Analysis of Four stroke S.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
4. Determination of Indicated H.P. of I.C. Engine by Morse Test.
5. Performance Analysis of Four stroke C.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
6. Study & experiment on Ignition system of I.C. Engine.
7. Study & experiment on Fuel Supply System of S.I. Engines- Carburetor, Fuel Injection Pump and MPFI.
8. Study & experiment on Fuel Supply System of C.I. Engines- Injector & Fuel Pump.
9. Experiment on Exhaust Gas Analysis of an I.C. Engine.
10. Demonstration and study of commercial exhaust gas analyzers.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME359	Subject Title	Computer Integrated Manufacturing						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: Introduce student to (mechanical) measurement techniques so as to appreciate relationship between process and system in manufacturing domain for identifying techniques for quality assurance of process.

Course Pre/Co- requisite (if any): Manufacturing Process

Detailed Syllabus

UNIT 1:

Introduction- Concepts of CIM, Manufacturing system, components of CIM, CASA/SME model of CIM, CIM II, Benefits of CIM, Communication matrix in CIM, Fundamentals of computer communication in CIM, computer networking in CIM- seven layers of OSI model.

UNIT 2:

NC & CNC part programming: Fundamental of NC technology, computer numerical control,
distributed numerical control, coding systems and formats, Manual NC part programming, Examples drilling and milling, turning, CNC machines and turning centers, CNC part programming.

UNIT 3:

Material Handling System -introduction to material handling, material transport equipment like industrial trucks, automated guided vehicles, monorail and other rail guided vehicles, conveyors, cranes and hoists.AS/RS design process
Identification technologies- introduction, bar code technology, radio frequency identification.

UNIT 4:

Flexible manufacturing systems: introduction, FMS components, equipment's, FMS tool
Management systems, system layout, FMS control, case study. FMS applications and benefits.
Group technology and cellular Manufacturing: part families, part classification and coding Production flow analysis, application of Group technology.

UNIT 5:

Process planning and Concurrent Engineering- process planning, computer aided process planning, concurrent engineering and design for manufacturing, advance manufacturing planning,
Production Planning and Control systems- Aggregate production planning and the Master Production Schedule, Material Requirement planning, Shop floor control, Inventory control, JUST IN TIME, Lean and Agile manufacturing.

Learning Outcome

At the end of the course the student can:
CO1: Identify measuring process, appropriate measuring tools for various manufacturing /shapes/ processes
CO2: Relate metrology parameters in manufacturing processes to dimensional accuracy, tolerances of products
CO3: Attain a hands on approach to practical measurements related to sensor based technology
CO4: Relate to overall optimization in manufacturing domain; relationship between processes and system
CO5: Identify techniques for the quality assurance of products in terms of process & resource management

Text book [TB]:

1. Groover. Mikell P,"Automation, Production systems and computer integrated manufacturing", Third edition, PHI learning private limited, ISBN-978-81-203-3418-2.

2. Rao P N, "CAD/CAM Principles and Applications "third edition, McGraw Hill Education Pvt. Ltd. ISBN-978-0-07-068193-4

References [RB]:

1. Groover. Mikell P and Zimmers jr.Emory, "CAD/CAM", Prentice hall of India Pvt Ltd., 1998.
2. James A, Regh and Henry W. Kreabber "Computer integrated manufacturing" Pearson Education second edition, 2005.
3. Paul G. Ranky., "Computer Integrated Manufacturing", Prentice hall of India Pvt Ltd., 2005

List Of Experiments:

1. Study of Flexible manufacturing system
2. Writing a part-programming (in word address formator in APT) for a job for turning operation and running on NC machine.
3. Writing a part-programming (in word address formator in APT) for a job for drilling operation (point-to-point) and running on NC machine.
4. Writing a part programming (in word address format or in APT) for a job for milling operation (contouring) and running on NC machine
5. Experiment on Robots and it programs
6. Experiment on Transfer line/Material handling (AS/RS).
7. Experiment on difference between ordinary machine and NC machine.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME360	Subject Title	Power Plant Engineering						
LTP	2 1 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective:

1. To teach students about the working of various power generation systems and cycles.
2. To introduce students to Coal (fuel) selection and its handling system, Pulverized fuel firing system, selection of boiler and its auxiliaries system.
3. Layout of steam and condensate layout system
4. Different electric power plant system.
5. To enable students understand in detail about Nuclear, Gas turbine, Hydrology and Diesel power plants which play an important role in power generation

Course Pre/Co- requisite (if any): Applied Thermodynamics I

Detailed Syllabus

UNIT 1: Coal based thermal power plants

Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam andheating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems

UNIT 2: Gas turbine and combined cycle power plants

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

UNIT 3: Nuclear power plants

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

UNIT 4: Hydroelectric power plants

Hydroelectric power plants, classification, typical layout and components

UNIT 5: Power plant economics

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Learning Outcome

Student will be able to

CO1: Understand basic power generation types and its basic cycles.

CO2: Know about the kind of Coal mill, furnace structure, turbine and its safety supervisory system and other auxiliaries' system being used in various industries and their applicability.

CO3: Solve problems related to Economics of power industries and basic thermodynamics cycle.

CO4: Distinguish between various power generation units and choose one that meets desired economic, environmental and social requirements

CO5: Gain knowledge of contemporary issues like fluidised bed combustion, nuclear waste disposal, supercharging of diesel engines and combined cycle power plants.

Text book [TB]:

1. Domkundwar, Arora. Power Plant engineering, 6th edition, Dhanpat Rai & Co.(P) ltd. 2016

2. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
3. Steam and Gas turbines and power Plant Engineering by R.Yadav, Central publishing House, Allahabad.2010

References [RB]:

1. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.
2. Black and Veatch, (1998), Power Plant Engineering, CBS Pub and Distributors, New Delhi
3. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
4. P. Chattopadhyay ,Boiler Operation Engineering : Questions and Answers 3rd Edition Tata McGraw Hill

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME361	Subject Title	Industrial Robotics						
LTP	2 0 2	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: The Industrial Robotic subject equips graduates with the basic understanding of robotics automation, necessary skills to program, design automated production systems required for high-tech manufacturing industries.

Course Pre/Co- requisite (if any): Mechatronics

Detailed Syllabus

UNIT 1: Fundamentals of Industrial Robot

Automation, Definition, Robot anatomy, Co-ordinate systems, work envelope, types and classification, Specifications of robot, Pitch, yaw, roll, joint notations, speed of motion and pay load, Robot parts and their functions, Different applications.

UNIT 2: Robot Drives And Actuators

Pneumatic drives, Hydraulic drives, Mechanical drives, Electrical drives, D.C. servo motors, stepper motor and A.C. servo motors. Salient features, applications and comparison of all these drives, piezoelectric actuators.

UNIT 3: End Effectors And Sensors

End effectors: Mechanical grippers, pneumatic and hydraulic grippers, magnetic grippers, vacuum grippers, RCC grippers, Two fingered and three fingered grippers, Internal grippers and external grippers, Selection and design considerations.

Sensors: Requirements of a sensor, principles and applications of the following types of sensors, Position of sensors (Piezo electric sensor, LVDT, Resolvers, Optical encoders, Pneumatic position sensors), Range sensors, Proximity sensors, Touch sensors, Slip Sensors.

UNIT 4: Robot Motion Analysis And Control

Introduction to manipulator kinematics, Homogeneous transformation and robot kinematics, Forward kinematics, Inverse kinematics, DH algorithm, Manipulator path control, overview of Robot dynamics.

UNIT 5: Robot Programming And Work Cell Design

Robot Programming- Introduction, robot programming technique, on line programming, lead through programming, Walk through programming, off-line programming, overview of robot programming languages.

Robot work cell- Robot cell layouts, Multiple robot and machine interference, work cell control, interlocks, error detection and recovery.

Learning Outcome

At the end of the course the student can:

CO1: Understand about fundamental of automation with industrial Robots.

CO2: Hardware understanding for any automated application and utilization in industry.

CO3: Selection of industrial robotics for an application and Programmed various application to design work cell.

CO4: Should able to design and developed industrial robot for any industrial application.

Text book [TB]:

1. Industrial Robotics, Technology programming and application by Mikell P. Groover , TMH publications.2010
2. Robotics technology and flexible automation by S.R.Deb , Mc Graw Hill publication.2006
3. Industrial automation and robotics by A.K.Gupta , University science press.2012

Reference books [RB]:

1. Robotics engineering, an integrated approach by Richard D klafter PHI publication.2006
2. A Textbook of Industrial Robotics by By Ganesh S. Hegde, Lakshmi publications.2012
3. Industrial Robotics, analysis, systems, applications by Saeed B Niku, Pearson publication.2010

List of Experiments:

1. Study of anatomy of industrial robotics.
2. Demonstration of robot with 2 DOF, 3 DOF, 4 DOF etc.
3. Programming the robot for pick up and place applications.
4. Robot programming by teach pendent
5. Programming the robot for applications in VAL –II.
6. Simulation of robot programming on software.
7. Design of robot work cell and simulation in software robot studios.
8. Two case studies of application.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME362	Subject Title	Process Planning & Cost Estimation						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To introduce process planning concepts to make cost estimation for various products.

Course Pre/Co- requisite (if any): Industrial Engineering and Management

Detailed Syllabus

UNIT 1:

Introduction of Process Planning- methods of process planning, drawing interpretation, material evaluation, steps in process selection, production equipment and tooling selection.

UNIT 2:

Process planning activities- process parameter calculation for various production processes, selection of jigs and fixtures, selection of quality assurance methods, documents for process planning, economics of process planning, case studies.

UNIT 3:

Introduction to cost estimation- importance of costing and estimation, methods of costing, elements of cost estimation, types of estimates, estimating procedure, estimation of labor cost, material cost, allocation of overhead charges, calculation of depreciation cost.

UNIT 4:

Machining time estimation- importance of machine time calculation, machining time for different lathe operations, drilling and boring time calculations, Machining time calculation for Milling, Shaping, Planning and Grinding.

UNIT 5:

Production costs- different production processes for different jobs, estimation of forging cost,
Estimation of welding cost, estimation of foundry cost, estimation of machining cost

Learning Outcome

After completing this course,

CO1: Students can use the concepts of process planning and cost estimation for various products.

CO2: Students can prepare process planning activity for any manufacturing operations.

CO3: Students should able to calculated machining time and production costing.

Text book [TB]:

1. Peter Scalon, Process Planning, Design/ Manufacture Interface, Elsevier Sci.&Tech. 2002.
2. Ostwaal P.F. and Munez J., Manufacturing Processes and Systems, 9th ed., John Wiley 1998.

Reference books [RB]:

1. Chitale A.V. and Gupta R.C., Product Design and Manufacturing, 2nd ed., Prentice Hall 2002.
2. R. Kesavan, C. Elanchezhian, B. Vijaya Ramanath, Process Planning and Cost Estimation New Age International, 2009.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME363	Subject Title	Industrial Ergonomics						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: This course provides an overview on principles of ergonomics and human factors, their applications to the design and management of industrial systems, Engineering anthropometry, Human performance, human-technology interaction, work place and work station design. The emphasis is on how methods are used to study, improve and optimize designing a product or industrial system.

Course Pre/Co- requisite (if any): ME345

Detailed Syllabus

UNIT 1: Human Physical Characteristics, Ergonomics and Human Factors Engineering, person machine system, cognitive core, work-space shell, Physiology of Work, Cognitive Psychology and Sensory Processes, Biomechanics and Engineering**.**

UNIT 2: Engineering Anthropometry, Human Machine System, Machine and Tool Design, Visuals displays, Auditory and textile display.

UNIT 3: Work Place and Work Station Design, Work Design, Fundamentals of Physical Working Environment, Information Technology, body measurement, safety and related corners, physical ability, Work station in health caring system.

UNIT 4: Office Systems and Ergonomics, Ergonomics of Technology Management.

UNIT 5: Consumer Ergonomics, Ergonomics Quality and Safety, Quality of Life

Learning Outcome

At the end of the course the student can:

CO1: Specify and design ergonomically appropriate industrial workstations for the industrial and office work environment.

CO2: Identify information-centered human factors relating to visual, illumination, controls, displays and symbols.

CO3: Compare, contrast and assess human body-centered ergonomic designs for posture, material handling, repetitive motion factors, heat stress, noise and vibration.

CO4: Define the ergonomic factors intrinsic in evaluating accidents, human errors and safety related incidents.

CO5: Illustrate and assess the ergonomic factors in computer work station design. Discuss and identify key components of cost-benefit analysis in human factors and ergonomic design.

CO6: Summarize key components in conducting a human factors or ergonomics related investigation.

Text book [TB]:

1. Human Factors in Engineering and Design By Sanders & Mccormick (McGrowHill Publication) 2010
2. Occupational Ergonomics – Principles and Applications By Tayyari & Smith (Chapman & Hall Publication)2006

Reference books [RB]:

1. The Power of Ergonomics as a Competitive Strategy By Gross & Right (Productivity Press) 2010.
2. Martand Telsang, Industrial Engineering and Production Management,S. Chand & Compagny Limited, 2006.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME364	Subject Title	Renewable Energy Sources						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To provide students an overview of global energy resources with focus on renewable energy sources and their importance in the context of limited supply of conventional energy resources & global warming.

Course Pre/Co- requisite (if any): Basic Thermodynamics, Heat Transfer

Detailed Syllabus

UNIT 1: ENERGY RESOURCES

Introduction: Energy & its importance in social & economic development; energy demand & supply, world energy status, energy scenario in India; energy & environment, greenhouse effect & global warming; role of renewable energy sources; a brief introduction to various renewable energy sources – hydro, solar, biomass, wind, geothermal & ocean energy – their availability & present status.

UNIT 2: SOLAR ENERGY

The sun as a source of energy, extraterrestrial & terrestrial solar radiation; solar radiation data & geometry, solar radiation on horizontal & inclined surfaces; solar thermal systems – various types of solar collectors & their applications in cooking, drying, water heating, distillation, space heating & cooling, refrigeration and power generation.

Solar photovoltaic systems, solar cell fundamentals, performance & characteristics, types of solar cells; solar cell, module, and array construction; solar PV applications.

UNIT 3: BIOMASS ENERGY

Origin of biomass, photosynthesis & generation of biomass, availability of biomass, usable forms of biomass – fuel wood, charcoal, fuel pellets, biodiesel, bioethanol, biogas and producer gas; biomass conversion technologies, thermochemical & biochemical methods, biomass gasification, classification & operational parameters of biogas plants, energy recovery from urban waste, sewage to energy conversion.

UNIT 4: WIND ENERGY

Origin & nature of winds; history of power from winds; global & local winds; estimation of wind energy at a site; maximum power extraction from wind – Betz criterion; capacity factor of wind power plants; types of wind turbines – horizontal and vertical axis wind turbines; wind energy storage; environmental & economic aspects; present status of wind energy systems.

UNIT 5: GEOTHERMAL & OCEAN ENERGY

Structure of earth's interior; origin & distribution of geothermal energy, types of geothermal resources – exploration & development of hydrothermal, geo-pressured & hot dry rock resources; electrical power generation from geothermal energy; environmental & economic considerations.

Ocean energy; tidal, wave & ocean thermal energy, energy from tidal streams (marine currents); technology for harnessing tidal & wave energy; ocean thermal energy conversion technology.

Learning Outcome

At the end of the course the student will:

CO1: Understand about the interaction between energy, economy, environment, and social development.

CO2: Appreciate the importance of renewable energy sources & future energy systems based on them.

CO3: Possess the basic technical knowledge to develop energy systems based on solar, biomass, wind, geothermal & ocean energy.

Text book [TB]:

1. B. H. Khan, "Non-Conventional Energy Resources", 3rd edition (2017), McGraw Hill Education (India) Private Limited, Chennai.
2. S. P. Sukhatme & J. K. Nayak,"Solar Energy", 4th edition (2018), McGraw Hill Education (India) Private Limited, Chennai.

References [RB]:

1. G. N. Tiwari & M. K. Ghosal, "Renewable Energy Resources – Basic Principles and Applications", 2005, Narosa Publishing House, New Delhi.
2. D.P. KOTHARI, K. C. SINGAL, RAKESH RANJAN, Renewable Energy Sources And Emerging Technologies, PHI Learning Pvt. Ltd., 25-Nov-2011.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME365	Subject Title	Nuclear Power Engineering						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective:

- To introduce students to different aspects of Nuclear power plant engineering
- To familiarize the students to the working of Nuclear power plants based on different fuels.
- To expose the students to the principles of safety and environmental issues.

Course Pre/Co- requisite (if any): Basic Thermodynamics, Heat Transfer

Detailed Syllabus

UNIT 1:

Energy & the world; Importance of nuclear energy; History of nuclear energy; Equivalence of matter & energy; Nuclear structure & stability; Radioactivity & laws of radioactive decay; Mass defect & binding energy; Nuclear fission & fusion reactions. Microscopic & Macroscopic cross sections; Rates of binary nuclear reactions.

UNIT 2:

Types of nuclear reactors; Pressurized & Boiling water reactors; Heavy water reactors; High temperature gas cooled reactors; Breeder reactors; Generation IV reactors; Nuclear reactors for propulsion; Introduction to fusion reactors..

UNIT 3:

Neutron chain reaction; Concept of a critical reactor; One-group neutron diffusion theory of a bare nuclear reactor; critical size and mass; Multiplication constant and reactivity; Delayed neutrons; Lifetime & reproduction time of neutrons; Point reactor kinetics; Reactivity feedbacks; Fission product poisoning.

UNIT 4:

Heat generation in fuel elements & temperature distributions; Heat removal; Reactor coolants; Single phase & two-phase heat transfer; Boiling and flow regimes; Basic thermal hydraulic analysis of reactor core using heat transfer & fluid flow correlations. Decay heat removal & its importance for nuclear safety.

UNIT 5:

Introduction to nuclear fuel cycle; Nuclear fuel resources & uranium enrichment; Fuel fabrication; Spent fuel storage and reprocessing; Nuclear waste disposal; Economics of nuclear power. Useful radioisotopes & their applications; Biological effects of radiation; Radiation protection. Ocean energy; tidal, wave & ocean thermal energy, energy from tidal streams (marine currents); technology for harnessing tidal & wave energy; ocean thermal energy conversion technology.

Learning Outcome

At the end of the course the student will:

CO1: Describe and analyze different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation.

CO2: Analyze the working and layout of Nuclear power plants and the different systems comprising the plant and discuss about its economic and safety impacts

CO3: Describe the working principle and basic components of the nuclear power plant and the economic and safety principles involved with it.

CO6: Discuss and analyze the mathematical and working principles of different electrical equipment involved in the generation of power.

Text book [TB]:

1. Mohamed Mohamed El-Wakil , Nuclear power engineering , McGraw-Hill, 1962.
2. Malcolm Joyce , Nuclear Engineering: A Conceptual Introduction to Nuclear Power, Butterworth-Heinemann, 18-Sep-2017.

References [RB]:

1. Viorel Badescu, George Cristian Lazaroiu, Linda Barelli , Power Engineering: Advances and Challenges, Part A: Thermal, Hydro and Nuclear Power , CRC Press, 06-Jul-2018.
2. Kenneth D. Kok, Nuclear Engineering Handbook, Second Edition , CRC Press, 03-Oct-2016

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME366	Subject Title	Product Design And Development						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: This course aims at introducing the students to the basic concepts of engineering design and product development with focus on the front end processes. At the end of this course the student is expected to demonstrate an understanding of the overview of all the product development processes and knowledge of concept generation and selection tools.

Course Pre/Co- requisite (if any): Manufacturing Process, Industrial Engineering and Management

Detailed Syllabus

UNIT 1:

Significance of product design, Need for developing products, product design and development process, the importance of engineering design, sequential engineering design method, relevance of product lifecycle issues in design, the challenges of product development.

Product Planning and Project Selection: generic product development process, Identifying opportunities, evaluate and prioritize projects, allocation of resources, various phases of product development-planning for products.

UNIT 2:

Identifying Customer Needs voice of customer, customer populations, Interpret raw data in terms of customers need, hierarchy of human needs, need gathering methods, establish the relative importance of needs.

Product Specifications: Establish target specifications, setting final specifications

Concept Generation: Activities of concept generation, clarifying problem, search both internally and externally, explore the output

UNIT 3:

Industrial Design: Assessing need for industrial design, industrial design process, management, assessing quality of industrial design, human factors design, user friendly design

Concept Selection: Overview, concept screening and concept scoring, methods of selection, case studies.

UNIT 4:

Theory of inventive problem solving (TRIZ): Fundamentals, methods and techniques, General Theory of Innovation and TRIZ, Value engineering Applications in Product development and design, Model based technology for generating innovative ideas measurement of customers response.

Concept Testing: Elements of testing: qualitative and quantitative methods including survey.

UNIT 5:

Intellectual Property: Elements and outline, patenting procedures, claim procedure.

Design for Environment: Impact, regulations from government, ISO system, case studies.

Learning Outcome

At the end of the course the student can:

CO1:Product Design and Innovation course is intended to introduce overall awareness of the product design process.

CO2:This course will give an understanding of methods, tools and techniques applied in product design.

CO3:This course includes overview of innovation, product design process, user study, need/problem identification, development of design brief, understanding competitive benchmarking, aspects of human factors in product design, tools for creative concept generation, and prototyping/model making and evaluation techniques for user-product interaction.

CO4:This course will be explained with lectures including case studies and hands-on exercises. This will help students to generate creative ideas in to product design, considering human factors aspects.

Text book [TB]:

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, “Product Design and Development”, Tata McGraw-Hill Education, 4th Edition, 2009.
2. Kevin Otto, Kristin Wood, “Product Design”, Pearson Education, Indian Reprint 2004.

REFERENCES [RB]:

1. Yousef Haik, T. M. M. Shahin, "Engineering Design Process Cengage Learning, 2010", 2nd Edition Reprint.
2. Kevin Otto, Kristin Wood, "Product Design", Pearson Education Indian Reprint 2004.
3. Clive L.Dym, Patrick Little, "Engineering Design: A Project-based Introduction", John Wiley & Sons, 3rd Edition 2009.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME367	Subject Title	Plant Layout And Material Handling						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective Introduce student to designing of plant layout and material handling system so that they can design layout and material handling system in such a way that production can be carried out smoothly at minimum total cost.

Course Pre/Co- requisite (if any): Manufacturing Process, Industrial Engineering and Management

Detailed Syllabus

UNIT 1: PLANT LOCATION AND FACILITIES

Factors to be considered –influence of location on plant layout, selection of plant site, Consideration in facilities planning and layout. Equipment's required for plant operation, Capacity, serviceability and flexibility and analysis in selection of equipment, space requirements, and man power requirements.

UNIT 2: PLANT LAYOUT

Need for layout, types of layout, factors influencing product, process. Fixed and combination layout: tools and techniques for developing layout, process chart, flow diagram, string diagram, template and scale models – machine data. Layout planning procedure. Visualization of layout, revision and improving existing layout, balancing of fabrication and assembly lines.

UNIT 3: MATERIAL HANDLING

Importance and scope. Principles of material handling. Planning, operating and costing Principles, types of material handling systems, factors influencing their choice.

UNIT 4: INDUSTRIAL BUILDING AND UTILITIES

Centralized electrical, pneumatic water line systems. Types of buildings, lighting, heating, air conditioning and ventilation utilities-planning and maintenance, waste handling, statutory requirements. Packing and storage materials: Importance of Packaging, layout for Packaging–Packaging machinery –wrapping and Packing materials, cushion materials.

UNIT 5: ANALYSIS OF MATERIAL HANDLING

Motion analysis, flow analysis, graphic analysis, safety analysis, equipment cost analysis, palletization analysis, analysis of operation, material handling surveys.

Learning Outcome

At the end of the course the student can:

CO1: Take the decision on selection of site and equipment's, space and manpower requirement.

CO2: Design the plant layout and material handling system.

CO3: Design the industrial building and planning and maintenance of various utilities.

Text book [TB]:

1. S. C. Sharma, Plant layout and material handling, Khanna publishers.2006
2. Agarwal, Plant layout and material handling, Jain brothers publication.2010

REFERENCES [RB]:

1. Shubin J A, Plant layout, P H I publications.1965
2. Oberman. Ya, Material handling, Mir publishers.1980
3. S.C. Sharma, Material Management And Material Handling, Khanna Publishers.1995

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	HS304	Subject Title	Aptitude and Soft Skills IV						
LTP	3 0 0	Credit	0	Subject Category	AC	Year	III	Semester	VI

Course Outline: Aptitude and Soft Skills IV is the final step of programme and the module is designed to enhance the analytical and interpersonal skills of students to make them ready to face various placements, interviews. It will also help them learn various personality development techniques by enhancing their GD and PI skills. Mock Placement Drive will test and improve students by Feedback Sharing & Error Correction.

Course Objective:

1. Align themselves with the placement requirements and their needs
2. Learn analytical and employability skills
3. Prepare students for job placements so that they could clear the selection process successfully and give them strategies and skills to crack GD as well as PI to get selected with decent job offers

Course Pre/Co-requisite (if any):

1. Understanding grammar, number system and basic arithmetic, analytical reasoning concepts, covered in Aptitude and Soft Skills III
2. Professional profile building and Self introduction

Detailed Syllabus

UNIT 1: QUANTITATIVE APTITUDE 11 HOURS

Partnership 02 hours

Introduction & types; Speed, Distance and Time: Average Velocity; Race tracks - Straight and Circular; Trains; Boats and Streams.

Time and Work 02 hours

Basic concepts (relationship between men, days and work); Understanding group efficiency; Alternate work; Negative work; Wages; Pipes and Cisterns.

Permutation and Combination 02hours Basic Principles of Counting (Addition and Multiplication); Arrangements around- Circular, Square and Rectangular tables and in straight lines, circular permutation, selection, distribution.

Probability 02 hours

Introduction, various types of events; Classical definition of probability; Random and Discrete variables; Bayes' Theorem and question types.

Data Interpretation 03 hours

Introduction; Different ways of representing data- Narration based, pictorial, pie chart, Bar graph, line charts; various questions based upon them.

UNIT 2: VERBAL APTITUDE 09 HOURS

Cloze test 02 hours

Intricacies of cloze test, correct use of specific adjectives, concept of sentence improvement, writing concept, auxiliaries and modals.

Words 02 hours

Concept of consistency, precision, concision in terms of reading and writing, advance word choice with respect to placement papers, SAP (Subject-Audience-Purpose) approach.

Clauses **02 hours**

Subordinate Clauses- The noun clause, the adjective clause, the adverb clause, Analysis of simple and complex sentences, prepositional phrases, transformation of sentences.

Vocabulary **01 hour**

Revisiting vocabulary- high, medium and low frequency words, organization of ideas an thoughts in order to understand the text- The Pyramid Principle.

Questions **02 hours**

Various test taking skills in accordance with the placement papers.

UNIT 3: LOGICAL REASONING **11 HOURS**

Deductive Logic **03 hours**

Premises and conclusion structure, Quality of deductive argument, Categorical arguments, Syllogism, Conditional Arguments- If..then, only if..then, If and only if , Either or.

Puzzles **02 hours**

Grouping and selection, Double line up, Binary logic- truth teller-lie teller, Team formation and miscellaneous puzzles.

Set Theory and Critical Reasoning-II **03hours** Union and Intersection of sets, Use of venn diagrams in problem solving with two, three, four set, concept of maxima-minima through Venn diagram.

Critical reasoning II: Statement and Inference, cause and Effects, Statement and Arguments- Strengthen or Weaken the argument, Statement Assertion and Reason.

Non-Verbal Reasoning **01 hour**

Mirror-image, Water-image, Spotting out the embedded figures, Completion of incomplete pattern, Figure matrix, Paper folding, Paper cutting, Grouping of identical figures, Counting figures, Non verbal series / analogies / odd man out.

Data Sufficiency **02 hours**

Data Sufficiency based on logical reasoning field like Coding-Decoding / Puzzle Test / Blood Relations / Mathematical calculations / clock / calendar / etc.

UNIT 4: SOFT SKILLS **08 HOURS**

Group Discussion **04 hours**

Importance, Do's & Don'ts, Personality Traits, Tips and Strategies, Types of Group Discussions.

Suggested Exercises, Games & Activities: Mock Group Discussions (on basic topics), with feedback sharing and error analysis.

Personal Interview **04 hours**

Importance, Do's & Don'ts, Personality Interview, Tips and Strategies, Etiquette Rules.

Suggested Exercises, Games & Activities: Mock Personal Interviews (contd.) with feedback sharing and error analysis.

Learning Outcomes:

By the end of this semester, students will:

1. Be prepared for the upcoming placements and they will also be ready for other competitive exams.
2. Improve their GD and PI Skills and be able to have firsthand experience of a Placement drive and gain sufficient confidence to perform well.

Text book [TB]:

1. Quantitative Aptitude **:** How to prepare for Quantitative Aptitude, Arun Sharma, McGraw Hill, 8th edition, 2018.
2. Logical Reasoning**:** A Modern Approach to Logical Reasoning-R.S. Aggarwal, S Chand Publishing; 2nd Colour edition-2018.
3. Verbal Aptitude : English is Easy- Chetanand Singh, BSC Publication-2018.
4. Soft Skills : Group Discussion on Current Topics by P. N. Joshi; Upkar Prakashan-2010.

Reference books [RB]:

1. Quantitative Aptitude:Quantitative Aptitude for Competitive Examinations- R.S. Agarwal, S. Chand Publications-2017.

Quantitative Aptitude:Quantitative Aptitude-Saurabh Rawat & Anushree Sah Rawat Savera Publishing House, 1st edition-2016.

2. Logical Reasoning: Logical Reasoning and Data Interpretation for the CAT - Nishit K Sinha, Pearson India; 5th edition-2016.
   Logical Reasoning: Wiley's Verbal Ability and Reasoning - P A ANAND, Wiley-2016.
3. Verbal Aptitude: Oxford Guide to English Grammar- John Eastwood, Oxford University Press-2003.
   Verbal Aptitude: Fun with grammar- Suzanne W. Woodward Pearson Education ESL-1996.
4. Soft Skills: AComplete Kit for Group Discussion by S. Hundiwala; Arihant publications; edition-2018.
   Soft Skills: Basic Interviewing Skills by Raymond L. Gorden, Waveland Press, Inc.; 1 edition-1998.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME441	Subject Title	Advanced RAC						
LTP	2 1 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective Expose students to advanced refrigeration and air-conditioning systems and their thermodynamic analysis to solve the design problems.

Course Pre/Co- requisite (if any): Applied Thermodynamics II

Detailed Syllabus

UNIT 1: Compound Vapor Compression Refrigeration System

Compound compression with flash and liquid intercooler, Compound compression with multiple expansion valve and parallel operations, cascade refrigeration system, analysis of the compound vapor compression refrigeration system with use of p-h charts and solution of problems.

UNIT 2:Unconventional Refrigeration System

Analysis of water ammonia absorption system using enthalpy concentration charts and equilibrium charts, heat balance and C.O.P., Steam Jet refrigeration system, and Thermo-electric refrigeration system

UNIT 3: Load estimation of Air-conditioning systems

Heat gain calculations, choices of supply conditions, Solar heat gain, empirical methods to evaluate heat transfer through walls and roofs, equivalent temperature differential and its determination by calculation and tables, heat gain through glass, Solar heat gain factor, load due to other sources, stack effect, different methods of calculating cooling load as per ASHRE- brief idea (other than ETD methods).

UNIT 4:Air distribution systems

Air distribution systems in air conditioning, types of ducts, friction charts, duct losses, design velocity and its selection, duct heat gain or loss, duct insulation, duct layouts, duct sizing methods: equal friction, static regain methods.

Learning Outcome

At the end of the course the student can:

CO1: analyze the compound vapor compression refrigeration systems
CO2: analyze the vapor absorption refrigeration systems
CO3: analyze various unconventional refrigeration systems
CO4: estimate the cooling load of air-conditioning systems
CO5: analyze the air distribution systems

Text book [TB]:

1. C. P. Arora, Refrigeration and air-conditioning, Tata McGraw-Hill Publishing Company Limited, New Delhi.2010
2. Dossat R.J., Principles of refrigeration, John Wiley, S.I. Version, 4th Edition, 2006.

REFERENCES [RB]:

1. Pita Edward G., Air conditioning principles and systems, Pearson education, 4th edition2010.
2. Stoecker W. F & Jones J. W, Refrigeration and air-conditioning, McGraw-Hill Higher Education, 2nd edition, 1989.
3. Goshnay W.B., Principles and Refrigeration, Cambridge University Press, 1982.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME442	Subject Title	Gas Turbine And Jet Propulsion						
LTP	2 1 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To understand the features of compressible isentropic flows and irreversibilities like shocks

Course Pre/Co- requisite (if any): Applied Thermodynamics I, Power Plant Engineering

Detailed Syllabus

UNIT 1:

Review of Thermodynamic principles, Gas turbine cycles, main components of Gas turbine power plants, performance characteristics, typical Gas Turbine Plants. Methods of improving efficiency and power output of gas turbine plants.

UNIT 2:

Types of Gas turbine plants and their theory of operation, design consideration of gas turbine plants. Detailed study of main systems of gas turbine plants. Selection of materials of Gas turbine components. Trouble shooting, maintenance and actual performance evaluation of gas turbine plants. Recent development of gas turbine plants

UNIT 3:

Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines.

UNIT 4:

Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, space flights.

Learning Outcome

At the end of the course the student can:

CO1: Have a basic knowledge of jet and rocket propulsion technologies.
CO2: Apply gas dynamics principles to jet and space propulsion systems.
CO3: Student will get brief knowledge about rocket engines and propulsion system.

Text book [TB]:

1. "Gas Turbine Fundamentals", Cohen, Rogers and Saravanamutto, Pearson Education 2010
3. Ahmed F. El-Sayed, Aircraft Propulsion and Gas Turbine Engines, CRC Press, 2008.

REFERENCES [RB]:

1. Gas Turbines", V. Ganeshan, Tata-McGraw-Hill, New Delhi.2006
2. Hill P. and Peterson C., Mechanics & Thermodynamics of Propulsion, Addison Wesley, 1992.
3. "Jet Propulsion", Jack D. Mattingly, McGraw Hill Inc 2016
4. Sutton G.P., Rocket Propulsion Elements, John Wiley, New York, 1986.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME443	Subject Title	Design of Transmission System						
LTP	2 1 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To learn about the design procedures for mechanical power transmission components

Course Pre/Co- requisite (if any): Design of Machine Elements

Detailed Syllabus

UNIT 1:

Flexible transmission elements- design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets

UNIT 2:

Gear transmission- speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears.

UNIT 3:

Straight bevel gear- tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears; Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses, efficiency, estimating the size of worm gear pair. Cross helical gears, terminology, helix angles, sizing of a pair of helical gears.

UNIT 4:

Gear box- geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multi-seed gear box for machine tool applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications.

UNIT 5:

Cam design, types: pressure angle and undercutting base circle determination, forces and surface stresses; Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches; Electromagnetic clutches; Band and Block brakes, external shoe brakes, internal expanding shoe brake.

Learning Outcome

At the end of the course the student can:

CO1: Design transmission systems for engines and machines..
CO2: Students will learn about gear box design and selection process.
CO3: students will able to design cam design and selection process of any application.

Text book [TB]:

1. Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill, 2010.
2. Yi Zhang, Chris Mi, Automotive Power Transmission Systems, John Wiley & Sons, 31-Aug-2018

REFERENCES [RB]:

1. Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010.
2. Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill, 2001.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME444	Subject Title	Avionics						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To understand the basic of avionics and its need for civil and military aircrafts.

Course Pre/Co- requisite (if any): Fluid Mechanics

Detailed Syllabus

UNIT 1: Introduction to Avionics

Need for avionics in civil and military aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems, design, technologies – Introduction to digital computer and memories

UNIT 2: Digital Avionics Architecture

Avionics system architecture – data buses – MIL-STD-1553B – ARINC – 420 – ARINC – 629.

UNIT 3:Flight Decks and Cockpits

Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS

UNIT 4:Introduction to Navigation Systems

Radio navigation – ADF, DME, VOR, LORAN, DECCA, OMEGA, ILS, MLS – Inertial Navigation Systems (INS) – Inertial sensors, INS block diagram – Satellite navigation systems – GPS.

UNIT 5: Air Data Systems and Auto Pilot

Air data quantities – Altitude, Air speed, Vertical speed, Mach number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

Learning Outcome

At the end of the course the student can:

CO1: Understand and develop the avionic architecture and various avionics data buses
CO2: Develop various avionics subsystems
CO3:Student will learn about air data and navigation system .

Text book [TB]:

1. Albert Helfrick.D., "Principles of Avionics", Avionics Communications Inc., 2004
3. Collinson.R.P.G. "Introduction to Avionics", Chapman and Hall, 1996

REFERENCES [RB]:

1. Middleton, D.H., Ed., "Avionics systems, Longman Scientific and Technical", Longman Group UK Ltd., England, 1989.
2. Spitzer, C.R. "Digital Avionics Systems", Prentice-Hall, Englewood Cliffs, N.J.,U.S.A. 1993.
3. Spitzer. C.R. "The Avionics Hand Book", CRC Press, 2000
4. Pallet.E.H.J., "Aircraft Instruments and Integrated Systems", Longman Scientific

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME445	Subject Title	Total Quality Management						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To facilitate the understanding of total quality management principles and processes.

Course Pre/Co- requisite (if any): Manufacturing Process, Industrial Engineering and Management

Detailed Syllabus

UNIT 1:

Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality.

UNIT 2:

TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

UNIT 3:

The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types.

UNIT 4:

TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.

UNIT 5:

Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation, Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

Learning Outcome

At the end of the course the student can:

CO1: To facilitate the understanding of total quality management principles and processes.
CO2: Student will learn about ISO systems
CO3: Student will learn about various quality tools to improve products quality.

Text book [TB]:

1. Besterfield D.H. et al., Total quality Management, 3rd ed., Pearson Education Asia, 2006.
5. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
6. Subburaj Ramasamy, McGraw-Hill Education, 2012 - Total quality management.

REFERENCES [RB]:

1. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
2. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME446	Subject Title	Design of Hydraulics & Pneumatics System						
LTP	2 0 2	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: The subject gives in-depth knowledge of different system working on fluid power and compressed air with understanding of different valves used in the hydraulic and pneumatic system.

Course Pre/Co- requisite (if any): Fluid Mechanics and Fluid Machines

Detailed Syllabus

UNIT 1: Introduction

Mechanization vs. Automation, low cost automation with hydraulics and pneumatics. Requirement of industrial automation with hydraulics and pneumatics.

Basic pneumatics and hydraulics system: Fundamentals and basic principal of Hydraulics, advantages and disadvantages, pneumatics power vs. hydraulics power, overview of basic pneumatics and basic hydraulic systems.

UNIT 2: Hydraulic and pneumatic Actuators

Pumps and compressors: Pumps vs. compressor, classification of pumps, positive displacement pumps, rotary pumps, and reciprocating pumps, centrifugal pumps. Pump selection parameters. Types of air compressors, positive displacement compressor, rotary compressor, reciprocating compressor.

Cylinders and motors: Symbolic representation of motors and cylinders, cylinder classification on the basic of construction, single acting cylinder, double acting cylinder, other types of cylinders. Hydraulic and pneumatics cylinders, cylinder sizing, types of motors, motor rating, gear motors and vane motors

UNIT 3: Fluid Accessories and control valves

Fluid Accessories: Air receiver, air dryer, air filter, Pressure regulator, Air service unit (FRL), Seals, hydraulic filters, accumulator, intensifier, Hoses ,pressure gauge.

Control Valves: Direction control valves, Pressure control valves, Flow control valves, Non-return valves, Reservoirs, Sequence valve, pneumatic logic valve, shuttle and servo valves, Selection of valves for circuits,

Symbolic representation of control valves and fluid accessories.

UNIT 4: Design of pneumatic circuits

Pneumatics circuits for control of single acting cylinder and double acting cylinder. Circuit with mechanical feedback, speed control circuit, use of flow control valve, quick exhaust valve in pneumatics circuits. Application with twin pressure and shuttle valves. Sequencing and cascading method for two and three cylinder application.

UNIT 5: Design of hydraulic circuits

Hydraulic circuits for control of single acting cylinder and double acting cylinder. Circuit with mechanical feedback, speed control circuit, use of flow control valve, quick exhaust valve in hydraulic circuits. Application with twin pressure and shuttle valves. Designing of Sequencing and cascading circuit for two and three cylinder application.

Learning Outcome

At the end of the course the student can:

CO1: Identify and analyse operation of industrial fluid power and pneumatics systems, including the design, application, and trouble-shooting.

CO2: Design an appropriate hydraulic or pneumatic circuit or combination circuit like electro-hydraulics, electro-pneumatics for a given application. Develop a circuit diagram.

CO3: Identify different symbols of components used in hydraulic and pneumatic system.

CO4: Selection and sizing of components of the circuit.

Text book [TB]:

1. Industrial Hydraulics by John Pippenger and Tyler Hicks, McGraw Hill. 2010
2. Oil Hydraulic Systems, Principle and Maintenance by S R Majumdar, McGraw-Hill.2006
3. Fluid Power with Applications by Anthony Esposito, Pearson. 2010
4. Industrial automation and robotics by A.K.Gupta , University science press.1012

Reference books [RB]:

1. Fluid Power: Generation, Transmission and Control, Jagadeesha T., Thammaiah Gowda, Wiley.2010
2. The Analysis & Design of Pneumatic Systems by B. W. Anderson, John Wiley.2009
3. Control of Fluid Power Analysis and Design by Mc Clay Donaldson, Ellis Horwood Ltd.2006
4. Hydraulic and Pneumatic Controls: Understanding made Easy, K.Shanmuga Sundaram, S.Chand & Co Book publishers, New Delhi, 2006 (Reprint 2009)
5. Basic Pneumatic Systems, Principle and Maintenance by S R Majumdar, McGraw-Hill.
6. Basic fluid power Dudley, A. Pease and John J. Pippenger, , Prentice Hall, 1987

List of Experiments:

A. Experiments on Hydraulics Circuits:
    1. Extend-Retract and Stop system of a linear actuator.
    2. Regenerative circuit.
    3. Speed Control circuits: meter-in, meter-out and bleed off.
    4. Sequencing circuit
    5. Use of solenoid operated DCV.
    6. Rapid Traverse and Feed circuit.

B. Experiments on Pneumatic Circuits:
    1. Study of Compressor, FRL unit and 5/3 DCV.
    2. Reciprocating motion of a single and a double-acting actuator using 5/3 DCV.
    3. Speed control circuits.
    4. Automatic to & fro motion of a pneumatic linear actuator.
    5. Sequencing circuit.
    6. Logical circuits using shuttle valve.
    7. Cascading Circuit

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME447	Subject Title	Mechanical Vibration						
LTP	2 1 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: This course aims to provide you with an understanding of the nature and behaviour of dynamic engineering systems and the capability of applying the knowledge of mathematics, science, and engineering to solve engineering vibration problems.

Course Pre/Co- requisite (if any): Theory of Machines

Detailed Syllabus

UNIT 1:

Periodic motion, harmonic motion, superposition of simple harmonic motions, beats, Fourier analysis. Single Degree Freedom System: Free vibration, Natural frequency, Newton's method, Rayleigh method and Energy method for determining natural frequency, Response to an initial disturbance, Torsional vibrations, Damped vibrations. Damping models – Structural, Coulomb and Viscous damping, Vibrations of system with viscous damping, Logarithmic decrement, Viscous dampers.

UNIT 2: Single Degree Freedom

Forced vibration, Sources of excitation, Harmonic Excitation with viscous damping, Steady state vibrations, forced vibrations with rotating and reciprocating unbalance, support excitation, Vibration Isolation and Transmissibility, Vibration measuring instruments- Displacement, Velocity, Acceleration and Frequency measuring instrument.

UNIT 3: Two Degree of Freedom System

Introduction, Principal modes, Double pendulum, Torsional system with damping, Coupled System, Vibration absorbers, Centrifugal pendulum absorber, Dry friction damper, Untuned viscous damper.

UNIT 4: Multi-degree of Freedom Systems

Exact Analysis, Undamped free and forced vibrations of multi degree system, Influence coefficients, Reciprocal Theorem, Torsional vibration of multi-rotor system, Principal coordinates, Numerical Analysis - Rayleigh's Mehod, Dunkerley's formula, Holzer's Method, Stodola's Methods and Rayleigh – Ritz method.

UNIT 5: Critical Speed of Shafts

Shafts with one disc with and without damping, Multi-disc shafts, Secondary Critical speed.
Continuous systems- Longitudinal vibration of bars, Torsional vibrations of Circular Shafts, Lateral vibration of beams.

Learning Outcome

At the end of the course the student can:

Upon successful completion of this course you should be able to:

CO1: Develop mathematical model of dynamic systems with single degree of freedom,

CO2: Develop mathematical model of dynamic systems with multiple degrees of freedom,

CO3: Calculate natural frequency and period of simple vibrating mechanical systems,

CO4: Deal with engineering systems involving vibration isolation and rotating imbalance

Text book [TB]:

1. S.S. Rao, Mechanical Vibrations, 4th edition, Pearson,2014
2. Magreb, Cengage, Mechanical Vibration, India, New Delhi 2012

Reference books [RB]:

1. Dr. Debabrata Nag, Mechanical Vibrations, 1st edition,2011
2. V. P. Singh, Mechanical Vibrations, 3rd edition, Dhanpat Rai & Co., 2011.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME448	Subject Title	Automobile Engineering						
LTP	2 0 2	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To understand the construction and working principle of various parts of an automobile.

Course Pre/Co- requisite (if any): Design of Machine Elements

Detailed Syllabus

UNIT 1:

Types of automobiles, vehicle construction and layouts, chassis, frame and body, vehicle aerodynamics, IC engines- components, function and materials, variable valve timing (VVT). Engine auxiliary systems, Fuel pump and acceleration advance, transistor-based coil ignition & capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS).

UNIT 2:

Transmission systems, clutch types & construction, gear boxes- manual and automatic gear shift mechanisms, over drive, transfer box, flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive.

UNIT 3:

Steering geometry and types of steering gear box, power steering, types of front axle, types of suspension systems, pneumatic and hydraulic braking systems, antilock braking system (ABS), electronic brake force distribution (EBD) and traction control.

UNIT 4:

Electric and Hybrid vehicles, application of Fuel Cells.

Types of Maintenance, Preventive Maintenance, Breakdown, Overhauling System

Learning Outcome

At the end of the course the student can:

CO1: Understand the function of each automobile component and also have a clear idea about the overall vehicle performance

CO2: Understand and have the knowledge of transmission system used in automobile.

CO3: have overview of steering systems and its types.

Text book [TB]:

1. Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 1997.
3. Crouse,W.L. and Anglin, D.L., "Automotive Mechanics", Tata McGraw Hill Publishing Company Ltd, New Delhi, 2005

Reference books [RB]:

1. Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi, 2002.
2. Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999.
3. Heisler H., Advanced Engine Technology, SAE International Publ., USA, 1998

List of Experiments:

1. Study of layout of an Automobile.
2. Study of braking system of an automobile.
3. Study of steering system of an automobile.
4. Study of Fuel supply system of an automobile.
5. Study of Suspension system of an automobile.
6. Heat balance sheet of diesel engine test rig.
7. Engine Performance Characteristics and Morse's test.
8. Study of Transmission system of an automobile.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME449	Subject Title	Micro & Nano Machining						
LTP	2 0 2	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To enable the students, understand the basic principles and mechanism of Traditional and Advanced Micro Nano machining and its applications, fundaments of MEMS and its techniques

Course Pre/Co- requisite (if any): Manufacturing Processes

Detailed Syllabus

UNIT 1: Introduction to Micro Nano Machining

Need-evolution- fundamentals and trends in micro and nano technologies-Consequences of the technology and society-challenges to manufacturing technology-evolution of precision in manufacturing, tooling and current scenario- Micro Nano materials, fabrication tools, requirements and applications.

UNIT 2: Traditional Micro Nano machining

Theory of micromachining – Chip formation – Size effect in micromachining – micro-turning micro milling, Micro drilling - Micromachining tool design – Precision Grinding – Partial ductile mode grinding – Ultraprecision grinding.

UNIT 3: Advanced Micro Nano machining

Introduction-Classification- Mechanical Micromachining (AJM, USM)- Thermal Micromachining (EDM, LBM, EBM)-Electrochemical and Chemical Micromachining, Ion Beam Machining, Photochemical Etching.

UNIT 4: Abrasive based Micro Nano machining

Abrasive Flow Finishing (AFF), Magnetic Abrasive Finishing (MAF), Magnetorheological Finishing, Magnetorheological Abrasive Flow Finishing, Elastic Emission Machining (EEM) and Magnetic Float Polishing

UNIT 5: MEMS

Introduction to MEMS, Definitions and classifications-History-applications-MEMS Market- Bulk Micromachining-Wet and Dry Etching-Surface Micromachining-Chemical-Vapor Deposition-Lithography-Wafer Bonding.

Learning Outcome

At the end of the course the student can:

CO1: Understand the basic need of Micro Nano Machining in different industries.
CO2: Demonstrate and understand the Traditional Micro Nano machining techniques.
CO3: Demonstrate and Understand different mechanisms in Advanced Micro Nano machining.
CO4: Understand the importance of Abrasives in Micro Nano Machining.
CO5: Understand the need of MEMS in Micro Nano Machining.

Text book [TB]:

1. V.K.Jain, Introduction to Micromachining, Narosa publishing House, New Delhi.2010
2. V. K. Jain (2012), Micromanufacturing Processes, CRC Press

Reference books [RB]:

1. J. Paulo Davim, Mark J. Jackson (2009) Nano and Micromachining, John Wiley & Sons
2. Mohamed Gad-el-Hak (2010) MEMS Introduction and Fundamentals, CRC Press

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME450	Subject Title	Automatic Control						
LTP	2 1 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: The objective of this course is to apply knowledge of mathematics and engineering to analyze and design a control system to meet desired specifications. Students should learn to analytically determine a control system's functionality and select appropriate tests to demonstrate system's performance and finally design a control system to meet a set of requirements.

Course Pre/Co- requisite (if any): Engineering Mathematics

Detailed Syllabus

UNIT 1:

Introduction to control system, types of control system, applications of control system, transfer function, block diagram analysis, signal flow graphs, introduction to differential equations, mathematical models of physical systems.

UNIT 2:

Introduction to Laplace transform, Laplace transform theorems, inverse Laplace transforms and theorems, application of the Laplace Transform to the Solution of Linear Ordinary Differential Equations.

UNIT 3:

Feedback characteristics of control systems, control systems and components; Time response analysis: Time Response of linear control systems, the Unit-Step Response and Time-Domain Specification, Steady-State Error, Time Response of a First-Order System, Transient Response of a Second-Order System.

UNIT 4:

Concepts of stability and algebraic criteria; Routh's stability criteria, Root locus technique; basic properties of Root Loci, properties of the Root Loci, Frequency response analysis, Bode plot and Nyquist stability criteria and Nyquist plot.

UNIT 5:

Stability in frequency domain; phase lag, phase lead, Introduction to controller design, PI, PD and PID controller. Introduction to state variable analysis.

Learning Outcome

CO1: An ability to apply knowledge of mathematics, science and engineering.
CO2: ability to perform laboratory work and report on its outcome.
CO3: An ability to use the analysis and design tools of classical linear control in simplified homework problems, and in more realistic laboratory problems.
CO4: Communication skills (personal and academic). To help the student develop critical thinking and Problem-solving. Practical and subject specific skills (Transferable Skills).

Text book [TB]:

1. Kuo, B., "Automatic Control Systems", John Willey and Sons, 8th edition, 2009.
2. Ogata, K., "Modern Control Engineering", Prentice Hall, 5th edition, 2010

Reference books [RB]:

1. U.A.Bakshi, V.U.Bakshi, Automatic Control System, Technical Publications, 2009.
2. Nagrath, I.J. and Gopal, M., 2006, Control system engineering, New Age International publishers.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME451	Subject Title	Finite Element Analysis						
LTP	2 0 2	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To enable the students, understand the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics, heat transfer and fluid flow problems.

Course Pre/Co- requisite (if any): Strength of materials, Engineering Mathematics

Detailed Syllabus

UNIT 1: Introduction to Finite Element Method

General description of Finit Element Method – Historical development – Comparision with classical methods – General procedure of FEM - Applications of FEM – FEA softwares. General field problems, discrete and continuous models, Variational formulation in finite elements – Ritz method - Weighted residual methods – Galerkin – sub domain – method of least squares and collocation method - numerical problems.

UNIT 2: Discretization and Interplolation Function

Discretization: Geometrical approximations – Simplification through symmetry – Element shapes and behaviour – Choice of element types – size and number of elements – Element shape and distortion – Location of nodes – Node and Element numbering.

Interpolation Function: Simplex - Complex and Multiplex elements – Selection of interpolation polynomials - Convergence requirements – Natural coordinate systems - Derivation of shape functions for various elements – Isoparametric elements – Numerical Integration.

UNIT 3: Applications in structural

One dimensional elasticity – Castigliano's first theorem – Principle of minimum potential energy - Linear spring - Elastic bar bar with constant and varying cross sections using linear and quadratic elements – Truss structures and Beams.

UNIT 4: Applications in plane elasticity

Introduction to plane elasticity theory – Plane stress, Plane strain and Axisymmetric problems – Finite Element formulations of plane elasticity problems using CST and four noded quadrilateral elements only.

UNIT 5: Applications in Heat Transfer and Fluid Mechanics

Finite Element formulation of One-dimensional and Two-dimensional steady state heat conduction problems with convection - Simplex elements only.

Finite Element formulation of inviscid and incompressible flow – Potential function formulation – Stream function formulation.

Learning Outcome

At the end of the course the student can:

CO1: Apply the knowledge of Mathematics and Engineering to solve problems in structural, heat transfer and fluid flow by FEM

CO2: Use commercial FEA packages like ANSYS and modern CAD/CAE tools for solving real life problems

CO3: Derive finite element equations for simple and complex elements

Text book [TB]:

1. Tirupathi R. Chandrupatla and Ashok D. Belugundu, (2011), Introdution to Finite Elements in Engineering, Prentice Hall.
2. David V Hutton, (2009), Fundamentals of Finite Element Analysis, Tata McGraw-Hill Education.

Reference books [RB]:

1. Daryl L. Logan, (2011) A First Course in the Finite Element Method, Cengage Learning.
2. Bathe Klaus-Jurgen, (2009), Finite element procedures, PHI Learning.
3. Rao S. S., (2011), The Finite Element Method in Engineering, Elsevier.
4. Zienkiewicz O.C., Taylor R.L., Zhu J.Z. (2011), The Finite Element Method: Its basis and fundamentals, Butterworth Heinmann.
5. Madenci Erdogan, Guven Ibrahim (2011), Finite Element Method and Applications In Engineering using ANSYS, Springer.

List of Experiments:

1. Introduction to ANSYS: 6 hrs.
2. Analysis of spring systems
3. One-Dimensional elasticity problems
4. Plane truss analysis
5. Beam analysis
6. 2-D frame analysis
7. Plane stress analysis using CST element
8. One-dimensional heat conduction considering convection

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	CS481	Subject Title	Software Quality Engineering						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4th	Semester	VII

UNIT-I: Introduction (7 L)

Defining Software Quality, Software Quality Attributes and Specification, Cost of Quality, Defects, Faults, Failures, Defect Rate and Reliability, Defect Prevention, Reduction, and Containment, Overview of Different Types of Software Review, Introduction to Measurement and Inspection Process, Documents and Metrics.

UNIT-II: Software Quality Metrics (8 L)

Product Quality Metrics: Defect Density, Customer Problems Metric, Customer Satisfaction Metrics, Function Points, In-Process Quality Metrics: Defect Arrival Pattern, Phase-Based Defect Removal Pattern, Defect Removal Effectiveness, Metrics for Software Maintenance: Backlog Management Index, Fix Response Time, Fix Quality, Software Quality Indicators.

UNIT-III: Software Quality Management and Models (8 L)

Modeling Process, Software Reliability Models: The Rayleigh Model, Exponential Distribution and Software Reliability Growth Models, Software Reliability Allocation Models, Criteria for Model Evaluation, Software Quality Assessment Models: Hierarchical Model of Software Quality Assessment.

UNIT-IV: Software Quality Assurance (8 L)

Quality Planning and Control, Quality Improvement Process, Evolution of Software Quality Assurance (SQA), Major SQA Activities, Major SQA Issues, Zero Defect Software, SQA Techniques, Statistical Quality Assurance, Total Quality Management, Quality Standards and Processes.

UNIT-V: Software Verification, Validation & Testing: (8 L)

Verification and Validation, Evolutionary Nature of Verification and Validation, Impracticality of Testing all Data and Paths, Proof of Correctness, Software Testing, Functional, Structural and Error-Oriented Analysis & Testing, Static and Dynamic Testing Tools, Characteristics of Modern Testing Tools.

Text Book:

1. Jeff Tian, Software Quality Engineering (SQE), Wiley-Interscience, 2005; ISBN 0-471- 713457.
2. Stephen H. Kan, Metrics and Models in Software Quality Engineering, Addison-Wesley (2002), ISBN: 0201729156

Reference Book:

1. Stephen H. Kan, Metrics and Models in Software Quality Engineering, Addison-Wesley Professional
2. Taz Daughtrey, Fundamental Concepts for the Software Quality Engineer, ASQ Quality Press.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	IT353	Subject Title	Basics of Data Science						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4th	Semester	VII

Course Objective:

1. The objective of the course is to make the students understand the different techniques for efficient mining of the data.
2. To introduce students to the concepts, processes and practice of Inference Rules at different abstraction levels of Data.
3. To provide an understanding of the Data management perspective regarding the use of business intelligence (BI), Data Mining systems and Advanced Applications.

Detailed Syllabus

UNIT 1

Data Science :Introduction to Data Science, Overview, Motivation, Data Mining-Definition & Functionalities.

Data Warehousing: Overview, Definition, Delivery Process, Difference between Database System and Data Warehouse, Multi-Dimensional Data Model, Data Cubes, Stars, Snow Flakes, Fact Constellations, Concept hierarchy, Process Architecture, 3 Tier Architecture, Data Marting.

(12L)

UNIT 2

Data Pre-Processing: Data Cleaning: Missing Values, Noisy Data,(Binning, Clustering, Regression, Inconsistent Data, Data Integration and Transformation.

Data Reduction: Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Clustering, Discretization and Concept hierarchy generation.

Data objects and attribute types, Measuring Data Similarity and Dissimilarity, Cosine Similarity.

(**7 L)**

UNIT 3

Concept Description: Definition, Data Generalization, Analysis of attribute relevance, Mining Class comparisons, Statistical measures in large Databases. Measuring Central Tendency, Box Plots, Measuring Dispersion of Data, Apriori Algorithm, Mining Multilevel Association rules from Transaction Databases , FP-growth algorithm.

(7 L)

UNIT 4

Classification: What is Classification, Issues regarding Classification, Attribute selection measures, Information Gain, Gain Ratio, Gini Index, Decision tree, Naïve Bayesian Classification, Metrics for evaluating classifier performance, Confusion matrix. **(6 L)**

UNIT 5

Cluster Analysis: Data types in cluster analysis, Overview of basic clustering methods, Partitioning methods: K-Means and K-medoids technique, Hierarchical Clustering: Agglomerative and Divisive, Density Based Methods :DBSCAN and OPTICS, Grid Based Methods: STING and CLIQUE, Outlier Analysis.

(8 L)

Learning Outcome

The course provides the students the ability to:

1 - Undertake systematic investigation/research related to the Data mining Concepts

2- Understand advanced Database systems and technologies for today's dynamic business environment.

Text book [TB]:

1. Jiawei Han, MichelineKamber, ”Data Mining Concepts & Techniques” Elsevier.

Reference books [RB]:

1. M.H.Dunham,”DataMining :Introductory and Advanced Topics” Pearson Education
2. Mallach,”Data Warehousing System” ,McGraw –Hill

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	IT356	Subject Title	Multimedia						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4th	Semester	VII

Course Objective:

1. To make students learn about basic understanding of the multimedia objects and tools for object generation
2. To teach students audio and video file formats used now days as a part of IT generation.
3. To make students learn clear understanding of multimedia projects.
4. To make students learn different compression techniques.

Detailed Syllabus

UNIT 1

Introduction: Introduction to Multimedia, Multimedia Information, Multimedia Objects, Multimedia in business and work, Stages of Multimedia Projects, presentation tools, tools for object generations, video, sound, image capturing, authoring tools, card and page based authoring tools **(8 L)**

UNIT 2

Multimedia Building Blocks: Text, Sound MIDI, Digital Audio, audio file formats, MIDI under windows environment Audio & Video Capture.
(8 L)

UNIT 3

Data Compression: Introduction to data compression, Compression ratio, loss less & lossy compression, Huffman Coding, Shannon Fano Algorithm, Huffman Algorithms, Adaptive Coding, Arithmetic Coding ,Finite Context Modelling, Dictionary based Compression, Sliding Window Compression, LZ77,LZ78, LZW compression.
(8 L)

UNIT 4

Image, Audio and Video Compression: Digital Audio concepts, Sampling Variables, Loss less compression of sound, loss compression & silence compression, lossy graphic compression, image file format, animations Images standards, JPEG Compression, Zigzag Coding, Multimedia Database. Content based retrieval for text and images, Video Compression, MPEG standards, MHEG Standard Video Streaming on net.
(8 L)

UNIT 5

Advanced forms of interaction in Multimedia: Video Conferencing, Elements of (immersive/non-immersive) Virtual Reality, Augmented Reality, Tele presence, Mobile technologies.
Multimedia Security: Overview- Multimedia Systems, Secured Multimedia, Digital Rights Management Systems and Technical trends, Multimedia Encryption and Digital Watermarking, Security Attacks and Multimedia Authentication. **(8 L)**

Learning Outcome

At the end of the course, Learning Outcomes Having successfully completed this course, the student will demonstrate:

1. Students will understand various multimedia tools available.
2. Students will be able to learn with Multimedia projects
3. Students can differentiate between lossy and lossless compression.

Text Book [TB]:

1. Tay Vaughan "Multimedia, Making IT Work" Osborne McGraw Hill,7th edition
2. Khalid sayood "Introduction to data compression" Morgan Kaufmann Publishers,3rd edition

Reference Book [RB]:

1. Buford "Multimedia Systems" Addison Wesley.,4th edition
2. Mark Nelson "Data Compression Book" BPB.,3rd edition
3. Sleinreitz "Multimedia System" Addison Wesley,5th edition

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	EC383	Subject Title	Consumer Electronics						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4th	Semester	VII

Objectives of the Course: The students will learn

- Consumer Electronics and its application
- Concept of audio and video related system.
- Concepts of recording and power supplies.

UNIT-I

Audio Systems: Microphones, Loudspeakers, Speaker baffle and enclosure, Acoustics, Mono, Stereo, Quad, Amplifying Systems, Equalisers and Mixers, Electronic Music Synthesisers, Commercial Sound, Theater Sound System

8LU

UNIT – II

Video Systems and Displays: Monochrome TV, Colour TV standards and systems, TFT, Plasma, HDTV, Digital TV, Video Telephone and Video Conferencing **8L**

UNIT III:

Domestic Appliances: Washing machines, Microwave ovens, Air- conditioners and Refrigerators, In car computers Office Systems: FAX, Xerox, Telephone Switching System, Mobile Radio System

8L

UNIT IV:

Recording and Reproduction Systems: Disc recording and reproduction, Magnetic recording and reproduction, Video tape recording and reproduction, Video disc recording and play back, Distortion and Noise reduction in Audio and Video System **8L**

UNIT-V

Power Supplies and other systems: SMPS, UPS and Preventive Maintenance, Set Top Boxes, Remote controls, Bar codes, ATM **8L**

Text Books:

1. Consumer Electronics S P Bali Pearson ed 2005

OUTCOMES OF THE COURSE:

The course provides an understanding of:

- Electronic systems related to consumer applications.
- Principle of working of various home appliances.
- Skills to use modern consumer electronics systems used in day to day life.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	EC385	Subject Title	Analog Electronics						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4th	Semester	VII

Objectives of the Course: To teach the fundamental concepts of various electronic devices, circuits and their application. To develop ability among students for problem formulation, system design and solving skills.

UNIT-I

Semiconductor materials and properties Group-IV materials, Covalent bond, electron-hole concepts Basic concepts of energy bands in materials, concepts of forbidden gap Intrinsic and extrinsic semiconductors, donors and acceptors impurities **4L**

UNIT-II

Junction diode and diode applications p-n junction, depletion layer, v- i characteristics, diode resistance, capacitance diode ratings (average current, repetitive peak current, non-repetitive current, peak-inverse voltage). **4L**

Diode Applications Rectifiers (half wave and full wave), filter (C – filter), clipping circuits, clamping circuits, voltage multipliers **4L**

UNIT-III

Breakdown diodes Breakdown mechanisms (zener and avalanche), breakdown characteristics, zener diode application as shunt regulator **4L**

UNIT-IV

Bipolar Junction Transistor Basic construction, transistor action, CB, CE and CC configurations, input/output Characteristics, Transistor Amplifier Graphical analysis of CE amplifier, concept of voltage gain, current gain.

6L

UNIT-V

Field Effect Transistor

JFET: Basic construction, transistor action, concept of pinch off, maximum drain saturation current, input and transfer characteristics, characteristics equation CG, CS and CD configurations,
MOSFFT: depletion and enhancement type MOSFET-construction, operation and characteristics.

6L

Reference Books:

1. Boylestad and Nashelsky, 'erlectronic Decvices and circuits' PHI, 6e, 2001.
2. A Mottershead, 'Electronic devices and circuits'. PHI, 2000.
3. Morris Mano, 'Digital Computer Design', PHI, 2003.
4. R.K. Singh & Ashish, Basic Electronics Engg. Laxmi Publication, 2007.

5. Milman & Halkias, Integrated electronics Electronics, PHI, 2005.

OUTCOME OF THE COURSE:

- Students will be able to build, develop, model, and analyze the electronic circuits along with learning the device ratings and characteristics
- Students will be able to design and analyse electronic circuits

List of Experiments:

1. To study V-I characteristics of p-n junction diode.
2. To study V-I characteristics of zener diode.
3. To study half-wave rectifier and calculate ripple factor and efficiency.
4. To study full-wave rectifier and calculate ripple factor and efficiency.
5. To study clipper circuits.
6. To study clamper circuits.
7. To study the input and output characteristics of CB and CE transistor.
8. To study drain and transfer characteristics of JFET.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	EE481	Subject Title	NEW AND RENEWABLE ENERGY SOURCES						
LTP	3 0 0	Credit		Subject Category	Open Elective	Year	4th	Semester	VII

Objectives of the Course

- To introduce fundamentals of various renewable energy source
- To introduce fundamentals of technologies used to harness usable energy from solar, wind,
- To introduce fundamentals of technologies used to harness usable energy from ocean and Biomass energy sources.

Unit 1	I**ntroduction :**Energy resources and their classification, oil crisis of late 20th century and its impacts on energy planning, consumption trend of primary energy sources, world energy future, energy audit and energy conservation, energy storage.	**8L**
Unit 2	**Solar Energy Conversion** :Solar resources, passage through atmosphere, solar thermal energy conversion: solar energy collectors, solar thermal power plant, solar PV conversion: solar PV cell, V-I characteristics, MPPT, Solar PV power plant and applications.	**8L**
Unit 3	**Biomass Energy Conversion :** Usable forms of Bio Mass, Biomass energy resources, biomass energy conversion technologies, ethanol blended petrol and diesel, biogas plants. Energy farming.	**8L**
Unit 4	**Wind Energy Conversion :** Wind Power: Energy estimation, Power extraction, lift and drag forces, horizontal axis wind turbine, vertical axis wind turbine, wind energy conversion and control schemes, environmental aspects.	**8L**
Unit 5	**Other Alternate Energy Sources/Technologies:** Geothermal Energy: geothermal fields, types, geothermal energy generation systems, ocean tidal energy systems, fuel cell: basic operation and classification, principle of MHD generation, output voltage and power, environmental aspects.	**8L**

Text Books:

1. B.H. Khan, Non conventional Energy Resources, 2nd edition, 2009.

Reference Books

1. G.D. Rai, Non Conventional Sources of Energy, (Khanna Publishers).
2. J.W. Twidell& A.D. Weir, Renewable Energy Resources, (ELBS / E. & F.N. Spon., London).
3. Godfrey Boyle, Renewable Energy, Oxford, 2nd edition 2010.

Outcome of the Course:

- **Identify renewable energy sources.**
- **Understand the mechanism of solar, wind and ocean energy sources.**
- **Demonstrate the understanding of various technologies involved in power generation from renewable energy sources.**

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	PE481	Subject Title	Fuel Technology						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4th	Semester	VII

1. Course Summary

This course will introduce students to classification of fuel and their properties. In this course, students unable to understand coal preparation, coal storage process, coal gasification process. This course also covers various topics which includes Fischer Tropsch Synthesis, Gaseous and liquid fuels i.e. natural gas, producer gas, water gas, coal gas, biogas, LPG, kerosene, diesel. Students will also learn combustion mechanism for solid, liquid and gaseous fuel.

2. Course Objectives

The students should be able to:

1. Understand different types of fuel, basic terms in fuels and combustion
2. Understand the coal preparation and conversion of coal into suitable products using gasification and Fishers Tropsch Synthesis process.
3. Understand physical and chemicals properties of different types of fuel and their storage techniques, combustion mechanism
4.

3. Course Outcomes

A good knowledge of this course will enable students to:

1. Understand origin of different of types of fuel and their properties and classification
2. Understand the Coal preparation and storage techniques, Physical and chemical properties of coal, Briquetting and liquefaction of solid fuels
3. Understand the conversion of coal into useful products using gasification techniques and Fischer Tropsch Synthesis
4. Understand about gaseous and liquid fuels, their physical and chemical properties and Testing methods for these fuels
5. Understand about combustion mechanism for different types of fuels and Furnace elements.

4. Curriculum Content

UNIT 1

Classification of Fuel- Solid Fuels, Liquid Fuels, Gaseous Fuels, Various Terms Related to the Study ofFuels and Combustion. Coal-Origin, Composition, Petrography,Analysis and Properties of Coal,Classification of coal

UNIT 2

Coal Preparation, Coal Storage, Coal Carbonization and by-product Recovery. Physical and Chemical, Properties of Coke.Briquetting of Solid Fuels. Liquefaction of Solid Fuels

UNIT 3

Coal: A Source of Energy- Gasification of Coal. Fixed Bed Gasification, Fluidized Bed Gasification,Entrained Bed Gasification. Integrated Gasification Combined Cycle (IGCC).Underground Gasificationof Coal. Indian Scenario related to Coal Gasification. Coal to Liquid (CTL) via Fischer – Tropsch (F-T)Synthesis.

UNIT 4

Gaseous and Liquid Fuels- Natural gas, Producer gas, Water gas, Carbureted Water gas, Coal gas, Gasesfrom biomass, LPG. Gasoline, Kerosene, Diesel.Physico Chemical Properties and Testing of LiquidFuels. Coal Tar Fuels (CTF).

UNIT 5

Combustion: General Principle of Combustion, Combustion of Solid Fuels – Grate Firing and Pulverized Fuel Firing System. Combustion of Liquid Fuels, Burners for Liquid and Gaseous Fuels Combustion

Text book [TB]:

1. **Kuo, K.K., Principles of Combustion, John Wiley and Sons, Inc. (2005).**
2. **Sarkar, S., Fuels and Combustion, Orient Longman, (1990).**

Reference books [RB]:

1. **Sharma, S.P., and Chander, M., Fuels and Combustion, Tata Mcgraw Hill (1984)**

5. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	PE482	Subject Title	Health Safety and Environment in Industry						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4th	Semester	VII

1. Course Summary

The course will introduce students to the need and scope of health, safety and environment in industry. The students will learn about the sources and causes of pollution, effects of the pollutants on livings and environment, and the safety and remedial measures that should be adopted to reduce the pollution.

2. Course Objectives

The students should be able to:

1. Understand the sources of pollutions.
2. Understand the effects of pollutions on health and environment.
3. Understand the remedial measures and safety precautions associated with each source of pollution.

3. Course Outcomes

On successful completion of the course, students have the understanding of the following:

1. Understand the scope of HSE in industry.
2. Understand the sources, effects and remedies of air pollution.
3. Understand the sources, effects and remedies of water pollution.
4. Understand the sources, effects and remedies of liquid and solid wastes.
5. Understand the sources, effects and remedies of noise pollution.

4. Curriculum Content

UNIT 1

Introduction: Man And Environment: Overview (Socio-Economic Structure & Occupational Exposures); Scope Of Environmental Engineering; Pollution Problems Due To Urbanization & Industrialization.

UNIT 2

Air Pollution : Causes Of Air Pollution; Types & Sources Of Air Pollutants; Climatic & Meteorological Effect On Air Pollution Concentration; Formation Of Smog And Fumigation; Analysis Of Air Pollutants Collection Of Gaseous Air Pollutants; Collection Of Particulate Pollutants; Analysis Of Air Pollutants Like : Sulphur Dioxide, Nitrogen Oxide, Carbon Monoxide, Oxidants &Ozone; Hydrocarbons; Particulate Matter; Control Of Particulate Emission- Control Of Gaseous Emission; Flue Gas Treatment Methods : Stacks Gravitational And Inertial Separation; Settling Chambers; Dynamic Separators; Cyclone; Filtration; Liquid Scrubbing; Spray Chambers; Packed Towers; Orifice And Venturi Scrubbers; Electrostatic Precipitators.

UNIT 3

Water Pollution & Its Control - Origin Of Waste Water – Types Of Water Pollutants And Their Effects ; Adverse Effects On: Human Health & Environment; Aquatic Life; Animal Life; Plant Life; Water Pollution Measurement Techniques; Water Pollution Control Equipments& Instruments; Indian Standards For Water Pollution Control.

UNIT 4

Liquid & Solid Wastes – Domestic & Industrial Wastes; Pesticides; Toxic: Inorganic & Organic Pollutants; Soil Deterioration; Ground Water Pollution; Concentration Of Infecting Agents In Soil; Solid Waste Disposal; Dumping Domestic & Industrial Solid Wastes; Advantages & Disadvantages; Incineration- Advantages & Disadvantages – Sanitary Land Field: Advantages & Disadvantages; Management Of Careful & Sanitary Disposal Of Solid Wastes.

UNIT 5

Noise Pollution & Control: Intensity; Duration; Types Of Industrial Noise; Ill Effects Of Noise; Noise Measuring & Control; Permissible Noise Limits.

Text book [TB]:

1. J. Turk & A. Turk, "Environmental Science Environmental Pollution".

Reference books [RB]:

1. Odum, "Fundamental of Ecology.

5. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	MA541	Subject Title	STATISTICAL TECHNIQUE AND APPLICATIONS						
LTP	3 0 0	Credit	3	Subject Category	Open Elective	Year	4th	Semester	VII

OBJECTIVE: The objective of this subject is to give the basic knowledge of descriptive and mathematical part of statistics. Applications of various probability distribution in the field of insurance and finance. The course will focus on the different situations in the field of actuarial science which can be dealt with transformation of variables. The course will make able the students to understand the association between two random quantities and to find their mathematical measure.

Unit I

Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, absolute moments, factorial moments, skewness and kurtosis, Sheppard's corrections.

Unit II

Bivariate data: Definition, scatter diagram, simple, partial and multiple correlation, rank correlation. Simple linear regression.

Unit III

Principle of least squares and fitting of polynomials and exponential curves. Theory of attributes Independence and association of attributes, consistency of data, measures of association and contingency, Yule's coefficient of colligation.

Unit IV

Testing of hypothesis: Z-test, t-test, F-test, Chi-square test for goodness of fit, Introduction to analysis of variance.

LEARNING OUTCOME: Students will able to:

- Analyze given statistical data.
- Have confidence to deal with real life situation, especially, in insurance and finance.
- Understand applications of standard probability distributions in every span of life.
- Find the association between two random quantities using mathematical theory.

Text Books:

1. Gupta, S.C. and Kapoor, V.K. (2007): Fundamental of Mathematical Statistics, 11thEdition. (Reprint), Sultan Chand & Sons.
2. Y.P. Agarwal (2012) Statistical Methods: Concepts, Application and Computation, 3rd edition; Sterling Publishers.

Reference Books:

1. Freund E F John, Mathematical statistics, 6th edition, Prentice Hall International, 1999.
2. Hogg, R. V. and Craig, T. T. (1978) Introduction to Mathematical Statistics (Fourth Edition) (Collier-McMillan).
3. Rohatgi, V. K. (1988) Introduction to Probability Theory and Mathematical Statistics (Wiley Eastern).

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Code	AR-481	Subject Title	GRAPHICS & PRODUCT DESIGN						
LTP	3 0 0	Credit	3	Subject Category	OE	Year	4th	Semester	VII

Course Objective:

To introduce the various aspects og graphics design and important stages of product design and development.

Unit 1: Introduction

Introduction and importance of graphics and product design.Principles and elements of design. History of Design.Colour Theory. Techniques and processes to communicate graphically.

Unit 2: Product Design Cycle

Stages of product development. Introduction to ergonomics

Unit 3: Design Process

Introduction to concept. Concept development. Role of sketching in concept development. Implementation stages of concept for product development

Unit 4: Technology & Market Assessment

Customer needs identification, Market research essentials. Advertising and marketing tools.

Unit 5: Design Tools

Introduction to various design tools.

LEARNING OUTCOME:

1. The student will be able to understand the importance of Graphics.
2. The students will be able to understand and demonstrate their ideas visually.
3. The students will be able to understand the various stages of product development.

Text Books:

1. The Elements of Graphic Design, Alex W. White
2. The Design of Everyday Things, Don Norman

Reference Books:

1. Product Design & Development, Karl T. Ulrich & Steven D. Eppinger

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME381	Subject Title	Entrepreneurship and Startup						
LTP	2 0 2	Credit	3	Subject Category	UC	Year	4th	Semester	VII

COURSE OBJECTIVE:

To understand the basic concepts Entrepreneurship and start up. To understand role and importance of entrepreneurship for economic development. To develop personal creativity and entrepreneurial initiative or start up.

COURSE OUTCOME

At the end of the course the student can:

CO1: Analyse the business environment in order to identify start up opportunities
CO2: Identify the elements of success of entrepreneurial ventures
CO3: Consider the legal and financial conditions for starting a start up
CO4: Evaluate the effectiveness of different entrepreneurial strategies

Unit 1: 4Hrs.

Conceptual definition of entrepreneurs, entrepreneurship and start up. Historical development of entrepreneurship. Entrepreneurship in economic theory. Entrepreneurial practice. Impact of Entrepreneurship on society. The role of entrepreneurship in economic development. Role of innovation in entrepreneurship.

Unit 2: 6Hrs.

Entrepreneurial economy. Entrepreneurship and Economic Development. Type of Entrepreneurship. Entrepreneur and small business. Features and types of entrepreneurs. Terms of entrepreneurship. Sources of business ideas. Technical and technological analysis of entrepreneurial projects. Designing a business investment. Angel Investor and Venture capitalist – Roles and Importance.

Unit 3: 5Hrs.

Forms of entrepreneurial organization. Entrepreneurial process. Entrepreneurial and start-up strategies. Role of Government agencies in Entrepreneurship development. Entrepreneurial project: entrepreneurial venture and entrepreneurial development chain. Knowledge of business economy. Group based strategies development.

Unit 4: 5Hrs.

Sources of capital. Market Research, Understanding the Market need for your concept. Defining the business concept and formulating a business plan for startup. Fundamentals of entrepreneurial management. Business process: product design, operational art, stock management.

Unit 5: 6Hrs.

Entrepreneurbiographies - the actual successes and failures. Exit strategies for entrepreneurs. Case studies of : Successful Entrepreneurial Ventures, Failed Entrepreneurial Ventures and Turnaround Ventures. Some case studies related to Product & Technology.

TEXT BOOKS:

1. S.S.Khanka, "Entrepreneurial Development". S.Chand & Co. Ltd.,10th edition, 2014.
2. Kuratko & Hodgetts, "Enterprenuership –Theory, process and practices", Thomson learning 6th edition, 2016.
3. Donald F Kuratko, "Entreprenuership – Theory, Process and Practice", 9th Edition, Cengage Learning 2014.

REFERENCE:

1. Hisrich R D and Peters M P, "Entrepreneurship". Tata McGraw-Hill. 9th Edition, 2014.
2. Rabindra N. Kanungo "Entrepreneurship and innovation", Sage Publications, 1998.

3. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development" Institute of India, Ahmadabad, 1986.
4. Rajeev Roy, 'Entrepreneurship' 2nd Edition, Oxford University Press, 2011.
5. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis" 2nd Edition Dream Tech, 2005.

EVALUATION BREAKUP:

- Case study – 25 Marks (Internal)
- Assignments – 10 Marks (Internal)
- Mid Term Evaluation of Project – 10 Marks (Internal)
- Startup Idea, Seminar - 15 Marks (External)
- End Term Evaluation of Project – 40 Marks (External)

*The End Term evaluation will consist of 25 to 30 minutes' presentation followed by questionnaire by External Experts.

RESOURCE PERSONS FROM VARIOUS DEPARTMENTS:

- Mechanical Engineering
- MBA
- Computer Science Engineering.
- Information Technology.
- Industry Persons.
    1. Experts from Industry – As recommended by STPI
    2. Dr Umakant Panwar – Entrepreneur
    3. Mr Vivek Harinarian - Entrepreneur.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME452	Subject Title	Solar Energy Systems						
LTP	2 1 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To provide students an overview of world's energy resources & their impact on environment. To highlight the importance of renewable energy sources with focus on solar energy and its importance in the context of limited supply of conventional resources & global warming. To impart essential technical knowledge of solar energy systems & their applications

Course Pre/Co- requisite (if any): Heat transfer

Detailed Syllabus

UNIT 1: Energy Resources & Solar Radiation

Introduction: Energy demand & supply; world's production & reserves of commercial energy sources; energy crisis – causes & options; alternative energy resources; Sun as a source of energy.

Solar radiation outside the earth's atmosphere & at the earth's surface, solar constant; spectral distribution of solar radiation; measurement of solar radiation; solar radiation data & geometry; solar radiation on horizontal & inclined surfaces; predicting the availability of solar radiation.

UNIT 2: Flat Plate Collectors

An overview of solar thermal collection & applications; conventional liquid flat plate collectors; performance analysis; transmissivity-absorptivity product; collector efficiency & heat removal factor; effect of various parameters on performance; analysis of collectors similar to the conventional collector; alternatives to the conventional collector.

UNIT 3: Concentrating Collectors

Description, classification and types of concentrating collectors; general characteristics; analysis of flat plate collector with plane reflectors; cylindrical parabolic collector – orientation, tracking modes, and performance analysis; linear reflector Fresnel collector; paraboloid dish collector; central receiver collector.

UNIT 4: Solar Thermal Applications

Solar water heating – natural & forced circulation systems; solar space heating using liquid flat collectors – active & passive methods; solar space cooling & refrigeration; solar drying & cooking; solar air heaters; solar electric power generation; solar thermos-mechanical systems; solar thermal energy storage – sensible, latent, and thermochemical storage; solar ponds.

UNIT 5: Solar Photovoltaic Systems

Fundamentals of photovoltaic conversion; description and basic principle of working of a solar cell; performance characteristics of a solar cell; maximum & actual conversion efficiencies; types of solar cells; solar cell, module, and array construction; photovoltaic systems and applications; stand-alone systems with battery storage & grid interactive systems; hybrid photovoltaic & thermal systems

Learning Outcome

At the end of the course the student can:

CO1: Understand about the interaction between energy, economy, environment, and social development.

CO2: Appreciate the importance of future energy systems based on solar energy.

CO3: Possess the basic technical knowledge to develop energy systems based on solar energy.

Text book [TB]:

1. S. P. Sukhatme & J. K. Nayak,"Solar Energy", 4th edition (2018), McGraw Hill Education (India) Private Limited, Chennai.
2. Napoleon Enteria, Aliakbar Akbarzadeh Solar Energy Sciences and Engineering Applications, CRC Press, 2013

Reference books [RB]:

1. J. A. Duffie & W. A. Beckman, "Solar Engineering of Thermal Processes", 4th edition (2013), Wiley
2. Soteris A. Kalogirou , Solar Energy Engineering: Processes and Systems, Academic Press, 2009

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME453	Subject Title	Machine Tool Design						
LTP	2 1 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To enable the students design tools, dies, jigs and fixtures and analyse and optimize an existing jig and fixture.

Course Pre/Co- requisite (if any): Design of Machine Elements, Manufacturing Processes

Detailed Syllabus

UNIT 1: Introduction and General Principles of Machine Tool Design

Developments in machine tools, Typesof machine tools, Constructional and Operational Features of basic machine tools e.g. Lathe, Drill, Milling, Shapers and Planers, Grinding machine etc., General requirement of machine tool design, Machine tool design process, Tool wear, Force Analysis.

UNIT 2: Machine Tools Drives

Classification of machine tool drives, Group vs Individual drives, Selection of electric motor, A brief review of the elements of mechanical transmission e.g. gear, belt and chain drives, slider-crank mechanism, cam mechanism, nut & screw transmission, Devices for intermittent motion, Reversing & Differential mechanisms, Couplings and clutches, Elements of hydraulic transmission system. e.g. pumps, cylinder, directional control valves, pressure valves etc., Fundamentals of kinematic structure of machine tools.

UNIT 3: Regulation of Speed and Feed rates

Laws of stepped regulation, Selection of range ratio, Standard progression ratio, Selection of best possible structural diagram, Speed chart, Design of feed box, Developing gearing diagrams, Step-less regulation of speed and feed in machine tool, Speed and feed control.

UNIT 4: Design of Machine Tool Structure

Function of machine tool structures and their requirements, Design criteria for machine tool structures, Selection of material, Basic design procedure for machine tool structures, Design of bed, column and housing, Model technique in design, Design of guide ways and power screws: basic guide way profiles, Designing guide way for stiffness and wear resistance, Hydrostatic and antifriction grand ways, Design of sliding friction power screws, Design of spindle & spindle supports, Layout of bearings, selection of bearings for machine tools.

UNIT 5: Dynamics of machine tools

General procedure for assessing the dynamic stability of cutting process, closed loop system, Chatter in machine tools. Control Systems: Functions, requirements & types of machine tool controls, Controls for speed & feed change, Automatic and manual Controls, Basics of numerical controls, Machine tool testing: Geometrical tests on Lathe, Milling and Drilling machines, their performance & significance

Learning Outcome

At the end of the course the student can:

CO1: Identify the importance of work holding device.

CO2: Design jigs and fixtures.

CO3: Calculate the required specifications of a press for required operations.

CO4: Design tools and dies for required operations.

Text book [TB]:

3. N.K. Mehta, “Machine Tool Design and Numerical Control” 3rd Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2012.
4. S.K. Basu and D.K. Pal, “Design of Machine Tools”, 5th Edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2009

Reference books [RB]:

3. N. Acherkan Machine Tool Design, Volume 2, University Press of the Pacific, 2000
4. G.C. Sen and A. Bhattacharya, “Principles of Machine Tools”, Second Edition, New Central Book Agency (P) Ltd., Kolkata, 2009

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME454	Subject Title	Principle of Management						
LTP	3 0 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To enable the students design tools, dies, jigs and fixtures and analyse and optimize an existing jig and fixture.

Course Pre/Co- requisite (if any): Industrial Engineering and Management

Detailed Syllabus

UNIT 1:

Definition of management, science or art, manager vs entrepreneur; Types of managers managerial roles and skills; Evolution of management- scientific, human relations, system and contingency approaches; Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management.

UNIT 2:

Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes..

UNIT 3:

Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management, Career planning and Management.

UNIT 4:

Directing, individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.

UNIT 5:

Controlling, system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

Learning Outcome

At the end of the course the student can:

CO1: Get a clear understanding of management functions in an organization.

CO2: Get knowledge about budgetary and non-budgetary system.

CO3: Students will understand the management technique controlling of system.

Text book [TB]:

1. Robins S.P. and Couiter M., Management, Prentice Hall India, 10th ed., 2009.
2. Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill, 1999

Reference books [RB]:

1. Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education, 2004.
2. Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill, 1999

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME455	Subject Title	Advanced Engineering Materials						
LTP	2 1 0	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To enable the students design tools, dies, jigs and fixtures and analyse and optimize an existing jig and fixture.

Course Pre/Co- requisite (if any): Materials Engineering

Detailed Syllabus

UNIT 1: Equilibrium and kinetics

Stability and metastability, basic thermodynamic function, statistical nature of entropy and kinetics of thermally activated process. Introduction to crystal structure and crystal imperfections Radius ratio rule. Diamond cubic structure and structure of graphite.

UNIT 2: Diffusion in solid

Fick's law of diffusion, Solution to ficks law of diffusion, application of fick's law, Kirkendall effect, atomic model of diffusion in solid, vacancy and interstitial model of diffusion and the mathematical modeling. Phase transformation: Gibs phase rule, Liver rule, some typical phase diagram. Nucleation and growth, Nucleation and growth kinetics, growth and over all transformation kinetics, transformation in steel and effect of alloying in steel and in cast iron. Precipitation process, solidification and crystallization, Glass transition, recovery re-crytallization and grain growth. Strengthening mechanism, Hall pitch relation.

UNIT 3: Plastic deformation

Mechanism of plastic deformation, shear strength of perfect and real crystal, stress required to move a dislocation. Effect of temperature in dislocation motion, multiplication of dislocation during deformation, effect of solute atom and grain size on dislocation motion. Fracture: Ductile and brittle fracture, Fracture toughness, ductile brittle transition, fracture mechanism map, method of protection against fracture.

UNIT 4: Composites Polymer

Polymer, metal-metal, ceramic –ceramic, ceramic-polymer, metal-ceramic, metal polymer composites. Dispersion reinforced, particle reinforced, laminated and fibre reinforced composites. Mechanical behaviour of polymer, ceramic and composite.

UNIT 5: Elasiomers and Masullaneous

Types, properties and identifications of different types of rubbers vulcanization, fabrication and forming techniques of rubber. Introduction of plastics and ceramics – types, application and process. Smart materials-introduction and types. Selection of materials and factors effecting deflection, Selection process and systematic evaluation.

Learning Outcome

At the end of the course the student can:

CO1: Get a clear understanding of advanced engineering materials.

CO2: Student will understand about process of development of composite.

CO3:Students will get the knowledge about basic fundamental of materials.

Text book [TB]:

1. Raghvan, V., "Materials Science and Engineering, "PHI Learning Private Limited, 2013.
2. Mittermeijer, Eric J. "Fundamentals of Materials Science: The Microstructure–Property Relationship Using Metals as Model Systems", Springer verlag Berlin Heidelberg, 2010

Reference books [RB]:

1. Van Vlack,L. H." Elements of Materials Science and Engineering, Pearson Education India,
2. Callister W. D. & Rethwisch, D. G. , "Materials Science and Engineering: An Introduction" John Wiley & Sons,2006

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME456	Subject Title	Non-Destructive Testing						
LTP	2 0 2	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To understand the basic principles underlying each NDT technique and become familiar with common types of defects arising in different types of manufactured products and the NDT method(s) best suited to evaluate them.

Course Pre/Co- requisite (if any): Manufacturing Processes

Detailed Syllabus

UNIT 1: Introduction to NDT

Introduction to non-destructive testing and evaluation, visual examination, liquid penetrant testing and magnetic particle testing. Advantages and limitations of each of these techniques.

UNIT 2: Radiographic Testing

Radiography principle, electromagnetic radiation sources, X-ray films, exposure, penetrameter, radiographic imaging, inspection standards and techniques, neutron radiography. Radiography applications, limitations and safety.

UNIT 3: Eddy Current and Ultrasonic Testing

Eddy current principle, depth of penetration, eddy current response, eddy current instrumentation, probe configuration, applications and limitations. Properties of sound beam, ultrasonic transducers, inspection methods, flaw characterization technique, immersion testing.

UNIT 4: Special/Emerging Techniques

Leak testing, Acoustic Emission testing, Holography, Thermography, Magnetic Resonance Imaging, Magnetic Barkhausen Effect. In-situ metallography.

Study of defects in castings, weldments, forgings, rolled products etc. and defects arising during service. Selection of NDET methods to evaluate them. Standards and codes.

Learning Outcome

At the end of the course the student can:

CO1: Develop NDT techniques for various products.

CO2: Select of appropriate NDT technique(s) for new inspection jobs.

CO3: Students will get the knowledge about various methods or non-destructive testing.

Text book [TB]:

1. Baldevraj, Jayakumar T., Thavasimuthu M., (2008) "Practical Non-Destructive Testing", 3rd edition, Narosa Publishers.
2. Ravi Prakash, "Nondestructive Testing Techniques", New Age International Publishers,1st rev. edition, 2010.

Reference books [RB]:

1. American Society for Metals, "Non-Destructive Evaluation and Quality Control": Metals Hand Book: 1992, Vol. 17, 9th Ed, Metals Park, OH.
2. Paul E Mix, "Introduction to nondestructive testing: a training guide", Wiley, 2nd edition New Jersey, 2005.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	ME457	Subject Title	Welding Technology						
LTP	2 0 2	Credit	3	Subject Category	DE	Year	--	Semester	--

Course Outline:

Course Objective: To understand the basic principles of welding and various types of advanced joining processes also to know about welding defects and remedial measures for it.

Course Pre/Co- requisite (if any): Manufacturing Processes

Detailed Syllabus

UNIT 1: Power sources

Classification of welding processes - heat sources, power sources, arc characteristics, V-I relationship, different types of electrodes, ingredients and function of electrode coverings, types of weld joints.

UNIT 2: Fusion welding processes and Welding metallurgy

Shielded metal arc welding, gas welding, TIG welding, MIG welding, Submerged arc welding processes. Weld thermal cycles and their effects, effects of pre and post weld heat treatments, concept of HAZ, concept of weldability and its assessment. Welding of different materials, defects in welds, their causes and remedies.

UNIT 3: Solid state welding processes

Resistance, friction, friction stir, ultrasonic, induction pressure, diffusion welding processes, explosive welding.

UNIT 4: Special welding processes

Electron beam, laser beam welding, plasma arc processes; advantages, limitations, Introduction to Robotic welding, underwater welding.

Learning Outcome

At the end of the course the student can:

CO1: Develop welding techniques for various alloys

CO2: Develop mechanized welding techniques.

CO3:student will understand the fundamental of welding methods and mechanism (principle)

Text book [TB]:

1. Cornu. J.,(2004)"Advanced Welding Systems"-Volumes I, II and III, JAICO Publishers.
2. Lancaster L.F, (1996) 'The Physics of Welding', Pergamon Press.

Reference books [RB]:

1. Welding Handbook (Section I) American Welding Society1999
2. Parmer R.S, (2005) "Welding processes", Khanna publishers.
3. Srinivasan N.K, (2004) "Welding Engineering", Khanna publishers.
4. Rao P.N – (1998)"Manufacturing Technology (Foundry, Forming and Welding) II Edition", Tata McGraw Hill Pub. Co. Ltd, New Delhi.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Humanities Electives III

Subject Code	HS493	Subject Title	Indian Culture & Tradition						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	IV	Semester	VIII

Course Objective

- To promote an integral and holistic growth of young minds
- Develop a broad understanding of Indian society and intercultural literacy through cultural immersion.
- Deepen your knowledge of Indian development, environmental, and cultural issues through coursework, local engagement, and independent projects.

Unit 1Indian Culture: An Introduction **8Hrs.**

Characteristics of Indian culture, Significance of Geography on Indian Culture; Society in India through ages- Ancient period- Varna and Caste, family and marriage in India, position of women in ancient India, Contemporary period; caste system and communalism.

Unit 2 Indian Languages and Literature **6 Hrs.**

Evolution of script and languages in India: Harappan Script and Brahmi Script;Short History of the Sanskrit literature: The Vedas, The Brahmins and Upanishads & Sutras, Epics: Ramayana and Mahabharata & Puranas.

Unit 3 Brief History of Indian Arts and Architecture **6Hrs.**

Indian Art & Architecture: Gandhara School and Mathura School of Art; Hindu Temple Architecture, Buddhist Architecture, Medieval Architecture and Colonial Architecture.

Indian Painting Tradition: ancient, medieval, modern Indian painting and Odishan painting tradition *Performing Arts:* Divisions of Indian classical music: Hindustani and Carnatic, Dances of India: Various Dance forms: Classical and Regional, Rise of modern theatre and Indian cinema.

Unit 4 Spread of Indian Culture Abroad **6Hrs.**

Causes, Significance and Modes of Cultural Exchange - Through Traders, Teachers, Emissaries, Missionaries and Gypsies,Indian Culture in South East Asia India, Central Asia and Western World through ages

COURSE OUTCOME:

- Understand background of our religion, customs institutions, administration and so on.
- Understand the present existing social, political, religious and economic conditions of the people.
- Analyze relationship between the past and the present relevance of Indian tradition.
- Develop practical skills helpful in the study and understanding of historical events.

TEXT BOOKS

1.Chakravarti, Ranabir: Merchants, Merchandise & Merchantmen, in: Prakash, Om (ed.): The Trading World of the Indian Ocean, 1500-1800 (History of Science, Philosophy and Culture 361 in Indian Civilization, ed. by D.P.Chattopadhaya.

2. Chaudhuri, Kirti N.: Trade and Civilisation in the Indian Ocean, CUP, Cambridge, 1985.

3.Malekandathil, Pius: Maritime India: Trade, Religion and Polity in the Indian Ocean, Primus Books, Delhi, 2010.

4. McPherson, Kenneth: The early Maritime Trade of the Indian Ocean, in: ib.: The Indian Ocean: A History of People and The Sea, OUP, 1993, pp. 16-75.

5. Christie, J.W., 1995, State formation In early Maritime Southeast Asia, BTLV

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Humanities Electives III

Subject Code	HS483	Subject Title	Indian Philosophy					
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	IV	Semester	VIII

Course Objective

- Develop an understanding of Indian philosophical systems
- To empower for self-exploration

Unit 1 Introduction **11Hrs.**

Meaning of Philosophy, Origin of Philosophy in India, Major Indian philosophical systems: Sankhya: Metaphysics, Theory of causation, Prakriti, Purusha, Evolution, Yoga: Concept of Chitta, Types and Modification of Chitta, Eight-fold Yoga & Vedant: Notions of Maya & Brahma

Unit 2 Major Principles **5Hrs.**

Panchkosha, Triguna, Tridosh, Macrocosm-Microcosm

Unit 3 Major Contemporary Indian Philosophers **6Hrs.**

Lord Buddha, Mahaveer, Gandhi, Vivekanand, Aurovindo-The Life Divine, Pt. Sri Ram Sharma Acharya, Vinoba & Acharya Rajneesh Osho, Paramhans Yogananda-Autobiography of a Yogi

Unit 4 Activities & Projects **4Hrs.**

Identifying human prakriti, Using Trigun inventory, Understanding self

COURSE OUTCOME:

- Students will acquire understanding of concepts of Indian philosophy.
- Students will be enabled to analyze their self.
- The students will be able to relate some of the core concepts and theories of modern Indian philosophy to concepts and ideas in classical Indian philosophy.
- The students will be able to appreciate how philosophical approaches may be integrated more practically as a “way of life”.

TEXT BOOK

Chattejee,S.G. and Datta, D.M. (1960) An Introduction to Indian Philosophy, Calcutta: University of Calcutta Press

EFERENCE BOOKS

- The Yoga Sutras of Patanjali: (annoted commentary) (Divine Cool Breeze Realized Writers Book 15) by Shri Patanjali, Shri Mataji Nirmala Devi (Introduction), Charles Johson (Translation)
- Acharya, Pt. Shri Ram Sharma (2015). Gayatri Mahavigyan. Mathura:Akhand Jyoti Prakashan.
- Vinoba, Acharya (2011). Vichar Pothi. Pawnar: Paramdham Prakaashan.
- Gandhi, M.K. (2013). The story of my experiments with truth. Varanasi: Sarvodaya Prakashan.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Humanities Electives III

Subject Code	HS491	Subject Title	Industrial Sociology						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	IV	Semester	VIII

Course Objective

- The course attempts to analyze the structure and process of industrial organizations from the sociological perspective.
- The course enables students to have a general view of modern industry.

Unit 1 **7Hrs.**

Industrial Sociology: Nature, Scope and Importance, Origin and Development, Industry as a social, System,Development of Industry in Post-Independence period, Evolution of Working Class, Changing nature of work, Growth of unorganized informal sector., Dynamics of Industrial Relations: Approaches to the study of Industrial Relations, Collective Bargaining,– Concepts, Types, Scope and Importance.

Unit 2 **7Hrs.**

Industrial Disputes: Concept, Features and Kinds of disputes, Settling disputes, Mediation, Arbitration, Conciliation, Negotiation,The Indian Worker: Features of Indian worker, the contribution of social - Philosophy, family, caste and community in determining the attitude of workers

Unit 3 **6Hrs.**

Trade Union: Concept, Features, Functions and Types, History of Trade Union Movement in India Trade Unions and Challenges of Privatization and Globalization; Law and work, Decline of Trade Unions.

Unit 4 **6Hrs.**

Dynamics of Industrial Relations: Corporate Social Responsibility, Inclusion of Women in the Corporate Sector, Scope of Industrial Sociology in India; Impact on Employment, Impact on HRD, impact on wages and benefits, Modern Industry in India

COURSE OUTCOME:

- It will enable students to demonstrate the different human components that make up modern industry.
- The student will get exposed to a specialized area of sociology and its insights.
- Apply sociological concepts and theories to understand contemporary social issues and/or public debates about these issues
- Communicate sociological concepts and/or research in a manner that is appropriate for the intended audience (e.g., academic, lay audience)

TEXT BOOKS

1. Davis, Keith, 1984. Human Behaviour at work, New Delhi. Mcgraw Hill.
2. Gisbert, Ascual S J 1972. Fundamentals of Industrial Sociology, New Delhi, Tata Mc Graw-Hill.
3. Ramaswamy, E. A, 1978. Industrial Relations in India. Delhi. MacMillian
4. Pascal Gilbert: Fundamental of Industrial Sociology; Orient-Longman.
5. E.V.Schneider – Industrial sociology
6. Baviskar et al - Social Structure and Change [Vol.IV] Sage Publishers

REFERENCE BOOKS

- Sheth, N R, 1979, Industrial Sociology in India, Jaipur Rawat.
- Dutt and Sundharam 2007. Indian Economy, S Chand Publications. New Delhi: Publications.
- P. Subha Rao: Human Resource Management and Industrial Relations – Himalaya Publishing House

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Humanities Electives III

Subject Code	HS485	Subject Title	Sustainable Development						
LTP	2-0-0	Credit	2	Subject Category	Elective	Year	IV	Semester	VIII

Course Objective

- To provide the overview of sustainable and its needs to the students.
- To provide the importance and components of sustainable development to the students.
- To provide the association of social and economic development to the students.

Unit 1 Overview of Sustainable Development **5 Hrs.**

History and emergence of the concept of Sustainable Development, Components of SD i.e. Economic, Social, Human, Institutional, Technological and Environmental development; Definitions, Sustainability in Ecosystem Services; natural resource degradation, greenhouse gases, factors affecting SD (i.e. Industrialization, urbanization, population growth, globalization, etc.)

Unit 2 Polices on Sustainable Development at international level **4Hrs.**

Government Policies for SD in India; Socio-economic policies for sustainable development in India, Sustainable development through trade, Carrying Capacity, global policies for sustainable development

Unit 3 Sustainable Development and International Contribution **10 Hrs.**

SDGs and MDGs, Complexity of growth and equity, International Summits, Conventions, Agreements, Initiations of international organizations like WHO, UNDP, WTO, FAO and World Bank towards sustainable development

Unit 4 Measurement of Sustainable Development **7Hrs.**

Role of developed and developing countries in the sustainable development, Demographic dynamics and sustainability, integrated approach for resource protection and management; Index based estimation of SD i.e. Environmental Sustainable Development Index and sustainable development, and other index

Course Outcome:

- The students will be able to understand the importance of natural resource in economic development.
- The students contribute significant efforts towards sustainable development
- Develop a future-oriented perspective that highlights the significance of their decisions, choices and actions on the quality of life of present and future generations.
- Understand and are empowered to address the real causes and consequences of unsustainable behaviour within the context of an interdependent and globalised world.

TEXT BOOK

The Sustainability Revolution: Portrait of a Paradigm Shift by Edwards, Andres R., New Society Publishers, 2005.

REFERENCE BOOKS

1. The Sustainability Revolution: Portrait of a Paradigm Shift by Edwards, Andres R., New Society Publishers, 2005.
2. Sustainable development in India: Stocktaking in the run up to Rio+20: Report prepared by TERI for MoEF, 2011.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	CS482	Subject Title	Human Computer Interaction						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4th	Semester	VIII

Unit 1 **(8L)**

Introduction: Importance of user Interface–definition, importance of good design. Benefits of good design. A brief history of Screen design. The graphical user interface –popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user –Interface popularity, characteristics- Principles of user interface.

Unit 2 **(7L)**

Design process–Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions.

Unit 3 **(8L)**

Screen Designing: Design goals–Screen planning and purpose, organizing screen elements, ordering of screen data and content –screen navigation and flow ,Visually pleasing composition -amount of information -focus and emphasis ,presentation of information simply and meaningfully information retrieval on web - statistical graphics –Technological consideration in interface design.

Unit 4 **(8L)**

Windows –New and Navigation schemes selection of window, selection of devices based and screen based controls.

Components – text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors.

Unit 5 **(8L)**

Software tools –Specification methods, interface–Building Tools.

Interaction Devices – Keyboard and function keys –pointing devices –speech recognition digitization and generation – image and video displays – drivers.

TEXT BOOKS:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale Human Computer Interaction, 3rd Edition Prentice Hall, 2004.

2. Jonathan Lazar Jinjuan Heidi Feng, Harry Hochheiser, Research Methods in Human Computer Interaction, Wiley, 2010.

REFERENCE:

1. Ben Shneiderman and Catherine Plaisant Designing the User Interface: Strategies for Effective Human-Computer Interaction (5th Edition, pp. 672, ISBN 0-321-53735-1, March 2009), Reading, MA: Addison-Wesley Publishing Co.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	IT357	Subject Title	Internet of Things						
LTP	3 0 0	Credit	3	Subject Category	DE /OE	Year	4th	Semester	VIII

Course Outline: To provide a detailed idea how the internet is connecting the entire world and helps to live a smart life with its technology.

Course Objective:

1. Vision and Introduction to IoT.
2. Understand IoT Market perspective.
3. Data and Knowledge Management and use of Devices in IoT Technology.
4. Understand State of the Art – IoT Architecture.
5. Real World Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

Course Pre/Co- requisite (if any): Wireless Sensor Networks

Detailed Syllabus

UNIT 1: M2M to IoT(05 Lectures)

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

UNIT 2: M2M to IoT (A Market Perspective)(10 Lectures)

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.
IOT related open source software tools introduction; tools like IoTivity, IBM Blue Mix. Introduction to Contiki, Cooja, Raspberry Pi etc.

UNIT 3:M2M and IoT Technology Fundamentals(05 Lectures)

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 4: IoT Architecture-State of the Art(12 Lectures)

Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model
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.

UNIT 5:Industrial Automation(08 Lectures)

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
Commercial Building Automation: Introduction, Case study: phase one-commercial building automation today, Case study: phase two- commercial building automation in the future.

Learning Outcome

- Explain the definition and usage of the term 'The Internet of Things' in different contexts
- Understand where the IoT concept fits within the broader ICT industry and possible future trends
- Able to build and test a complete working IoT system Pursue lifelong learning for professional advancement.

Text book [TB]:

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.

Reference books [RB]:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	IT359	Subject Title	Mobile Computing and Services						
LTP	3 0 0	Credit	3	Subject Category	DE /OE	Year	4th	Semester	VIII

Course Objective:

1. Understand the fundamentals of wireless networks.
2. Understand and evaluate emerging wireless technologies and standards
3. To explore mobile security issues
4. To explore the mobility concept.

Detailed Syllabus

UNIT 1

Introduction: Mobile computing with functions & devices, Networks, Middleware & gateways, Application & services, Developing mobile computing applications, Security & standards why it necessary, Architecture for mobile computing. **(3 L)**

UNIT 2

Emerging Technologies: Bluetooth, Rfid, WiMAX, Mobile IP, IPv6, GSM architecture, Call routing in GSM, Mobile computing over SMS, Value added service through SMS, GPRS architecture & operations, 3G & applications **(10 L)**

UNIT 3

Wireless Transmission:
Signal propagation- path loss of radio signals, additional signal propagation effects, Multipath propagation,
Multiplexing- Space division, frequency division, time division, code division,
Modulation- ASK, FSK, PSK, AFSK, APSK, Multi-carrier modulation
Spread spectrum- Direct sequence & frequency hopping
Mac- Hidden & exposed terminals, near- far terminal, SDMA, TDMA, FDMA, Fixed TDM, CSMA, PRMA, Multiple access with collision avoidance **(12 L)**

UNIT 4

Wireless LAN: IEEE 802.11 in details, HIPERLAN, Link manager protocol, L2CAP, security, SDP. **(5 L)**

UNIT 5

Mobility & Security in mobile computing: HTTP,
Wireless application protocol- architecture, wireless datagram protocol, wireless transport layer security, wireless transaction & session protocol, WML, Push architecture, push/ pull services, i-mode & SyncML
Information security, Security techniques & algorithms, public key infrastructure, **(10 L)**

Learning Outcome

At the end of the course, Learning Outcomes Having successfully completed this course, the student will demonstrate:

1: Apply the fundamental design paradigms and technologies to mobile computing applications.
2: Develop consumer and enterprise mobile applications using representative mobile devices and platforms using modern development methodologies.
3: Appraise the quality and performance of mobile applications.

4: Assess and implement security principles in mobile applications.
5: Evaluate wireless network topologies, wireless connectivity and characteristics, and the impact of wireless networks on security and Internet communications.
6: Select appropriate wireless technologies in commercial and enterprise applications.

Text book [TB]:

- Jochen H. Schiller: Mobile Communications - Second Edition, Pearson
- Asoke K Talukder & Roopa R Yavagal: Mobile Computing Technology, Applications and Service Creation – Tata McGraw-Hill Publishing Company Limited

Reference books [RB]:

- William Stallings: Wireless Communications & Networks - Second Edition, Pearson
- Theodore S. Rappaport : Wireless Communications Principles & Practice - Second Edition, Pearson

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	EC386	Subject Title	Fundamental of Communication & Networks						
LTP	3 0 0	Credit	3	Subject Category	DE /OE	Year	4th	Semester	VIII

Objectives of the Course:

- To understand the concept of Computer Communication.
- To learn the basics of Data communication and Networks
- To develop and design the protocol systems for advance computer communication.

UNIT I: Introduction to Communication:

Communication system, Analog and Digital Communication, channel bandwidth. Ideal and Practical Filters, Concept of Signal Distortion over a Communication Channel, Energy Signal and Power Signal, Introduction to noise in Communication systems. **6L**

UNIT II: Introduction to Modulation techniques:

Concept of Amplitude Modulation, Concept of Frequency & Phase Modulation, Concept of ASK, FSK & PSK, Concepts of PCM. **8L**

UNIT III: Introduction to Data Communication Network & OSI Model:

Switching systems, network hardware and software, Layering, design issues for layering, reference models and their comparison, example of networks. Concepts of OSI model. **6L**

UNIT IV: Introduction to Data Communication Protocols and transmission media

MAC protocols- Aloha, CSMA, collision free protocols, Ethernet, IEEE 802.3 standard, IP protocols, IP addressing, OSPF, IPv4, IPv6. Transmission media and channel impairments, multiplexing, digital channels, switching. Repeaters, bridges, routers and gateways. **8L**

Text Books:

1. Forouzan, B.A., "Data Communication and Networking", 4th Ed., Tata McGraw-Hill.
2. Tanenbaum, A.S, "Computer Networks", 4th Ed., Pearson Education.
3. Stallings W., "Data and Computer Communication", 8th Ed., Prentice-Hall.
4. Simon Haykins, 'Communication Systems', John Wiley,5th edition

Reference Books:

1. Kurose, J.F. and Ross, K.W., "Computer Networking: A Top-Down Approach Featuring the Internet", 3rd Ed., Addison Wesley.

List of Experiments:

1. To generate amplitude modulated wave and determine the percentage modulation and Demodulate the modulated wave using envelope detector.
2. To generate AM-Double Side Band Suppressed Carrier (DSB-SC) signal.
3. To generate the SSB modulated and Demodulated wave.
4. To generate frequency modulated signal and determine the modulation index and bandwidth for various values of amplitude and frequency of modulating signal and to demodulate a FM signal
5. To study ASK modulation and Demodulation.
6. To study FSK modulation and Demodulation.
7. To study PSK modulation and Demodulation.
8. To Study TDM/PCM Transmitter /Receiver.

OUTCOMES OF THE COURSE:

The course provides an understanding of:

- Computer Communication and networks.
- Protocol design and their design issues.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	EC382	Subject Title	Biomedical Instrumentation						
LTP	3 0 0	Credit	3	Subject Category	DE /OE	Year	4th	Semester	VIII

Objectives of the Course: The students will learn

- Requirement of bio-medical and its application
- Concept of bio-potential electrodes and measurements related to them.
- Concepts of bio-transducers and measurements related to them.
- Concept of bio-medical instruments and their uses experimentally.

UNIT I: ANATOMY AND PHYSIOLOGY:

Basic Cell Functions, Origin of Bio-potentials, Electrical Activity of Cells, components of man Instrument system, types of bio-medical stems, design factors and limitations of biomedical instruments, terms and transducers to various physiological events. **8L**

UNIT II: BIO-POTENTIAL ELECTRODE:

Types of bio-potential electrodes., Electrode-Electrolyte interface, half cell potential, Polarization- polarisable and non-polarisable electrodes, Ag/AgCl electrodes, Electrode circuit model; Electrode and Skin interface and motion artifact. Body surface recording electrodes for ECG. Electrodes standards. **8L**

UNIT III: BIO-TRANSDUCER:

Transduction Principles: Resistive Transducers Strain Gauge- types, construction, selection materials, Gauge factor, Bridge circuit, Temperature compensation. Strain Gauge type Blood pressure transducers. Inductive Transducers, Capacitive Transducer, Piezoelectric Transducer. **8**

UNIT IV: BIOTELEMETRY AND ELECTRICAL SAFETY:

Bio-telemetry design, single channel bio telemetry transmitter and receiver system based on AM, FM and, pulse modulation. Significance of Electrical Danger, physiological effect of current, ground shock Hazards. **8L**

Text Books:

1. Joseph J. Carr & John. M. Brown, 'Introduction to Biomedical Equipment technology'
2. R.S. Khandpur, 'Handbook of Biomedical Instrumentation', McGraw Hill.

Reference Books:

1 J.G. Webster, 'Medical instrumentation application and design', Houghton Miffin Co., Boston USA.
2 Mohan Murali H, 'Monograph on Biomedical engineering', O.U. Press 1985.
3 Geddes L. A. & L. E. Baker, 'Principles of Applied Biomedical Instrumentation', Wiley, 1989.
4 Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, 'Biomedical Instrumentations and Measurements' (2nd edition), PHI, 1991.

OUTCOMES OF THE COURSE:

The course provides an understanding of:

- Bio-medical instruments and measurements.
- Principle of working of bio-medical transducers.
- Skills to use modern bio-medical tools and equipment for measurements related to human body.

LIST OF EXPERIMENTS

2. Pulse measurement
3. Heartbeat measurement
4. Automatic BP measurement

5. Heart sound study using electronics stethoscope
6. ECG measurement

Following experiments to be done on the breadboard

7. Design of low noise and low frequency amplifier for biomedical application
8. Design of Instrumentation amplifier
9. Construction of chopper amplifier

Two Value Added Experiments to be added by Instructor.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	EE485	Subject Title	BASIC INSTRUMENTATION AND PROCESS CONTROL						
LTP	3 0 0	Credit		Subject Category	Open Elective	Year	4th	Semester	VIII

Objectives of the Course

- To make students understand the construction, working principle and application of various transducers used for flow measurement, strain measurement, pressure and vacuum measurement,
- force, torque and power measurement
- To develop an understanding about the different types of telemetry systems used and types of instruments required for display and recording of the data to be transmitted
- Understand about components, characteristics of various control processes used and their modes of operation.

Unit 1	**Transducer – I :** Definition, advantages of electrical transducers, classification, characteristics, factors affecting the choice of transducers, Potentiometers, Strain guages, Resistance thermometer, Thermistors, Thermocouples, LVDT,RVDT	**8L**
Unit 2	**Transducer – II: Capacitive**, Piezoelectric Hall effect and opto electronic transducers. Measurement of Motion, Force pressure, temperature, flow and liquid level.	**8L**
Unit 3	**Telemetry: General** telemetry system, land line & radio frequency telemetering system, transmission channels and media, receiver & transmitter. Data Acquisition System: Analog data acquisition system, Digital data acquisition system, Modern digital data acquisition system.	**8L**
Unit 4	**Telemetry: General** telemetry system, land line & radio frequency telemetering system, transmission channels and media, receiver & transmitter. Data Acquisition System: Analog data acquisition system, Digital data acquisition system, Modern digital data acquisition system. **Display Devices and Recorders:** Display devices, storage oscilloscope, spectrum analyser, strip chart & x-y recorders, magnetic tape & digital tape recorders.	**8L**
Unit 5	**Process Control:** Principle, elements of process control system, process characteristics, proportional (P), integral (I), Derivative (D), PI, PD and PID control modes. Electronic, Pneumatic & digital controllers.	**8L**

Text Books:

1. A.K.Sawhney, "Advanced Measurements & Instrumentation", Dhanpat Rai & Sons
2. B.C. Nakra&K.Chaudhry, "Instrumentation, Measurement and Analysis", Tata Mc Graw Hill 2nd Edition.
3. Curtis Johns, "Process Control Instrumentation Technology", Prentice Hall

Reference Books

1. E.O. Decblin, "Measurement System – Application & design", Mc Graw Hill.
2. W.D. Cooper and A.P. Beltried, "Electronics Instrumentation and Measurement Techniques" Prentice Hall International

3.RajendraPrasad,"Electronic Measurement and Instrumentation Khanna Publisher

4. M.M.S. Anand, "Electronic Instruments and Instrumentation Technology" PHI Learning.

Outcome of the Course:

- **Identify the appropriate instruments for measurement of different quantities.**
- **Ability to analyze, formulate and select suitable sensor for the given industrial applications**
- **Ability to analyze various control processes used and their modes of operation.**

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	CE483	Subject Title	GIS						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4th	Semester	VIII

Course Objective: The course provides wide knowledge about basics of GIS and its applications in various fields

Unit-1: Introduction

8L

Definition of GIS, Cartography and GIS, GIS database: spatial and attribute date; Spatial models: Semantics, spatial information, temporal information, conceptual models of spatial information, representation of geographic information: point, line and area futures, topology,

Unit-2: Components

12L

Raster and vector data, raster to vector data conversion, map projection, analytical transformation, rubber sheet transformation, manual digitizing and semi-automatic line following digitizer; Remote sensing data as an input to GIS data;

Unit-3: Classifications and Functions

10L

Attribute database: scale and source of inaccuracy; GIS functionality; data storage and data retrieval through query, generalization, classification, containment search within a spatial region;

Unit-4: Analysis

5L

Overlay: arithmetical, logical and conditional overlay, buffers, inter visibility, aggregation; Network analysis;

Unit-5: Applications

4L

Applications of GIS in planning and management of utility lines and in the filed of environmental engineering, geotechnical engineering, transportation engineering and water resources engineering.

Course Outcome: The students will learn from this course:

- Basic understanding of GIS concepts, components.
- Analyzing geo-spatial data with various techniques and GIS tools
- Apply the concepts in solving environmental and engineering problems
- Create new information and theoretical knowledge after applying GIS tools

Books Recommended:

1. Geographic Information Systems: A Management Perspective, by Stan Arnoff, WDL Publications.
2. Fundamentals of Spatial Information Systems by Robert laurini and Derek Thompson, Academic Press.
3. Geographical Information Systems, Vol. I and II edited by Paul Longely, M.F. Good child, et.al, John Wiley and Sons, Inc. 1999

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	PE491	Subject Title	Carbon Capture and Sequestration Technology						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4th	Semester	VIII

1. Course Summary

The course provides information about the students to learn the basic concept and Applications of Carbon capture and storage process. In this course, students will learn about carbon capture techniques and the concept of the contribution of fossil fuel to climate change. During this course students will examine the Co2 emission and Carbon dioxide recycling.

2. Course Objectives

The students should be able to:

1. The objective of this course is make students familiar with the principles and applications of carbon capture and storage capture techniques and role of CCS.

3. Course Outcomes

1. To acquaint the students substantially to the objectives and necessity of Carbon Sequestration and capture.
2. To introduce the contribution of fossil fuel to climate change.
3. To understand the concept of emission and recycling of CO2.
4. To introduce the candidates to the concept of underground storage and other Carbon Capture and sequestration concepts.
5. To understand the implementation of CCS technology and IPCC.

4. Curriculum Content

UNIT 1

Introduction: Scope, Objectives and Necessity of CCS.

UNIT 2

The contribution of fossil fuels emission to Climate change and global warming. Concept of Carbon Credit and carbon footprint.

UNIT 3

Carbon capture techniques: Carbon-di-oxide emission, Scrubbing of CO2, Carbon dioxide recycling.

UNIT 4

Carbon dioxide sequestration: Underground storage, Potential for Geologic Storage, Application in Oil and gas industry, Carbon di oxide flooding projects, Methane recovery projects.

UNIT 5

Strategy for implementing CCS technology: Modelling of Cost and Performance of CCS Plants. Role and function of IPCC.

Text book [TB]:

1. Carbon Capture; Jennifer Wilcox; Springer
2. Capturing Carbon – The new weapon in the War Against Climate Change; Mills, Robin M.; Columbia University Press

Reference books [RB]:

1. Piping and pipeline engineering, George A. Antaki, Marcel Dekker Inc. New York.
2. Fundamentals of pipeline engineering by J. Vincent Genod, Technip Editions

5. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Subject Code	MA452	Subject Title	Optimization Techniques						
LTP	3 0 0	Credit	3	Subject Category	Open Elective	Year	4th	Semester	VIII

Unit 1: Introduction to optimization, Statement and classification of optimization problem, Multi-objective optimization, Multi-variable optimization problem with equality and inequality constraints, Classical optimization techniques, Single variable and multivariable optimization problems,Operation Research approach, general methods for Operation Research models, methodology and advantages of Operation Research.

Unit 2: Introduction to LPP and formulation of Linear Programming problems, Graphical solution method, alternative or multiple optimal solutions, Unbounded solutions, Infeasible solutions, Maximization – Simplex Algorithm, Minimization – Simplex Algorithm using Big-M method, Two phase method, Duality in linear programming.

Unit 3: Introduction to Transportation problems, various methods of Transportation problem, Variations in Transportation problem, introduction to Assignment problems, variations in Assignment problems. Sequential optimization, Representation of multistage decision process; Types of multi stage decision problems; Concept of sub optimization and the principle of optimality.

Unit 4: Optimization techniques,Memetic algorithm, Differential evolution, Evolutionary algorithms,Dynamic relaxation,Genetic algorithms, Hill climbing with random restart, Genetic Algorithm (GA), Artificial Bee Colony (ABC), Particle Swarm Optimization (PSO),Firefly algorithm, Fish School Search, Fly algorithm, Ant colony optimization algorithms

References:

1. S.S. Rao, "Engineering Optimization: Theoryand Practice", New Age International P)Ltd.,New Delhi, 2000.
2. G. Hadley, "Linear programming", NarosaPublishing House, New Delhi, 1990.3.
3. H.A. Taha, "Operations Research: AnIntroduction", 5th Edition, Macmillan, New York, 1992.4.
4. K. Deb, "Optimization for Engineering Design-Algorithms and Examples", Prentice-Hall ofIndia Pvt. Ltd., New Delhi, 1995.
5. S.D. Sharma, “Operations Research”, Kedar Nath Ram Nath Publishers, 2009.

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Code	AR-485	Subject Title	ART APPRECIATION						
LTP	3 0 0	Credit	3	Subject Category	OE	Year	4th	Semester	VIII

Course Objective:

To create an overview and understanding of various art forms that exists from ancient to modern times.

Unit 1: INTRODUCTION

Understanding various art forms in society and in different cultures.

Unit 2: Sociological Perspective

Relationship between art, culture and society. Influence of art forms on people.

Unit 3: Appreciation-I: Painting/ Sculptures

Understanding and appreciating films/ documentaries from past to present timesand between east and west

Unit 4: Appreciation-II: Films/ Documentries

Understanding and appreciating painting and sculptures from past to present times and between east and west

Unit 5: Appreciation-III: Indigenous/ Folk Art

Understanding and appreciating Indigenous/ Folk art from past to present times and between east and west.

LEARNING OUTCOME:

4. The student will be able to understand the various art forms.
5. The students will be able to understand and establish a relationship between art, culture and society.
6. The students will be able to appreciate the various art.

Text Books:

3. Creative Authenticity: 16 Principles to Clarify and Deepen Your Artistic Vision, Ian Roberts

Reference Books:

The Writer: A Concise Complete and Practical Text Book of Rhetoric. Designed to Aid in The Appreciation, George Lansing Raymond

Course Structure of B.Tech. – Mechanical Engineering
Applicable from 2018-2022

Code	PY481	Subject Title	Nano scale science and technology						
LTP	3 0 0	Credit	3	Subject Category	DE/OE	Year	4th	Semester	VIII

Unit 1 **(10L)**

Introduction to nanotechnology, definition, history of nanotechnology, nanotechnology in relation to other branches of engineering, characteristic length scale of materials and their properties, classification of nano materials, dimensionality and size dependent phenomena, confinement in 0-D, 1-D, 2-D and 3-D,surface to volume ratio, fraction of surface atoms, surface energy.

Unit 2 **(7L)**

Nanomaterials synthesis techniques; top-down and bottom-up techniques, ball milling, PVD, CVD, self-assembly.

Unit 3 **(8L)**

Nanomaterials characterization; XRD, SEM, TEM, AFM, UV-VIS.

Unit 4 **(8L)**

Nanomaterials and their properties: carbon based nano materials, metal based nano materials, quantum dots, biological nano materials.

Unit 5 **(7L)**

Applications of nanotechnology in engineering, solar energy conversion, nanomedicine.

Text Books:

1. Poole, Jr. CP and Owens, FJ, "Introduction to Nanotechnology", Wiley India. 2006.
2. Cao, G., Nanostructures and Nanomaterials: Synthesis, Properties and Applications, Emperial College Press (2004).
3. Edward L. Wolf: Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience, 2nd ed., Wiley-VCH, 2006.