Annexure-3

CURRICULUM

FOR

B.Tech

IN

MECHANICAL ENGINEERING

महात्मा ज्योतिबा फुले
रुहेलखण्ड विश्वविद्यालय, बरेली

DEPARTMENT OF MECHANICAL ENGINEERING
FACULTY OF ENGINEERING AND TECHNOLOGY
M. J. P. ROHILKHAND UNIVERSITY,

BAREILLY-243006 (U.P.) INDIA

SCHEME OF COURSES FOR B.TECH. Ist YEAR
COMMON TO ALL BRANCHES

B. Tech. Ist year, I Semester

S. No	New Code	Old Course Code	Subject	Page No	Credits	Teaching Schedule Hrs. L T P	Total
1.		CY-103T 23003	Environmental Studies		2	2 0 0	2
2.		HU-103T 23013	Fundamental of Economics		2	2 0 0	2
3.		MA-101T 23021	Engineering Mathematics-I		4	3 1 0	4
4.		PH-101T 23031	Engineering Physics-I		4	3 1 0	4
5.		EI-101T 23501	Basic Electronics Engineering		4	3 1 0	4
6.	BME-501C	ME-101T 23601	Manufacturing Techniques (ME, CS, CH) 1st Sem (EC, EI, EE) 2nd Sem		2	2 0 0	2
7.	BME-503C	ME-107T 23604(ME, CH, EI & EE) 23605 (CSIT & EC)	Engineering Graphics (ME, CS, CH) 1st Sem (EC, EI, EE) 2nd Sem		2	1 2 0	3
			Total		**20**		**21**
Laboratory Courses							
8.		EI-101P 71177	Basic Electronics Engineering Lab		2	0 0 3	3
9.		PH-101P 71176	Engineering Physics lab-I		2	0 0 3	3
10.	BME-501P	ME-101P 72005	Workshop Practice Lab		2	0 0 3	3
			Total		**6**		**9**
			G. Total		**26**		**30**

B.TECH. I year II Semester

(Common to All Branches)

S. No	New Code	Old Course Code	Subject	Page No	Credits	Teaching Schedule Hrs. L T P	Total
1.		CY-101T 23001	Engineering Chemistry		4	3 1 0	4
2.		HU-101T 23011	English language and literature		3	2 1 0	3
3.		MA-102T 23022	Engineering Mathematics-II		4	3 1 0	4
4.		PH-102T 23032	Engineering Physics-II		4	3 1 0	4
5.		CS-101T 25201	Computer Fundamentals and C++Programming		4	3 1 0	4
6.		EE-101T 23401	Basic Electrical Engineering		4	3 1 0	4
7.	BME-505C	ME-105T 23602	Basic Mechanical Engineering (EC, EI, EE)1st Sem (ME, CS, CH) 2nd Sem	24	4	3 1 0	4
			Total		**27**		**27**
Laboratory Courses							
8.		CY-101P 72002	Engineering Chemistry Lab		2	0 0 3	3
9.		CS-101P 72006	Computer Programming Lab in C++		2	0 0 3	3
10.		EE-101P 72003	Basic Electrical EngineeringLab		2	0 0 3	3
			Total		**6**		**9**
			G. Total		**33**		**36**

B.TECH. II year III Semester Mechanical Engineering

S. No	New Code	Old Course Code	Subject	Page No	Credits	Teaching Schedule Hrs. L T P	Total
1.	BME-601C	ME-201T 23621	Kinematics of Machines		4	3 1 0	4
2.	BME-603C	ME-203T 23622	Production Processes-I		4	3 1 0	4
3.	BME-605C	ME-205T 23623	Fluid Mechanics		4	3 1 0	4
4.		MA-201T 23023	Engineering Mathematics -III		4	3 1 0	4
5.	BME-607C	ME-207T 23624	Material Science		4	3 1 0	4
6.	BME-609C	ME-209T 23626	Engineering Thermodynamics	34	4	3 1 0	4
			Total		**24**		**24**
Laboratory Courses							
7.	BME-601P	ME-201P 71025	Kinematics of Machines Lab		2	0 0 3	3
8.	BME-603P	ME-203P 71027	Production Process lab		2	0 0 3	3
9.	BME-605P	ME-205P 71026	Fluid Mechanics Lab		2	0 0 3	3
			Total		**6**		**9**
			G. Total		**30**		**33**

B.TECH. II year IV Semester Mechanical Engineering

S. No	New Code	Old Course Code	Subject	PageNo	Credits	Teaching Schedule Hrs. L T P	Total
1.	BME-602C	ME-202T 23631	Dynamics of Machines		4	3 1 0	4
2.	BME-604C	ME-204T 23632	Mechanics of Solids-I		4	3 1 0	4
3.	BME-606C	ME-206T 23633	Internal Combustion Engines		4	3 1 0	4
4.	BME-608C	ME-208T 23634	Production Processes-II		4	3 1 0	4
5.	BME-610C	ME-214T 23637	Fundamentals of MATLAB	41	2	1 1 0	2
6.		EE-202T 23431	Elements of Electrical Machines		3	2 1 0	3
			Total		**21**		**21**
Laboratory Courses							
7.	BME-602P	ME-202P 72016	Dynamics of Machines Lab		2	0 0 3	3
8.	BME-606P	ME-204P 72018	I.C. Engines lab		2	0 0 3	3
9.		EE-202P 72008	Electrical Machines Lab		2	0 0 3	3
			Total		**6**		**09**
			G. Total		**27**		**30**

B.TECH. III year V Semester Mechanical Engineering

S. No	New Code	Old Course Code.	Subject	Page No	Credits	Teaching Schedule Hrs. L T P	Total
1.	BME-701C	ME-301T 23641	Mechanics of Solids-II	43	4	3 1 0	4
2.	BME-703C	ME-303T 23642	Mechanical Engineering Design-I	44	4	3 1 0	4
3.	BME-705C	ME-305T 23643	Energy Conversion	45	4	3 1 0	4
4.	BME-707C	ME-307T 23647	Heat Transfer		4	3 1 0	4
5.	BME-709C	ME-309T 23645	Mechanical Measurement and Metrology		4	3 1 0	4
6.	BME-711C	ME-311T 23646	Operations Management		4	3 1 0	4
			Total		**24**		**24**
Laboratory Courses							
7.	BME-701P	ME-301P 71028	Mechanics of Solid Lab		2	0 0 3	3
8.	BME-707P	ME-303P 73002	Heat Transfer lab		2	0 0 3	3
9.	BME-709P	ME-305P 71030	Mechanical Measurement Lab		2	0 0 3	3
			Total		**6**		**9**
			G. Total		**30**		**33**

B.TECH. III year VI Semester Mechanical Engineering

S. No	New Code	Old Course Code	Subject	Page No	Credits	Teaching Schedule Hrs. L T P	Total
1.	BME-702C	ME-302T 23651	Computer Aided Design		4	3 1 0	4
2.	BME-714C BME-716C	ME-330T (23691)/ ME-332T (23696)	Introduction to Robotics/ Fundamental of Energy Engineering (Only for Minor specialization)	53-54	4	3 1 0	4
3.	BME-706C	ME-306T 23653	Production Planning & Control		4	3 1 0	4
4.	BME-708C	ME-308T 23654	Turbo & Fluid Machinery		4	3 1 0	4
5.	BME-710C	ME-310T 23655	Operation Research		4	3 1 0	4
6.		ME-XXXT	Elective-I	59-60	4	3 1 0	4
			Total		**24**		**24**
Laboratory Courses							
7.	BME-702P	ME-302P 72044	CAD Lab		2	0 0 3	3
8.	BME-708P	ME-306P 72099	Turbo & Fluid Machinery Lab		2	0 0 3	3
9.	BME-712P	ME-308P 73001	Product Development Lab		2	0 0 3	3
			Total		**6**		**9**
			G. Total		**30**		**33**

Student has to undergo a summer training of 45 days at the end of VI Sem.

B.TECH. IV year VII Semester Mechanical Engineering

S. No	New Code	Old Course Code	Subject	Page No	Credits	Teaching Schedule Hrs. L T P	Total
1.		**	Open Elective (Offered by Science and Humanities Department.)		3	3 0 0	3
2.		***	Pool Elective		4	3 1 0	4
3.	BME-811C (23692)/ BME-813C (23697)	ME-431T/ ME-433T	Mechanics of Robots / Design of Energy Systems (Only for Minor Specialization)	61-62	4	3 1 0	4
4.	BME-803C	ME-403T 23661	Computer Aided Manufacturing		4	3 0 0	4
5.	BME-815C	ME-415T 23666	Value Engineering		4	3 1 0	4
6.		ME-XXXT	Elective-II		4	3 1 0	4
			Total		**23**		**23**
Laboratory Courses							
7.	BME-807P	ME-401P 71033	Industrial Engg. Lab		2	0 0 3	3
8.	BME-803P	ME-403P 71034	CAM Lab		2	0 0 3	3
9.	BME-809P	ME-405P 71035	Major Project-I (As per specialization)		2	0 0 3	3
10.	BME-805P	ME-405 71032	Seminar		2	0 0 3	3
11.	BME-801P	ME-401P 71031	Industrial Training (viva)		3	-----	----
			Total		**11**		**12**
			G. Total		**34**		**35**

B.TECH. IV year VIII Semester Mechanical Engineering

S. No	New Code	Old Course Code	Subject	Page No	Credits	Teaching Schedule Hrs. L T P	Total
1.	BME-802C BME-804C	ME-438T(23693)/ ME-436T (23698)	Microprocessor and Embedded Systems/ Computational methods in Energy Systems (Only for Minor Specialization)	68-69	4	3 1 0	4
2.	BME-806C BME-808C	ME- 440T (23694)/ ME-442T (23699)	Control of Robotics Systems/ Energy Efficiency and Economics (Only for Minor Specialization)	70-71	4	3 1 0	4
3.		ME-XXXT	Elective-III		4	3 1 0	4
4.	BME-810C	ME-406T 23673	Refrigeration & Air Conditioning		4	3 1 0	4
5.	BME-812C	ME-414T 23672	Industrial management		4	3 1 0	4
			Total		**20**		**20**
Laboratory Courses							
6.	BME-810P	ME-406P 72076	Refrigeration & Air Conditioning lab		2	0 0 3	3
7.	BME-820P	ME-404P 72074	Major Project-II (As per minor degree)		10	0 0 20	20
			Total		**12**		**23**
			G. Total		**34**		**43**

LIST OF POOL ELECTIVES

S.No.	New Code	Course No.	Subject
1.	BME-873E (23668)	ME-473T	Work Study
2.		EC-475T	Audio Engineering
3.		EC-477T	Integrated Circuit Technology
4.		CS-479T	Artificial Intelligence
5.		CS-481T	Image Processing
6.	BME-875E (23669)	ME-475T	Non-Conventional Energy sources

The above list is subject to expansion/modification.

LIST OF OPEN ELECTIVES

S.No.	New Code	Course No.	Subject

1.		HU-491T	Principal of Management
2.		MA-491T	Operations Research
3.		CY-491T	Charge Transfer in Plasma
4.		HU-493T	Introduction to Psychology
5.		CY-401T	Polymeric Materials and their Applications
6		PH-419T	Futuristic Materials
7.		PH-429T	Material Imperfection and Applications
8.		HU-402T	Engineering Economics
9.		HU-409T	Quantitative Methods in Economics
10.		HU-407T	Foreign Trade

The above list is subject to expansion/modification.

LIST OF DEPARTMENTAL ELECTIVES

Elective-I			
S.No.	**New Code**	**Course No.**	**Subject**
1.	BME-716E 23658	ME-316T	Automotive Mechanics
2.	BME-718E 23659	ME-318T	Statistical Quality Control

Elective-II			
S. No.	**New Code**	**Course No.**	**Subject**
1.	BME-807E 23662	ME-407T	Power Plant Engineering
2.	BME-809E 23663	ME-409T	Composite Materials

Elective-III			
S. No.	**New Code**	**Course No.**	**Subject**
1.	BME-814E 23676	ME-412T	Mechanical Vibration
2.	BME-816E 23678	ME-416T	Gas Dynamics
3.	BME-818E 23686	ME-424T	Total Quality Management

B.TECH. FIRST YEAR (FIRST SEMESTER)

Engineering Physics-I LTP(310)

Unit 1: Interference: Coherent sources, Theory of interference, displacement of fringes, Fresnel's biprism experiment, Interference in thin film, wedge shaped film, Newton's rings.

Unit 2: Diffraction: Basic idea of Fresnel & fraunhofer diffraction, single, double and n slit diffraction,diffraction grating, Rayleigh's criterion of resolution, resolving power of telescope, microscope and grating.

Unit 3: Polarization: Phenomenon of double refraction, Malus law, Nicol prism, quarter wave andhalf wave plates, production and analysis of plane, circularly and elliptically polarized light, optical activity, specific rotation, Lorentz half shade and biquartz proarimeters.

Unit 4: Wave Mechanics: Elementary idea of quantization, black body radiation, Frank-Hertz experiment, Photoelectric effect. Wave particle duality, De Broglie concept of matter waves, Heisenberg's uncertainty principle, Schrodinger's wave equation, physical significance of wavefunction, applications of Schrodinger's wave equation: (i) Particle in one dimensional box. (ii) Potential Step (iii) Potential barrier-quantum mechanical tunneling (Basic idea).

Unit 5: Solid State Physics: Structure of crystalline solid: Lattice translational vectors, Unit cell, Bravaislattice, Miller indices and simple crystal structures.

Unit 6: Free electron model: Free electron gas in one and three dimensions, Fermi energy, Density of states, Heat capacity of the electron gas, failure of free electron model.

Unit 7: Band theory: Kronig Penny model, motion of electrons in one dimension according to theband theory, effective mass of an electron, concept of hole, distinction between metals, insulatorsand intrinsic semi-conductors.

Books:

1. Geometrical & Physical Optics: B.K.Mathur
2. Introduction of Solid State Physics: C. Kittel
3. Solid State Physics: A.J. Dekkar
4. Quantum Mechanics: Singh and Bagdel
5. Optics: Ajai Ghatak
6. Quantum Mechanics: B.K. Agarwal & Hari Prakash
7. Optics: A.H. Flower
8. Geometrical & Physical: Zenkin's & White
9. Quantum Mechanics: Eisberg

B.TECH. FIRST YEAR (SECOND SEMESTER)

Engineering Chemistry **LTP (310)**

Unit 1: **Schrődinger equation:** origin of quantization; applications of particle in a box problem; hydrogen atom; properties of atomic orbitals; many electron atoms; molecular orbital theory; bonding and intermolecular forces.

Unit 2: **Thermodynamics:** Fundamental definition and concepts of thermodynamics; Work, heat and energy; First law: *Cp* and *Cv*; Second law: entropy; Helmholtz and Gibbs Energy; chemical potential; Third law; phase equilibria; chemical equilibrium.

Unit 3: **Chemical kinetics:** Rate laws; elementary reaction and chain reaction.

Unit 4: **Periodic table and periodic properties:** basis of periodic table, trends in size, electron affinity,ionization potential and electro negativity, Use of Ellingham diagram and thermodynamics in the extraction of elements; Transition metal chemistry: inorganic complexes, isomerism, nomenclature; bonding in transition metal complexes; valence bond and crystal field theory, magnetism, bonding aspects, structural distortion; Bioinorganic chemistry: storage and transportproteins; Catalysis: hydrogenation, hydroformylation and olefin metathesis.

Unit 5: **Organic Chemistry:** Hűckel treatment of ethylene, butadiene and benzene, concept of aromaticity, configuration, molecular chirality and isomerism, conformation of alkanes and cycloalkanes, reactivity of carbonyl groups (additions, addition-eliminations, reactions due to acidic proton, reactivity of acid halide, ester and amide), functional group inter-conversions involving oxidation and reduction. Introduction to bio-organic chemistry: carbohydrates, aminoacids proteins and nucleic acids. Polymer chemistry definition, classification of polymers, orientation of polymers, types of polymerization, Mechanism of addition and condensation polymerization, thermo plastic and thermo setting revius: Important thermosetting and thermoplastic polymers: eg. Bakelite, polyester, cellulose derivatives, PVC, Poly ethylene, Teflon, Polystyrene, Nylon Natural and synthetic rubbers.

Suggested Books:

1. P.W. Atkins, **Physical Chemistry** (7th Edition), Oxford University Press, 2006.
2. A. Levine, **Physical Chemistry**, McGrawHill, 2009
3. D.A. McQuarrie and J.D. Simon, **Physical Chemistry -a Molecular Approach**, Viva Books Pvt. Ltd., 1998.
4. R.T. Morrison and R.N. Boyd, **Organic Chemistry**, Prentice Hall of India Pvt. Ltd., 5thEd, 1990
5. G. Solomons and C. Fryhle, **Organic Chemistry**, John Wiley & Sons (Asia) Pte Ltd.
6. J.D. Lee, **Concise Inorganic Chemistry**, (5th Edition), ELBS, 1996.
7. D. F. Shriver and P. W. Atkins, **Inorganic Chemistry,** Oxford University Press, 2006
8. F.W. Bill mayer, Polymer Science, Tata McGraw Hill.

B.TECH. FIRST YEAR (FIRST SEMESTER)

Engineering Mathematics-I LTP(310)

Note: A setting of eight questions will be there covering all the Units proportionally out of which any five are to be attempted.

Unit 1: Differential Calculus: Limit, continuity and differentiability of functions of single variable. Successive, Differentiations, Leibnitz Theorem, Expansion of functions by Maclaurin'sand Taylor's theorems. Functions of several variables: Partial derivatives, Euler's theorem, change of variables, total differential coefficients, maxima and minima, Lagrange's method of multiplier.

Unit 2: Integral Calculus: Fundamental and mean value theorems of integral calculus. Reduction formulae, Walli's formula, Beta and Gamma functions, Double and Triple integrals, change of orders of integrations. Area enclosed by plane curves, surfaces and volumes of revolutions.

Unit 3: Vectors and Matrices: Differentiations and integrations of vectors. Gradient, Divergence and Curl. Vector identities, Green's, Gauss's and stoke's theorems with applications. Types and algebra of matrices, rank, solution of simultaneous linear equations, Eigen values and Eigen vectors, diagonalisation of matrices, Cayley-Hamilton Theorem.

References:

1. E.Kreyszig: Advance Engineering mathematics, John Wiley & Sons, 2005.
2. B.V.Ramana: Higher Engineering Mathematics, Tata McGraw Hill Co. Ltd., 2008
3. R.K.Jain & S.R.K. Iyenger: Advance Engineering Mathematics, Narosa Publishing House,2002.
4. J.C. Sharma: Vector Algebra, Students & Friends Co. Ltd. Agra.
5. J.K.Goel & K.P.Gupta: Matrix algebra, Students & Friends Co. Ltd. Agra.
6. H.K.Dan: Advanced Engineering Mathematics.

B.TECH. FIRST YEAR (FIRST SEMESTER)

Communicative English LTP(310)

English Language and Literature Lab

This course has a double purpose. It introduces literature and its forms and also helps students learn the English language. The linguistic aspect will be dealt with by concentrating on the dictionary skills and introducing principles of pronunciation, vocabulary development, and syntax.

The main topics include:

(a) **Pronunciation:** basic sounds of English (vowels and consonants) and word-stress
(b) **Vocabulary:** word-formation (prefixes and suffixes),synonyms and antonyms
(c) **Syntax:** parts of speech, active and passive voice, direct and indirect speech, tenses, basic sentence patterns, etc. The literary aspect will be dealt with through suitable texts such aspoems, short stories and plays (chosen be the instructors). The main topics for discussion will be :
    (a) What is literature?
    (b) The nature of literary language (mainly "figurative "language)
    (c) The literary forms or genres
    (d) Literature and socio-cultural context

Pre-Requisities of Scientific Writing: Salient features: BOCUST formula. Grammaticalpre requisites: Usage, Sentence fragments, questions tag. Modifiers, connectives Split infinitives, Dangling participle Gereunds, ellipsis coherence & Unity: Method.

B.TECH. FIRST YEAR (SECOND SEMESTER)

Computer Programming and Fundamentals LTP (210)

Unit 1: **Introduction to Computers:** Basic definition, Generation, Classification of computers, Introduction to Computer architecture. **Number Systems:** Introduction, Classification-Decimal, Binary, Octal, Hexa Decimal, and their convertibility, Datarepresentation, ASCII, BCD, Gray Code. **Input/Output:** Input System, Input device- Keyboard,Mouse, Joystic, Lighten, MCR MICR, Touch Screen, Graphic Tablet, Voice Input System, Output System, Output Devices-VDU, Printers, Plotters.

Unit 2: **Planning The Computer Program:** Purpose of program planning, Algorithms, Flowcharts, Decision Tablets, Pseudo code. **Memory:** Introduction, Characteristic, Main Memory, secondary memory, Back- Up Memory, Cache Memory, Primary Memory, Semiconductor Memory, Memory Management Unit.

Unit 3: **Basic Operating System Concept:** MS-DOS, WINDOWS, Introduction to basic commands Of DOS, Evolution of Operating Systems, Batch Processing, Spooling, Multiprogramming, Multiprocessing, Time Sharing, On Line Processing, Real-Time Processing,Introduction to Internet, Basic Terms related with internet.
Computer Software: Introduction to Software, Relationship between Hardware and Software, Types of Software, Acquiring software, Firmware.

Unit 4: **Programming in C:** History, Introduction to C Programming, Language, Structure of C Programs, Compilitation and Execution of C Programs, Debugging Techniques, Data Type and sizes, Declaration of Variables, Modifiers, Identifiers and Keywords, Symbolic constants, Storage Classes(Global, Automatic, External, Register, And Static), Enumerations, Command line Parameters, Macros, The C Preprocessors.

Unit 5: **Operators:** Unary Operators, Arithmetic and Logical Operators, Bit wise Operators, Assignment Operators, Expressions, Conditional Expressions, Precedence and order of evaluation. **Control Statements:** if-else, switch, break continue, the comma operator, Go to statement. **Loops:** for, while, do-while. **Functions:** Built-in and user-defined, Function declaration, Definition and Function call, parameter passing, call by value, Call by reference, Recursive Functions, Multi file programs. **Arrays:** Linear Arrays, Multidimensional Arrays, Passing arrayto functions, Arrays of strings.

Unit 6: **Structure And Union:** Definition and differences, Self-referential Structure. **Pointers:** Introduction, Accessing the address of a variable, Declaring & Initializing pointers, Accessing avariable though in pointer, Pointers and Arrays, Pointers and character strings, Pointers and functions.

References:

1. Computers Fundamental by Rajaraman
2. Computers Fundamental by B. Ram.
3. Computers Fundamental by P.K. Sinha.
4. 'Programming in C' by E. Balagrusamy, TMIL.
5. 'Let Us C' by Yashwant Kanetkar, Narosa.
6. Exploring 'C' by Yashwant Kanetkar

B.TECH. FIRST YEAR (FIRST SEMESTER)

Sub. Code: ME-101T **Manufacturing Techniques** **LTP (200)**
New Code: BME-501C

Unit: **1 Carpentry:-**
Wood, timber-exogenous & endogenous, Cross section of an exogenous tree, Seasoning of wood, Seasoning methods, defects (Both natural and that occurs during conversion), Brief description of carpentry tools, various carpentry process. Carpentry joints.

Unit: **2 Foundry and Foundry tools & equipment:-**
Moulding materials, types of foundry sands; characteristics of foundry sands; Binders &additives; moulding procedures: Floor moulding, Bench moulding, Pit moulding, Machine moulding, Green sand moulding, Dry sand moulding, CO2, Core making processes. Tools used in foundry (hand tools); moulding machine- (Jolt machine, Squeezing machine, SandSlinger, Push off machine), Furnaces (Pit furnace, cupola furnace).

Pattern & Pattern making:-
Pattern, types of pattern (Single piece, split, Match plate, Sweep, Loose piece, Gated patterns), Pattern making allowances, Design considerations in pattern making, pattern making materials,Core prints.

Unit: 3 Welding:-Welding: Pressure and non-pressure, arc welding (AC and DC arc welding, Introduction to Carbon arc welding, metal arc welding, TIG & MIG welding); Electric resistance welding (Spot,seam, projection, But, thermit welding), welding tools and equipments, Gas welding (oxyacetylene).

Unit: 4 Machine tools: Definition, types.
Lathe specifications; Lathe operations in brief (facing, plain turning, step turning, taper turning, threading, drilling and boring). Milling machine (introduction & brief description of operations only).

Bench work & fitting:-
Tools (holding tools, striking tools, cutting tools), various operations performed in fitting shop (detailed).

Jigs & Fixture:
Introduction, Location points, Basic Design of Jigs & Fixture, Types ofJigs & Fixture.

Text Book:

1. A text Book on workshop technology by B. S. Raghuvanshi

Reference Book:

1. Workshop technology by Hazara & Chaudhry,
2. Production technology by R.'K.Jain

B.TECH. FIRST YEAR (FIRST SEMESTER)

Sub. Code: ME-107T **Engineering Graphics** **LTP (120)**
New Code: BME-503C

Unit 1: Importance of Engineering Drawing, Engineering Drawing Instruments and uses, Layout of Drawing sheet, Lettering and Dimensioning, Types of Lines. Scales: What is scale, Representative factor, Types of Scale: Plain, Diagonal and Vernier scales, Metric Measurementsand conventions, Plain Scale, diagonal scale& Vernier scale (forward & backward both).

Unit 2: Conic Section, Definition, and different methods of construction of ellipse, hyperbola and parabola by Eccentricity method Construction of parabola and ellipse by Concentric circlesmethod, Oblong method, Parallelogram method.

Unit 3: Projections, Principle, types and conventions, Theory of Projections and orthographic projections:- Introduction, Types of projections, Orthographic projections, Planes of Projection,Four quadrants, Types of orthographic projections, (a) Projections of point and straight lines, (b)Projections of lines inclined to both the planes, Projection of planes, (a) Projection of solids (b) Projection of solids inclined to both H.P. & V.P. (of prisms pyramids etc).

Unit 4: Isometric Projections: Theory of isometric projection- Isometric lengths, Isometric scales:- Methods to draw Isometric view or projection, various positions of Isometric axes. Isometric projection with isometric lines, non-isometric lines and with curved & circularsurfaces.

Recommended Text Book:-

1. A Text book of Engineering Drawing (Geometrical Drawing) by R.K. Dhawan
2. Engineering Drawing & Graphics, by K.Venugopal Rao
3. Engineering Drawing by P.S. Gil
4. Engineering Drawing by N. D. Bhatt

B.TECH. FIRST YEAR (SECOND SEMESTER)

Basic Electronics Engineering LTP(310)

Unit 1: Introduction of Semiconductor Physics: Band Theory of solids, Insulator, Semiconductor & Metals, Mobility and Conductivity, Electrons and holes in an intrinsic semiconductor, Carrier concentration in an intrinsic semiconductor, n-type material, p-type material, Donor and Acceptor impurities, Charge densities in a semiconductor, Hall-effect, Diffusion, the continuity equation, Fermi level in a semiconductor having impurities.

Unit 2: Junction Diode Characteristics: p-n junctions, Forward bias, Reverse bias junction, V-I characteristics, Effect of temperature on a p-n junction diode, Maximum temperature operation, Reverse breakdown voltage, Capacitive effects in a p-n junction diode, Space chargecapacitance, Diffusion capacitance, Diode Resistance, Static and Dynamic Resistance, Comparison of practical with ideal diode, load line analysis of a diode circuit.

Unit 3: Rectifying Circuits and DC Power supplies: p-n junctions as an rectifier, form factor, average voltage and current, haft wave & full wave rectifier, voltage regulation, Ripple factor, Bridge rectifier, Comparison of rectifier circuits, Filter circuits for power supplies, inductor filter, capacitor filter, Effect of capacitor series resistance, Peak inverse voltage of a half wave rectifier, LC filter, Comparison of filter circuits.

Unit 4: Diode Applications: Clippers, Series and parallel, Clampers, Zener diodes, Zener diode specification, Voltage regulator circuits, Design of a voltage regulator circuits, Effect of supply voltage variations, Zener diode breakdown mechanism, Voltage multiplier circuits, voltage doublers, voltage Tripler, Quadrupoler.

Unit 5: Bipolar Junction Transistor: The junction transistor, Transistor current components, transistor as an amplifier, Common base configuration. Early effect, the input and output characteristics, Common emitter configuration I/O characteristics, Active, Saturation, Cut-off regions for both configurations, common collector configuration, common base current gain, common emitter current gain.

References:-

1. Integrated Electronics: Analog and Digital Circuits and System by Millman, halkias and Parikh, TMH, Second Edition.
2. Electronic Devices and Circuits, An introduction by Allen Mottershead, TMH.
3. Electronic Devices and Circuits theory by Robert L. Boylestad, Lonis nashelsky,

B.TECH. FIRST YEAR (SECOND SEMESTER)

Engineering Mathematics-II LTP(310)

Note: A setting of eight questions will be there covering all the Units proportionallyout of which any five are to be attempted.

Unit 1: Numerical Techniques: Numerical solution of algebraic and transcendental equations by Bisection method, Secant method, Regula- Falsi and Newton-Raphson methods. Numerical integration by Gauss quadrature formula, Trapezoidal rule, Simpson's rule and Weddle's rule. Numerical solution of ordinary differential equations by Euler's method, Milne's method and Runge-Kutta method.

Unit 2: Probability and statistics: Definitions of probability and simple theorems, conditional probability, Baye's Theorem, random variables, discrete and continuous distributions, Binomial,Poisson and normal distributions, correlation and linear regression.

Unit 3: Complex Analysis: Analytic functions, C-R equations in Cartesian and polar forms, Harmonic functions, Milne-Thomson method, complex integration, Cauchy's theorem, Cauchy's integral formula. Lioville's and Morera's Theorems, Taylor's and Laurent's theorems.Residues:
Cauchy's residue theorem, evaluation of real integrals of the type $\int 02\pi$ (cos θ, sin θ) do and $\int_{-\infty}^{\infty}$ fen,dx.

References:-

1. E. Balagurusamy: Numerical Methods, Tata McGraw Hill, 2008.
2. Devi Prasad: An introduction to Numerical analysis, Narosa Publishing House, 2006.
3. J.B. Conway: Functions of one complex variable, springer verlag, International StudentsEdition Narosa Publishing House, 1980.
4. A.M. Goon, M.K.Gupta & B.Das Gupta: Basic Statistics, The world Pren Pvt. Ltd.,Calculta, 1991.
5. L.V. Alhfors: Complex analysis, Tata McGraw Hill, 1979.

B.TECH. FIRST YEAR (SECOND SEMESTER)

Basic Electrical Engineering LTP(310)

Unit 1: Basic Concept: Definitions & Units, Introduction to Basic Laws, Circit Elements, KVL, KCL, Ideal & Real Sources, Dependent & Independent Sources, Conversion of Voltage Source into Current Source & vice Versa, Controlled and Uncontrolled Sources, Loop and NodalMethod of analysis, Star to Delta Transformation & vice-versa.

Unit 2: Magnetic Circuit: MMF, Flux, Reluctance, Magnetic Effect of Electrical Current, Hysterisis & Eddy Current Losses.

Unit 3: Network Theorems: Superposition, Thevenin, Norton, Maximum Power Transfer & Reciprocity Theorems.

Unit 4: Steady-State Response: Steady-State Response of Circuit to Sinusoidal functions, Phasor Representation of Sinusoids, Concept of Complex Impedance, Series & Parallel AC Circuits, Series & Parallel resonance

Unit 5: Balanced Three-Phase Circuit: Generation of Three Phase Voltage, Star/Delta Connected Supply, Balanced Load Circuits, Line and Phase Voltage & current Relations. Concept of Three Phase Power.

Unit 6: Transient: Response of RC, RL & RLC Circuit to DC Excitation only (simple problem).

Unit 7: Instruments: Introduction to MI, MC Instruments, Extension of range, Dynamometer Type Wattmeter, Simple problems based on these instruments.

Books:-

1. Basic Circuit Therory by L.P. Huelsman, PHI.
2. Hughes Electrical Technology by M. Smith, Addison-Wessley Pub
3. Electrical Technology by B.L. Theraja.
4. Electrical Engineering Fundamentals by V. Deltoro, PHI

B.TECH. FIRST YEAR (SECOND SEMESTER)

Engineering Physics-II LTP(310)

Unit 1: Dielectric Properties of Materials: Polarization of dielectrics, dielectric constant, electric susceptibility, non-uniform polarization, electric displacement vector, Lorentz local field, Polarizability, Clausius-Mosotti relation, frequency dependence of dielectric constant.

Unit 2: Magnetic Properties of Materials: Magnetization, three magnetic vectors (B.M & H), susceptibility and permeability, Dia, Para, and ferromagnetism, Magnetic domains, hysteresis, Ferro electricity & Piezoelectricity.

Unit 3: Maxwell's Equations: Displacement Current, Maxwell's equation in vacuum & medium(Integral and Differential forms), Poynting theorem, Poynting vector.

Unit 4: Electromagnetic Waves: Wave equation, plane waves, Propagation of electromagnetic waves through non-conducting medium, reflection and transmission.

Unit 5: Superconductivity: Temperature dependence of resistivity in superconducting materials, Effect of magnetic field (Meissner effect), Type I and Type II superconductors, BCS theory (Qualitative), high temperature superconductors. Characteristics of superconductors in superconducting state, applications of superconductors.

Unit 6: Nuclear Physics: Basic properties and constituents of nucleus, mass defect, packing fraction and binding energy, semi empirical mass formula, elementary idea of nuclear forces and their characteristic properties, Nuclear fission, important components and working of nuclear fissionreactor, Basic Concept of nuclear fusion reactors.

Books:-

1. Electricity and Magnetism: Berkley Physics Course-II.
2. Electromagnetic waves & Radiating systems: Jordan and Keith.
3. Solid State Physics: C. Kittel
4. Nuclear Physics: I. Kaplan
5. Modern Physics: A. Beiser
6. Electrodynamics: D. J. Griffith.

B.TECH. FIRST YEAR (FIRST SEMESTER)

Environmental Studies **LTP(300)**

Program Outcome:

This involves the environment based studies to make the students well aware about the environment and sustainability, Pollution and pollutants etc.

Course Outcome:

CO-1- It will let the students aware about environmental and the knowledge to protect it and keep it clean and free from pollution
CO-2- It will explain Environmental policies and legistration.
CO-3- It will give knowledge **about Global issues including climate changes**

Unit 1: Multidisciplinary nature of environmental studies, Ecosystems, Biodiversity and its conservation, Indicators of environmental pollution, Environment and human health.

Unit 2: Consumption of natural resources and environmental degradation of forests, water, coal, minerals, energy, and land. Sustainable development, Environmental policy and legislation, Environmental impact assessment.

Unit 3: Pollution of lakes, rivers, ground water, coasts, and oceans, Science and technology for drinkingwater and wastewater treatment and issues in management of systems. Solid and hazardous waste management: causes, effects and control measures.

Unit 4: Air and noise pollution, science and engineering of pollution control, Global Issues including climate change, global warming, acid rain, ozone layer depletion, nuclear hazards, Disaster management, industrial accidents, floods, earthquakes, cyclones and landslides, Greenhouse effect etc.

Suggested Books:-

1. W.P. Cunningham and M.A. Cunningham, **Principles of Environmental Science,** TataMcGraw-Hill Publishing Company, New Delhi, 2002.
2. J.A. Nathanson, **Basic Environmental Technology**, Prentice Hall of India, New Delhi,2002.
3. S.J. Arceivala, and S.R. Asolekar, **Wastewater Treatment for Pollution Control andReuse** (3rd Edition), Tata McGraw Publishing Co. Ltd., New Delhi, 2006.
4. S.R. Asolekar, and R. Gopichandran, **Preventive Environmental Management: An IndianPerspective**, Foundation Books Pvt. Ltd., New Delhi, 2005. Some selected book-chapters, monographs and journal papers

B.TECH. FIRST YEAR (FIRST SEMESTER)

Fundamentals of Economics LTP(300)

Unit 1: **Microeconomics:** What is Economics? Basic economic problems and nature of economics; demand and supply; consumer choice; individual and market demand; production and cost of production; profit maximization and perfect competition; market structure-monopoly, monopsony, monopolistic competition, and oligopoly; externalities and public goods; factor markets-land, labour and capital market.

Unit 2: **Macroeconomics:** National income accounting-income, expenditure and components of GDP; consumption and saving; investment spending and demand for money; financial systems centralbank, money, credit, financial markets and asset prices; income and spending; money, interest and income; fiscal and monetary policies; economic growth and accumulation; aggregate supplywages, prices and unemployment; inflation.

Suggested Books:-

1. R.S. Pindyck and D.L. Rubinfeld. Microeconomics (7th Edition), Pearson Prentice Hall, New Jersey, 2009.
2. 2. R. Dornbusch, S. Fischer, and R. Startz. Macroeconomics (9th Edition), McGraw-Hill Inc. New York, 2002.

B.TECH. FIRST YEAR (SECOND SEMESTER)

Sub. Code: ME-105T **Basic Mechanical Engineering** **LTP(310)**
New Code: BME-505C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Determine resultant of forces acting on a body and analyze equilibrium of a body subjected to a system offorces.
CO 2: Solve problem of bodies subjected to friction.
CO 3: Find the location of centroid and calculate moment of inertia of a given section.
CO 4: Understand the kinetics and kinematics of a body undergoing rectilinear, curvilinear, rotatory motion andrigid body motion.
CO 5: Solve problems using work energy equations for translation, fixed axis rotation and plane motion and solveproblems of vibration.

Unit 1: Introduction to Engineering Mechanics - Force Systems: Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Varignon's Theorem Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Types of Supports, Structural Members and Beams, Reactions of Beams. Properties of Lines, Areas and Solids: Centre of Gravity, Centroid of Lines (Basic and Composite Areas), Built-Up Sections, Product of Inertia, Mass Moment of Inertia.

Unit 2: Trusses, Frames and Mechanisms: Connected Bodies, Two Force and Three Force Members, Trusses, Method of Joints, Method of Sections, Determinateness of Truss, Rigid and Non-Rigid Frames, Simple Mechanisms, Space Frames.

Unit 3: Friction: Types of friction, Limiting friction, Laws of Friction, Laws of coulomb friction, Static and Dynamic Friction;Motion of Bodies, wedge friction.

Unit 4: Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Product of Inertia, Parallel Axis Theorem, Perpendicular Axis Theorem, Mass Moment of Inertia: Moment of Inertia of Masses - Transfer Formula for Mass Moments of Inertia– Mass moment of inertia of composite bodies.

Unit 5: Work Power & Energy: work-Units of work-Problems (horizontal & inclined surface). Power Derivation of the expression for power required to drive a body, problems energy, Types of energy problems. Laws of conservation ofenergy. Newton's law of conservation of momentum. Plastic impact & Elastic impact. Driving a pile into ground-problems. Motion of connected bodies, work done by spring.

Unit 6: Newton's Second Law: D' Alembert's Principle-problems (for horizontal & inclined surface). Analysis of lift, motionproblem. Motion of several connection bodies, Motion of two bodies connected by as tiring, when one body is lying on horizontal surface and

other is hanging free, when one body is lying on inclined plane and other is hanging free case (i) Smooth inclined surface case (ii) Rough inclined surface of co-efficient of friction 'μ' (only problems).

Unit 7: Stress and Strain Analysis: Simple stress and strain: Introduction, Normal shear stresses, stress strain diagrams for ductile and brittle materials, elastic constants, one dimensional loading of members of varying cross sections, strain Energy.

Text Books:

1. Shames and Rao (2006), Engineering Mechanics, Pearson Education
2. Reddy Vijay Kumar K. and J. Suresh Kumar (2010), Singer's Engineering Mechanics –Statics & Dynamics

Reference Books:

1. Beer F.P & Johnston E.R Jr., Vector Mechanics for Engineers – Statics and Dynamics, McGraw Hill, 12th Edition.
2. Dumir P.C, Sengupta, Srinivas, Engineering Mechanics- Universities Press, 2020.
3. Hibbeler R.C, Engineering Mechanics, Pearson, 14th Edition.
4. Arshad Noor, Zahid & Goel, Engineering Mechanics, Cambridge University Press, 2018.
5. Khurmi R.S, Khurmi N., Engineering Mechanics, S. Chand, 2020.

B.TECH. SECOND YEAR (THIRD SEMESTER)

Sub. Code: ME-201T **Kinematics of Machines** **LTP(310)**
New Code: BME-601C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Designing a suitable mechanism depending on application.
CO 2: Drawing displacement diagrams and cam profile diagram for followers executing different types of motions and various configurations of followers.
CO 3: Drawing velocity and acceleration diagrams for different mechanisms
CO 4: Selecting gear and gear train depending on application.

Unit 1: **Basic Concepts:** Kinematic Quantities (Displacement, velocity, Acceleration), structure, machine, degree of freedom, mechanisms, Kinematic link, Kinematics Pairs,Kinematics chain, joints, Types of joints, inversion of Mechanism, four bar mechanism,Inversion of four bar mechanism, slider crank mechanism, Inversion of slider-crank mechanism, Inversion of double slider crank Mechanism, Grublers Equation, Kutzbach Criterion (Numerical problems).

Unit 2: **Kinematic Synthesis of linkages:** Type, Number and Dimensional Synthesis, Synthesis of dwell mechanisms Intermittent Rotory Motion problems Movability of four bar mechanism (Grashoffs Criterion), function generation, path generation, approximate& exact synthesis of function & path generation, chebyshev‟s spacing ofaccuracy points, function generation of four bar linkages (Freudenstein‟s Equation),function-generation of Slider-Crank mechanism using three accuracy points only, Three position synthesis, Bloch‟s Method of synthesis.

Unit 3: **Velocity in Mechanism:** Instantaneous Center Method-Analysis of reciprocating engine mechanism, Analysis of four bar mechanism, Number and types of instantaneous centres in mechanism, Method for locating an instantaneous Center, Kennedy Theorem, Procedure for locating instantaneous Centres, (Numerical problems).
Relative velocity method: Velocities in four bar chain, velocities in slider-crank mechanism, rubbing velocity, Mechanical advantage. (Numerical problems) Acceleration in Mechanism: Acceleration of a body moving along a circular path, Acceleration diagram for a link, Acceleration diagram for slider-Crank mechanism,Acceleration of intermediate and affect points. Coriolis acceleration Component.(Numerical problems)

Unit 4: Analysis & Synthesis of cam follower mechanism, cam profile, pressure angle, cam size, Motions of followers, cycloidal motion, Cam profile construction with different followers.

Unit 5: **Gear:** Introduction, Classification of gears, Basic terminology, Law of gearing, velocity of sliding Cycloidal profile teeth, In volute profile teeth, length of path of contact, length of arc Contact, interference, minimum no of teeth to required to avoid interference wheel and pinion helical gears, Spiral gears. (Numerical problems).

Gear Train: Introduction, Types of gear trains-Simple, Compound, reverted, Epicyclic, velocity ratio of simple gear train, compound gear train, Epicyclic gear train, Sun and planet gear train, Compound epicyclic gear train. (Numerical problems)

TEXT BOOKS:

(i) Theory of Machines by Jagdish Lal
(ii) Theory of Machines by P.L.Baliney
(iii) Theory of Machines by S.S. Rattan

B.TECH. SECOND YEAR (THIRD SEMESTER)

Sub. Code: ME-203T **Production Processes-I** **LTP(310)**
New Code: BME-603C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Student will be able to understand the basic principles of casting, metal forming, powder metallurgy, nondestructive testing, numerical control and various aspects of production processes etc.
CO 2: Apply these principles to solve the problems on fluid flow, gating design and solidificationtimes of different shape of castings.
CO 3: Solve the problems on design of rolling mills.
CO 4: Analyze the problems on forging and extrusion force.
CO 5: Solve the problems on density and pressure variation in powder metallurgy.
CO 6: Discuss and analyze various aspects of metallurgy of welds and its effects on weld quality.

Unit 1: **Casting processes:** Introduction, pattern and mould, melting pouring cooling and solidification mechanism of solidification, continuous casting process, Riser design and placement, generation of residual stresses, defects in castings, miscellaneous casting processes, inspection and testing of castings, Micro-welding.

Unit 2: **Joining Processes:** Introduction principles of solid phase welding, principles of fusion welding (Heat source, modes of metal transfer in are welding, heat flow characteristics, gas metal reaction, cooling of fusion weld, principles of solid/liquid state joining, various joining processes, weld defects and inspection)..

Unit 3: a) **Mechanics of forming processes:**
Forming processes: Introduction, plastic deformation and field criteria, relationship b/w ten site and shear field stresses.
b) **Powder Metallurgy:**
Definition, Principle & uses, Methods of Powder production, Mechanical pulverization, Electrolysis. Nano fabrication, nano materials, nano powders.

Unit 4: **Non Destructive Testing:** Principles, Types &Applications, Liquid penetrant test, Magnetic particle test, Radiographic &Ultrasonic testing.

Unit 5: **Numerical controlled machine tools:** Introduction, procedure for manufacturing through N-C machine tool system. Classification of NC system.Advantages and disadvantages of using NC machines, types of numeric controls.
Rapid prototyping operations: Introduction, subtractive process, additive process, virtual prototyping, applications.

Reference Book:-

1. Production Engineering by R.K.Jain
2. Manufacturing Engineering &Technology by S.Kalpakajian, S.R. Schmid
3. Manufacturing Engg. & Technology by Degarmo
4. Manufacturing Science by Amitabha Ghosh, A.K. Mallik

B.TECH. SECOND YEAR (THIRD SEMESTER)

Sub. Code: ME-205T **Fluid Mechanics** **LTP(310)**
New Code: BME-605C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Student will be able to understand the fluid properties and basic law of mechanics that govern the fluid flow.
CO 2: Apply the principles of fluid statics to solve the problem of force acting on inclined flat surface and curved surface.
CO 3: Analyze the problem of fluid flow through the pipe and parallel plate.
CO 4: Calculate the Major and minor head loss through the pipe.
CO 5: Apply the Bernoulli theorem for venturi meter, orifice meter and Pitot Tube.
CO 6: Solve the problem of notches and weir and time for emptying the tank.

Unit 1: **Fluid and Their Properties:** Phases of matter-Definition of fluid, continuum. Density mass density-weight density-specific volume. Specific gravity, vapour pressure, compressibility. Relationship between bulk modules (k) and pressure (p) for a Gas; for isothermal condition (constant temperature), for adiabatic condition, importance of compressibility. Viscosity, Kinematic viscosity- Newton's law of Viscosity. Cohesion &Adhesion. Surface tension; Effect of surface tension on forming a droplet of liquid; pressure inside a liquid droplet (Raindrop); pressure inside a soap bubble; pressure inside a liquid jet. Capillarity. Types of fluid-Ideal and real fluid, Newtonian and Nonnewtonian fluids. Numerical problems on properties of fluid.

Fluid Pressure & it's Measurement: Fluid pressure at a point. Pascal's law. Hydrostatic law (Pressure variation in a fluid at rest). Effect of shape and size ofthe container on the intensity of pressure-Numerical Problems. Absolute, gauge, atmospheric and vacuum pressure-Problems. Measurement of pressure; Barometer; Manometers; simple manometer, single piezometer, u-tube simple manometer, sensitive inclined tube simple manometer; Differential manometer, two piezometer, inverted U-tube differential manometer, U-tube differential manometer-Problems; Micro manometer; Mechanical Gauges, Bourdon tube pressure gauge, diaphragm pressure gauge, deadweight-pressure gauge

Unit 2: **Fluid Static's:** Total pressure force on a horizontal lamina; Total pressure force on a vertical lamina; Centre of pressure-to locate the position of center of pressure; Total pressure on an inclined lamina; To locate the center of pressure for inclined lamina; Force on curved surface, Pressure Diagram.

Numerical problems on total pressure for horizontal lamina, total pressure force and center of pressure for vertical Lamina and inclined lamina, force on curved surface, pressure diagram. Buoyancy, Buoyant forces &center of buoyancy, metacentre and metacenteric height, determination of met centric heights, equilibrium bodies Numerical Problems.

Fluid Kinematics (fundamental of fluid flow): Description of fluid motion-langrangian method & EuleriIan methods of study of fluid flow (theory). Basic scientific laws used in the analysis of fluid flow (basic principles of fluid flow)-Law of conservation of mass. Newton's law of motion, law of conservation of energy, thermodynamic laws (theory). Types of fluid flow; Steady and unsteady

flow, uniform flow and non-uniform flow, one dimensional flow, two dimensional flow and three dimensional flow, rotational flow and Irrotational flow, laminar and turbulent flow, Description of the flow pattern-stream linestream tube-path line, streak line. Continuity Equation; Equation of continuity for one dimensional steady flow, equation of continuity for three, dimensional unsteady compressible flow. Velocity Potential and Stream function; relation between stream function and velocity potential (Cauchy Riemann Equation). Flow nets; method of drawing flow nets, uses and limitation. Circulation and Vorticity. Vortex flow; Forced vortex flow, free vortex flow, numerical problems finding rate of flow. Examine whether the given velocity fluid represents possible incompressible fluid flow and the possible cases whether irrotational or not, steadyor unsteady.

Unit 3: **Fluid Dynamics:** Eulers equation of motion along a stream line (Derivation). Bernoulli's equation (derivation from Euler's equation), assumptions in deriving Bernoulli's equation; Modified form of Bernoulli's equation (real fluid); Bernoulli's Equation from energy principles (Derivation); Limitations of Bernoulli's equation; Total Energy line. Hydraulic gradient line; Practical applications of Bernoulli equation; Venturi meter, inclined venturi meter, orifice meter, pitot tube, pitot static tube (Prandtl pitot tube), flow nozzle. Numerical problem on Bernoulli equation and its application.

Flow Measurement: Orifice and mouth piece; Venturi meter, orifice meter, flow nozzle meter, pitot tube, notches &weirs, Flumes-Problems

Unit 4: **Flow Through Pipes:** Reynolds experiment to demonstrate type of flow; Equation for head loss in pipe due to friction. Darey-Weisback Equation (derivation); Other formulae for head loss due to friction in pipe, Chezy's formula, Manning formula, Hazen Williams formula. Other energy losses in pipes; major losses; minor losses; headloss due to sudden enlargement of pipe (Carnot or Borda's equation), head loss due to sudden contractions, head loss at entry, head loss due to pipe fittings. Energy line & Gradient line. Pipe in series, equivalent pipes, pipes in parallel, objects of laying pipes in parallel, elements of pipe networks. Siphon. Moody's diagram. Power transmission through pipes; Condition for maximum transmission of power, maximum efficiency of transmission of power, problems. Water hammer in pipes (only theory).

Unit 5: **Boundary Layer Theory:** Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sub-layer, separation and its control,Drag and lift, drag on a sphere, a two dimensional cylinder, and an aero foil, Magnus effect.

Text Books:-

1. Hydraulics & Fluid mechanics-By P.N. Modi & S.N.Seth (Standard Bookhouse, Delhi.)
2. Fluid mechanics & Hydraulic machines-by RK. Rajput (S.Chand & Company Ltd. New Delhi.)
3. Fluid mechanics & Hydraulic Machines-By RK. Bansal (Laxmi Publications (P) Ltd, New Delhi).

Reference Book:-

1. Fluid mechanics-By VL Streeter (Mc Graw Hill-SI Edition)
2. Fluid Mechanics-by Douglas (ELBS Edition)
3. Fluid Mechanics through problems-by Garde (New Age Publication)

B.TECH. SECOND YEAR (THIRD SEMESTER)

Mathematics-III **LTP (310)**

Unit 1: Ordinary Differential Equations: First order equations (linear and non-linear). Linear equations of second and higher orders with constant and variable coefficients. Solution of second order equations by removing first derivative, changing of dependent and independent variables and method of variation of parameters.

Unit 2: Special Functions & Partial Differential Equations: Power Series solutions of second order equations by frobenious method. Legendre polynomials and Berel‟s functions of first kind and their properties method of separation of variable for heat, wave and Laplace equations: Their solutions and related application.

Unit 3: Integral Transforms: Laplace transform, existence theorem, Laplace transform of derivatives and integrals, Laplace transform of special functions. Inverse Laplace transform, convolution theorem. Applications of Laplace transform and its inverse to solve ordinary and partial differential equation. Introduction to Fourier transforms. Fourier series, half range sine and cosine series, related applications.

Reference Book:-

1. J.N.Sharma: Differential Equations, Krishna Prakashan Media (P) Ltd.,Meerut.
2. B.V.Raman: higher Engineering Mathematics, Tata McGraw Hill Co., Ltd.,2008.
3. R.K.Jain & S.R.K. Iyenger: Advance Engineering Mathematics, Narosa Publishing House, 2002.
4. A.R.Vashistha: Integral Transforms Krishan Prakashan Media (P) Ltd.,Meerut.
5. G.G.Simmons: Differential Equations, Tata McGraw Hill Co. Ltd., 1981.

B.TECH. SECOND YEAR (THIRD SEMESTER)

Sub. Code: ME-207T **Material Science** **LTP (310)**
New Code: BME-607C

Course Outcomes (COs)

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

CO 1: The ability to apply knowledge of Material science and engineering.
CO 2: Understand about material fundamental and processing.
CO 3: The ability to select proper metal, alloys, nonmetal and powder metallurgicalcomponent for specific requirement.
CO 4: The ability to detect the imperfections in solid and its effect on crystal properties.
CO 5: Ability to evaluate the different properties of material by studying different test.
CO 6: Ability to design and develop metallic alloy for specific application.
CO 7: Recognize how metals can be strengthened by cold-working and hot working.

Unit 1: Introduction to materials science, Introduction & types of advanced materials, some mechanical properties. Atomic structure and' bonding, types of atomic and molecular bonds, primary and secondary bonds, ionic bonding mechanism and examples, inter atomic forces for ion pair, covalent bonding, mechanism and examples, covalent bonding in carbon, energy and separation distance relationships, metallic bonding, secondary bonding mechanism and example.

Unit 2: **(a)** Crystal structures and crystal geometry, space lattice and Unit cells, crystal systems and Bravais lattices, classification of space lattices by crystal system, principal metallic crystal structures, BCC, FCC and SC crystal systems, relationship between lattice constant 'a' and atomic radius in SC, BCC & FCC system, atomic packing factor, miller indices for crystallographic planes in cubic Unit cells, determination of miller Indices in cubic system. An introduction to crystal system, determination by X-ray diffraction method.

(b) Crystalline imperfections, types of imperfections, zero dimension, one dimension and two dimension defects, point defects, line defections, edge &screw dislocations, their formation and Burger vectors, grain boundaries, rate process in solids, Numerical determination of number of vacancies.

Unit 3: Atomic diffusion in solids, diffusion in solids in general, Diffusion mechanisms, vacancy mechanism, substitutional mechanism, types of diffusion, steady state diffusion and non-steady state diffusion, Fick's Laws of diffusion, factors affecting diffusivity, Numerical problem on Non-steady diffusion (Industrial applications).

Unit 4: Phase diagrams, definition, explanation of phases, phase diagram of pure substances (water and Iron), Gibbs phase rule, Binary isomorphous alloy systems, Lever rule, numerical examples on lever rule for binary alloys, binary eutectic alloysystems, Invariant reactions, their representations and examples, Iron-Iron carbide phase diagram, phases of Fe-Fe3C phase diagram, invariant reactions, slow cooling of plain carbon steels, numerical problems using lever rule, rapid cooling of plain-carbon steels, isothermal transformation of Austenite in eutectoid plain carbon steel, continuous cooling of eutectoid plain carbon steel T.T.T. diagram

Unit 5: Heat Treatment, purpose, application, types of heat treatment processes, Annealing, Normalizing, tempering, surface hardening, case hardening techniques.

Text Books:

1. Materials Science by F.W.Smith.

Reference Book:

1. Material Science by Van Vlack 2. Material Science by V. Raghwan

B.TECH. SECOND YEAR (THIRD SEMESTER)

Sub. Code: ME-209T **Engineering Thermodynamics** **LTP (310)**
New Code: BME-609C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Explain the basic fundamental of the Thermodynamics.
CO 2: Discuss the various laws pertaining to heat engine, heat pump, refrigerator etc.
CO 3: Identify, formulate and solve problems related to thermodynamic machines.
CO 4: Specify, interpret data, and make a judgment about the best possible solution. Aspire fordeveloping career with specialization in areas of thermal engineering.

Unit 1: Fundamental Concepts and definitions: Definition of thermodynamics, system, surrounding and universe, phase, concept of continuum, macroscopic & microscopic point of view. Density, specific volume, pressure, temperature. Thermodynamic equilibrium, property, state, path, process, cyclic process, Energy and its form, work and heat, Enthalpy, PMM Machines.

Unit 2: **Zeroth Law:** Concepts of temperature, zeroth law. First Law: First law of thermodynamics. Concept of processes, flow processes and control volume, flow work, steady flow energy equation, Mechanical work in a steady flow of process.
Second Law: Essence of second law, the corollaries & their proofs, Thermal reservoir, Heat engines. COP of heat pump and refrigerator, Statements of second law. Carnot cycle, Clausius inequality, Concept of Entropy, entropy change of a pure substance; Tds equations and calculation of entropy change; concept and uses of entropy; the entropy generation principle. Concept of energy.

Unit 3: Pure Substance, Properties of pure substance; Phases of pure substances- Phase rule; Phase Change Processes of Pure Substances – triple pt., critical pt.; Property diagrams of Phase change Processes; P-V-T surface for phase change; Property tables of real substances - compressed liquid, saturated, wet & superheated vapor. Rankine cycle, Vapor power cycles & its modifications, Reheat & Regenerative cycle for steam, Binary cycle and cogeneration.
Thermodynamic property relations: Maxwell relations; Clapeyron Equation, Joule Thompson co- efficient.

Unit 4: I.C. Engine, Air Standard cycles; Otto, Diesel, Dual Combustion cycle.

Unit 5: Refrigeration cycles, reversed Carnot cycle; main components introduction to simple vaporcompression Refrigeration cycle and Vapor Absorption Refrigeration cycle.

Unit 6: Steam boilers, Introduction, classification of boilers, fire tube, water tube boilers, highpressure boilers, boiler mountings and accessories.
Performance of boilers: Evaporative capacity, Equivalent evaporation, Factor of evaporation, Boilerefficiency, heat losses and heat balance sheet for boilers

Text Books:

1. Thermodynamics by P.K. Nag.
2. Thermodynamic by P.L. Ballaney.

3. Thermodynamic by, J.P Holman., MC Graw Hill book Co. NY.

Reference Book:

1. Thermodynamics: An engineering approach by Cengel, Boles, Konguru, MC Graw hill.
2. Thermodynamics Basics and applied by Ganeshan, MC Graw hill.
3. Fundamentals of Engineering Thermodynamics, 9th Edition
4. Michael J. Moran, Howard N. Shapiro, Daisie D. Boettner, Margaret B. Bailey, Wiley publication.

B.TECH. SECOND YEAR (FOURTH SEMESTER)

Sub. Code: ME-202T **Dynamics of Machines** **LTP (310)**
New Code: BME-602C

Course Outcomes (COs)

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

CO 1: The ability to analyze the static and dynamic forces of mechanism using mathematical methods.
CO 2: The ability to analyze the motion, the dynamical forces acting on mechanical systems.
CO 3: The ability to balance the mechanical systems.
CO 4: The ability to understand the gyroscopic motion and the effect of gyroscopic couple on aeroplane, ships, automobiles and machines.

Unit 1: Static Force Analysis- Applied and Constraint forces, Free Body diagrams, Conditions for equilibrium, Friction-force models, Static force analysis with friction, gear force analysis.
Dynamic force Analysis- Inertia forces and D‟ Alembert‟s principle, Euler‟s Equations of motion, the principle of Superposition

Unit 2: Dynamical System- Force on reciprocating parts of an engine. Considering friction and inertia of moving parts, Turning moment on Crank-shaft, Turning moment diagrams for different types of engines, Fluctuation of energy, Fluctuation of speed of Crank-shaft, Fly wheels, calculation of fly wheel size operation of a fly wheel in a punching press (Numerical problems).

Unit 3: Governors-Functions, type and analysis of following types of governors: Watt, Porter, Prowel, Hartnell, Willson Harnell, Pickering. Hunting, Isochronisms, Stability, Efforts and Power of governors. Sensitiveness, controlling forces (Numerical problems).
Gyroscope-Principle and application of gyroscope. Gyroscopic Couple, Effect of Gyroscopic couple on the stability of automotive vehicles, Gyroscopic Power on the ships and aero-planes. (Numerical problem).

Unit 4: Definitions, Types of friction, friction in screw jack, Limiting friction, friction in pivot and collar bearing, Disc and collars. Friction clutches-Disc clutch, Multi plate clutch, Centrifugal Clutch, Cone clutch.
Brakes-Types of brakes, shoe brake, Band brake, Band and block brake, Internal expanding shoe brake. (Numerical problems).
Dynamometer- Absorption dynamometer, Transmission dynamometer, Torsion dynamometer. (Numerical problems).
Power transmission in belt drives and gear trains, Condition of maximum power. Open flat belt drive, Cross belt drive, length of belt, ratio of belt tensions, Power transmitted by belt, V-belt drive, Rope drive, Chain drive, Centrifugal tension. (Numerical problems).

Unit 5: (a) Balancing of rotating masses-in one plane, in different planes, Balancing of Reciprocating masses. Balancing of radial, In-line, V-engines. (Numerical problem).
(b) Vibrations- Free and Forced vibrations, Types of vibrations, whirling speeds,

Damped vibrations, Forced- Damped vibrations, Logarithmic decrement, Torsional vibrations. (Numerical problems)

Reference Book:-

1. Theory of Machines and Mechanisms by Joseph Shigley,
2. Theory of Machine by P.L. Balianey
3. Theory of Machine and Mechanisms by J. Lal
4. Theory of Machine by Dr. R.K. Bansal

B.TECH. SECOND YEAR (FOURTH SEMESTER)

Sub. Code: ME-204T **Mechanics of Solids-I** **LTP (310)**
New Code: BME-604C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Student will be able to understand the basics of mechanics of solid like Stress, strain,Hooke's Law and problem of simple bar and compound bar.
CO 2: Students can draw the shear force and bending moment diagram of the various beam sections.
CO 3: By applying the basic principle of mechanics students can solve the problem of compound stress system.
CO 4: Students can be determined the bending stress, deflection in beams and torsional shearstress in the shaft.
CO 5: Students would understand the problem of thin cylinder and Colum & strut.

Unit 1: Simple Stress & Strains: Introduction to Stress-Strain, Elastic limit, Hooke's Law, Young Modulus of Elasticity (E),Poisson's ratio (1/m)-Bars of Varying Cross section, compound bars (Composite section),Relationship between volumetric stress and linear strains along any 3 mutually perpendicular directions, Temperature stresses in compound bars, Yield stress, working stress, Factor of safety, Ductile &brittle materials, Stress-Strain Curve for a ductile material, Saint Vanant's principle and numerical problems.

Bending Moment and Shear force diagram: Introduction to Bending Moment diagrams, Shear Force and Bending Moment, Determinate structures & indeterminate structures, Shear Force and Bending Moment diagrams for simply supported beams with a point load at mid-point, Eccentric point, Beam carrying Uniform Distributed Load, Beam carrying Uniform Varying Load, overhanging beams, Beams carrying inclined loads, Beams subjected to couple-problems, relation between loads.

Unit 2: a) Principal Stresses and Strains: Simple stress &compound stress, General two dimensional or biaxial stress system,expression for Normal & tangential stress for a general 2D stress system-Principalstress & principal planes- expressions for principal stress & directions of principle plains, Shear stress on Principal plane, Normal stresses on any two mutually plane, Analysis of maximum shear stress & directions of planes carrying maximum shear Stress, Graphical method-Mohr' circle.

b) **Thin cylinders:** Hoop or Circumferential stresses, Longitudinal stresses, Maximum shear stress, Design of thin cylindrical shells, spherical shells.

Unit 3: Column & Struts: Types of columns, Slenderness ratio, Effective length, Longand Short columns, Eulers theorem, Rankine formula.

Unit 4: Deflections: Slope, deflection & Elastic Curve. Moment area method, Double Integration method, Macaulay method.

Unit 5: Bending Theory: Homogenous & isotropic materials, Pure bending, Location of

Neutral axis, Derivation of the Bending Equation, Variation of bending stress across given section, Moment of resistance, Section modulus, Moment of inertia for various sections

Torsion of Shafts: Analysis of torsion of circular shaft, Pure torsion, Power transmitted by a shaft, Analysis of principal stress & maximum shear stress developed in a shaft subjected to Bending Moment.

Text Book:

1. Strength of Materials by Sadhu Singh
2. Strength of Materials by S.Ramamuthum

Reference Book:

1. Strength of Materials R.K. Raiput
2. Strength of Materials Tumoshinko & Gere

B.TECH. SECOND YEAR (FOURTH SEMESTER)

Sub. Code: ME-206T **Internal Combustion Engines** **LTP (310)**
New Code: BME-606C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Design parameters like fuel-air mixtures and cycle analysis.
CO 2: Combustion process in SI engine and CI engine and emissions formation during the combustion cycle and their treatment.
CO 3: Flow in carburetor, fuel injection system and Intake manifolds.
CO 4: Modern concepts in internal combustion engines like HCCI, GDI.

Unit 1: Introduction to I. C. Engine, Classification of I.C. Engine, Difference betweentwo stroke and four stroke engines, difference between SI & CI engines Cycles-Otto, diesel and dual; calculation of air standardefficiency, work ratio, mean effective pressure, volumetric efficiency, IHP, BHP etc. Testing & Performance-Introduction, Rating and testing methods; Measurement of fuel and air consumption, brake horse power, frictional horse power, Mechanical and thermal efficiency, engine losses and heat balance.

Unit 2: **a)** Combustion in SI Engines-Introduction; ignition limits, stages of combustion; ignition lag, factors affecting detonation, effects of detonation, control of detonation, knock, rating of volatile fuels, octane number, firing order; salient feature of different combustion chamber.

b) Combustion in SI Engines-Introduction; ignition limits, stages of combustion; ignition lag, factors affecting detonation, effects of detonation, control of detonation, knock, rating of volatile fuels, octane number, firing order; salient feature of different combustion chamber.

Unit 3: Carburetion-Introduction, different mixture requirement in SI engine, Elementary carburetor, complete carburetor, additional systems required, carburetor types; calculation of air fuel ratio for simple carburetor; petrol injection- Introduction, continuous and timed injection system. Fuel injection- Introduction, requirements of a fuel injection system; Types of injection system-Air and solid injection system; type of fuel injectors, Engine emission and control; Ignition System-Introduction, Magneto and Battery ignition system, Advantages and disadvantages of both the systems.

Unit 4: Supercharging-Introduction, object of supercharging of SI and CI engines, Turbo charging its effect on engine.

Unit 5: Cooling-Introduction, Necessity of cooling, disadvantages of overcooling, cooling systems- Air and water or liquid cooling, types of liquid cooling; Advantages and disadvantage of air and water cooling; Radiator, Lubrication- Introduction, function of a lubricating system, Different lubrication systems, mist and wet sump lubrication systems, Properties of lubricants.

Text Book:

1. I. C. Engine by Sharma & Mathur
2. I. C. Engine by V. Ganeshan
2. I. C. Engine by V. Domkundvar

B.TECH. SECOND YEAR (FOURTH SEMESTER)

Sub. Code: ME-208T **Production Processes-II** **LTP (310)**
New Code: BME-608C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Student will be able to understand the tool geometry in ORS system, mechanism of chip formation.
CO 2: Acquire the knowledge of Milling machine and it cutting paraments. Solve the problem of slab and face milling operations.
CO 3: Analyze the problems related to shaper and planer machine.
CO 4: Calculate the time required in twist drilling operation.
CO 5: Apply the different methods of machining manufacture the gears of different materials.

Unit 1: Introduction to machine processes: Mechanics of basic machining operation, Orthogonal & Oblique cutting, principle angles of a single point cutting tool, Tool reference system, Machine reference System, orthogonal reference system, and normal reference system, Tool geometry and signature in MRS, ORS & NRS systems, there interrelationship, numerical examples, chip formation mechanism, chip thickness ratio, dynamic shearing strain, velocity relationship, force relationship in orthogonal cutting merchant's circle diagram.

Unit 2: a) Turning and boring: Lathe machines, Its principle of working, types, parts of lathe, operations on lathe, Work holding devices & accessories, turning parameters, design consideration for turning operations, high-speed & ultra-precision machining.

b) Drilling &Reaming: Introduction, tools for drilling, classification of drills, twist drills, its parts, angles and terminology, type of drilling machines, Design consideration for drilling, reaming and tapping.

c) Shaping and planning: Introduction to shapers and planes, working principle of shaper, principal parts, size, specification and classification of shaper, quickreturn crank & slotted are, hydraulic mechanism, working principle of a planner, main parts types of planers, difference between planner & shaper.

d) Milling: Working principle, types of milling machines, column & knee type milling machines, horizontal, vertical & universal milling machines milling methods, milling cutters, milling operations, milling parameters.

Unit 3: Gear Manufacturing: Types of materials, methods of gear manufacturing, Brief introduction to gear cutting and gear shaping, design consideration for gear machining, Gear finishing methods.

Unit 4: Abrasive machining and finishing operations: Grinding, finishing operations, surface finish in machining and grinding.

Unit 5: Economics of machining operations: Introduction, optimizing cutting parameters. (a) For minimum cost. (b) For minimum production. (c) Optimum cutting speed for maximum efficiency.

Text Book:

1. Manufacturing Engineering &Technology by S. Kalpakajian, S.R. Schmid
2. Production Process by P.C. Sharma
3. Manufacturing Engineering & Technology by S. Kalpakjian & Steven R. Schmid

B.TECH. SECOND YEAR (FOURTH SEMESTER)

Sub. Code: ME-214T **Fundamentals of MATLAB** **LTP (110)**
New Code: BME-610C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Introduce vectors and matrices in MATLAB.
CO 2: Apply basic concepts of Linear Algebra for vector and matrix operations.
CO 3: Perform 2D and 3D plotting.
CO 4: Formulate and solve systems of linear equations by Gaussian elimination, and matrix inversion.
CO 5: Write conditional statements and loops.
CO 6: Write Scripts and functions in MATLAB.
CO 7: Solve some engineering problems using MATLAB.
CO 8: Apply the fundamental knowledge of mathematics, science & engineering, to solve the real mechanical engineering problems (through case studies).

Unit 1: Introduction to MATLAB and Basic Commands: Overview of the MATLAB interface, Command window, workspace, and file management, Basic arithmetic operations and variables, frequently used built-in functions and data types, Saving and loading workspace variables, Using the disp and fprintf commands for displaying formatted output, Reading and writing Excel files using xlsread, xlswrite, and readtable, Manipulating data from Excel files in MATLAB.

Unit 2: Linear Algebra, Matrices, and Engineering Fundamentals: Creating and manipulating matrices, Matrix operations: addition, multiplication, transposition and inversion**,** Eigenvalues, eigenvectors, and diagonalization**,** Determinants and rank of matrices**,** solving linear equations using matrix methods: inv, linsolve and operator**,** Application of matrix equations in engineering problems.

Unit 3: MATLAB Programming and Control Flow: if, else, elseif, and switch constructs**,** Logical operations and relational operators**,** for loops and while loops**,** Nested loops and loop control (break, continue)**,** Writing and running scripts, Creating and using functions, Input/output arguments in functions.

Unit 4: Data Visualization and Numerical Methods: Plotting basic 2D graphs: plot, xlabel, ylabel, legend, and title**,** creating 3D plots: mesh, surf, plots**,** customizing graphs: colors, markers, and line styles**,** Subplots and multiple figures**,** Creating and evaluating polynomials**,** Polynomial differentiation and integration**,** finding polynomial roots using roots.

Unit 5: Advanced Engineering Applications with MATLAB: Approximations, errors, and numerical methods in engineering problems**,** Application of MATLAB in solving real-world engineering issues**,** Case studies and problem-solving using MATLAB**,** Applications in mechanical, civil, electrical, and other engineering fields.

B.TECH. SECOND YEAR (FOURTH SEMESTER)

Elements of Electrical Engineering LTP (210)

Unit 1: Transformer: Principle & construction of single phase transformer, EMF equation, phasor diagram,equivalent circuit diagram, SC test, OC test, efficiency.

Unit 2: DC Machines: Principle & construction of DC generator, types of windings, types of DC generator, OCC, load characteristics, principle & construction of DC motor, back EMF, torque equation, load characteristics.

Unit 3: Induction Motors: Principle and construction of 3-phase induction motor, concept of slip, phasor diagram. Equivalent circuit diagram, T-S characteristics.

Unit 4: Synchronous Machines: Principle and construction of synchronous machines, EMF equation, OCC & SCC,synchronous impedence, principle of synchronous motor, V-curve, synchronouscondenser.

Text Book:-

1. Electrical Technology by B.L.Theraja
2. P.S.Bimbhra, "Electrical Machinery", Khanna Publisher.

B.TECH. THIRD YEAR (FIFTH SEMESTER)

Sub. Code: ME-301T **Mechanics of Solids-II** **LTP (310)**
New Code: BME-701C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Determine and interpret stress components, principal stresses, and stress invariants, applying transformation techniques.
CO 2: Calculate and analyze deformation and strain, including normal, shear, and volumetric changes.
CO 3: Analyze bending stresses in curved beams and unsymmetrical bending, including shear center calculations.
CO 4: Compute stresses in thick-walled and compound cylinders for practical applications.
CO 5: Understand fatigue and creep, calculate endurance limits, and evaluate factors affecting material performance.

Unit 1: Analysis of stress: Introduction, Body force surface force and stress vector, state of stress at a point normal and shear stress components, rectangular stress component, stress component in an arbitrary plane, Equality of cross shears, Principal stress, Stress invariants, Octahedral stresses, state of pure shear, decomposition into hydrostatic and pure shear stress, Equations of equilibrium in cylindrical coordinates, St. Venant's principle, Arrays stress function, compatibility condition.

Unit 2: Analysis of Strain: Deformation, deformation in the neighborhood of a point, change in the length of a linear element, State of strain at a point, Interpretation of Vxy, Vyz, Vxz as shear strain components, Cubical dilation.

Unit 3: a) **Curved beams:** Winkler back theory, Bending stresses in curved beam with circular, rectangular, Trapezoidal, I and T sections. (Numerical on curved beams).
b) **Unsymmetrical Bending:** Introduction, product of Inertia, Deflection of beam due to unsymmetrical bending, shear centre. (Numerical on above).

Unit 4: Thick Cylinder: Stresses in thick cylinders, Compounding of cylinders. (Numerical).

Unit 5: Fatigue and Creep: Fatigue of material, endurance limit, Soderberg triangle, notch sensitivity and sensitivity factor, Factor influencing the endurance limit, Creep analysis.

Text Book:-

1. Mechanics of Solids by LS. Srinath
2. Mechanics of Solids by Abdul Mubeen
3. Mechanics of Solids by Ryder

Reference Book:-

1. Timosherko &Gere
2. E.J. Hearn Vol I &II

B.TECH. THIRD YEAR (FIFTH SEMESTER)

Sub. Code: ME-303T **Mechanical Engineering Design** **LTP (310)**
New Code: BME-703C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Student will be able to understand the introduction to mechanical engineering design, design synthesis, Design procedure of mechanical engineering parts.
CO 2: Apply the principles of design under various stress and strain.
CO 3: Analyze the problem based on joint and designing of joints.
CO 4: Calculate the power through transmission.
CO 5: Solve the problem of springs, fully.

Unit 1: a) Introduction to Mechanical Engineering Design, Design synthesis, Design procedure for a machine part. Design considerations based on strength, rigidity, fatigue, corrosion, wear and thermal consideration, Allowable stresses, stress concentration, factor of safety.
b) Design under static load, modes of failures, stress strain relationship, shear stresses and shear strain, stresses due to Bending moment, stresses due to torsional moment, principal stresses. Theories of failures, maximum normal stress theory, maximum shear stress theory, distortion energy theory, maximum strain theory, maximum strain energy theory.

Unit 2: a) Design under variable loading, stress concentration, stress concentration factors, reduction of stress concentration effects, fluctuating stresses, fatigue failures, Endurance limit and its approx. estimation.
b) Design of shaft under different kinds of loading such as twisting moment only and combination of twisting, bending moment. Design of keys. Design of different types of couplings such as muff, compression, flexible coupling. Types of coupling, flexible and rigid coupling.

Unit 3: Riveting: strength of riveted joint, efficiency, design of riveted joint, riveted joint of uniform, strength, Design of riveted joint for Boilers etc. Welded joint, strength of transverse and parallel fillet welded joints, axial loaded unsymmetrical, welded sections, eccentrically loaded welded sections.

Unit 4: Power transmission, types of pulleys for flat belts, design of C! pulleys, design of belts.

Unit 5: Bearing, bearing loads. Design of Journal bearing (selection parameters) types of lubrication, hydrostatic bearings.

Unit 6: Design consideration of Gear, Lewis formula, dynamic effect, Design for spur, helical and bevel gears.

Text Book:-

1. Machine Design by P.C Sharma & D.K. Agarwal Reference

Reference Book:-

1. Machine Design by Shigley 2. Machine Design by Muben Ahmed

B.TECH. THIRD YEAR (FIFTH SEMESTER)

Sub. Code: ME-305T **Energy Conversion** **LTP (310)**
New Code: BME-705C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Explain the basic fundamental of the various Steam and gas turbines.
CO 2: Discuss the various laws pertaining to steam turbines, gas turbines and jet propulsion.
CO 3: Identify, formulate and solve problems related to steam turbines gas turbines and jetpropulsion.
CO 4: Specify, interpret data, and make a judgment about the best possible solution. Aspire fordeveloping career with specialization in areas of thermo-fluid drives.

Unit 1: Steam Nozzles: Introduction, Definition, principle uses, types of nozzles, flow of steam through nozzle, condition for maximum discharge, Expansion of steam considering friction, nozzle efficiency, velocity coefficient, Relation between nozzle efficiency and velocity coefficient. Supersaturated or Metastable flow through nozzle, General relationship between area, velocity& pressure in nozzle flow, aspect ratio.

Unit 2: Steam Turbine: Introduction, definition, working principles, uses, types of steam turbine, advantages of steam turbine over Reciprocating steam engine, Working of Impulse &Reaction turbine, Compounding of steam Turbine, velocity diagram, balding efficiency, stage efficiency or gross efficiency, nozzle efficiency, influence of blade tip speed ratio or blade efficiency, Difference between impulse and reaction turbine, degree of reaction, carry over factor, reheat factor, Methods of governing (throttle, nozzle control; by pass governing etc).

Unit 3: a) Gas Turbine Introduction, application, advantage of gas turbine, classification of gas Turbine, Brayton or Joule cycle & its related formulae derivation, Thermal efficiency of Brayton cycle, work ratio, advantages & disadvantages of closed cycle over open cycle Units, Ideal & practical gas turbine cycle, Methods for improvement of thermal efficiency of simple open cycle constant pressure gas turbine, Advantage of gas turbine over I-C engine &steam engines, numerical problems.

b) Jet Propulsion: Types of jet propulsion, screw propeller, turbo jet, turbo prop, ram jet, specific thrust, thermal efficiency, propulsive efficiency, ram efficiency, overall efficiency, Introduction to rocket engineering, Comparison between turbo machine & positive displacement machines.

Unit 4: Condensers: Introduction, definition, uses, types of steam condensers, Air leakage and Its effect on theperformance of condenser & methods of Its removal from condensers.

Unit 5: Reciprocating Compressors: Reciprocating air compressors; the compressor cycle with and without clearance, efficiencies; volumetric efficiency & its effect on performance; multi-staging.

Text Book:

1. Thermal Engineering by P.C. Ballaney

Reference Book:

1. Thermal Engineering by R.K. Rajput

B.TECH. THIRD YEAR (FIFTH SEMESTER)

Sub. Code: ME-307T **Heat Transfer** **LTP (310)**
New Code: BME-707C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Explain about the real time applications of solid medium heat transfer.
CO 2: Describe the real time applications of fluid medium heat transfer.
CO 3: Express the knowledge of design skills of heat exchangers.
CO 4: Illustrate the real time applications of radiation mode of heat transfer **(**no media**)**.

Unit 1: a) Introduction to Basic modes of heat transfer: Conduction, Convection, Radiation, Overall heat transfer co-efficient.

b) Steady state one dimension heat conduction, General heat conduction equation, in Rectangular, cylindrical, and spherical co-ordinates, Steady state one dimension-heat conduction without internal heat generation (with uniform thermal conductivity and non-uniform thermal conductivity)- for flat plate, hollow cylinder, spherical shell, Electrical Analogy, log mean area, One dimension heat conduction with heat generation or system with internal heat source - plane wall, hollow cylinder, sphere; Insulation, purpose of insulation, critical radius of insulation for cylinders and spheres.

Unit 2: Heat transfer through extended surface- fins, Types of fins, heat transfer through rectangular fin, pin type fin (Spine), fin effectiveness and efficiency;

Unsteady state heat conduction- Introduction to unsteady state heat conduction, System with negligible internal resistance (Lumped heat analysis).

Unit 3: Heat transfer by convection; Introduction, convective heat transfer co-efficient, basic equations- Continuity equations, momentum equations, Energy equations; Boundary layer- Velocity boundary layer, thermal boundary layer; Dimensional analysis, Buckingham's theorem, dimensional analysis applied to force convection; Dimensionless numbers and their physical significance.

Forced Convection:

Thermal boundary layer, Energy equation of thermal boundary layer over a flat plate, Integral Energy equation (Approximate solution of energy equation), Laminar tube flow, Development of boundary layer, velocity distribution, temperature distribution turbulent flow over a flat plate, turbulent boundary layer, Reynolds Analogy, Colburn Analogy, Heat transfer parameters for combination of laminar and turbulent flow.

Free Convection:

Characteristic parameters in free convection, Momentum and energy equations for laminar free convection, Heat transfer on a vertical flat plate, integral equations for momentum and energy on a flat plate, velocity and temperature profiles on a vertical flat plate, and solution of the integral equation for a vertical flat plate, Transition and turbulence in free convection, Empirical Correlations for free convection.

Unit 4: Heat Exchanges: Type of heat exchangers, heat exchanger analysis, Logarithmic mean

temperature difference, overall heat transfer co-efficient, fouling factor, heat exchanger effectiveness and Number of Transfer Unit (NTU).

Unit 5: **Radiation:** Surface emission properties, absorptivity, reflectivity, transmittivity; Concept of black body, Stefan Boltzmann law, Kirchhoff's law, Plank's Law, Wein's displacement law, Intensity of radiation and Lamberts Cosine Law; Radiation exchange between black bodies separated by a non-absorbing medium, shape factor and salient features of the shape factor, shape factor calculation for simple configuration such as: a black body inside a black enclosure, A tube with a cross section of a equilateral triangle, hemispherical surface and a plane surface, Heat Exchange between two nonblack parallel surfaces, Heat Exchange between infinite long concentric cylinders; Electrical network analogy for thermal radiation system, Radiation Exchange between three grey surfaces, Radiation shield.

Text Book:

1. Heat &Mass Transfer by Dr. D.S. Kumar
2. Introduction to Heat &Mass Transfer by J.P. Holeman
3. Heat & Mass Transfer by Domkundwan

B.TECH. THIRD YEAR (FIFTH SEMESTER)

Sub. Code: ME-309T **Mechanical Measurement and Metrology** **LTP (310)**
New Code: BME-709C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Student will be able to understand the selecting suitable mechanical measuring instruments for basic and special requirement in the industries.
CO 2: Designing the fits and tolerances to improve the existing performance.
CO 3: Identify and apply various measuring instruments.
CO 4: Interpret measurement of field variables like force, torque and pressure.
CO 5: Calibrating and analyzing the characteristics of measuring instruments.

Unit 1: **Principle of Measurement:** Classification of measurement, precision, accuracy & sensitivity, standards of measurements-primary, secondary, tertiary &working standards; length standards-line standards, wave length standards; characteristics of various standards of measurement; Linear Measurement: Linear Measuring instruments, Vernier height gauge, Vernier depth gauge, inside micrometer, depth micrometer etc. surface plate; spirit level; surface gauge; radius & feeler gauges; pitch screen gauges; slip gauges-requirement of slips; wringing of slips; use of slip gauges, measurement with slip gauges. Classification of instruments, null and deflection type, contacting and non-contacting type, analog and digital type.

Unit 2: **a) Motion Measurement:** Linear motion measurement, angular motion measurement, measurement of displacement, velocity and acceleration, seismic.
b) Force, Torque and Power Measurement: Analytical balance, Elastic force measuring devices; spring axially loaded member, cantilever type, proving ring; load cell; pneumatic load cell, hydraulic load cell. Dynamometers; types of dynamometers; pony brake, fluid friction type, Electrical dynamometer, D.C. dynamometer, eddy current dynamometer. Numerical Problem base on prony brake.
c) Temperature Measurement: Classification, Expansion type thermometer; bimetallic type; liquid in glass thermometer. Electrical thermometer; resistance thermometer, thermostat, thermo couple, thermopiles, laws of thermocouple, Pyrometers; Radiation pyrometer, optical pyrometer.

Unit 3: **a) Stress Strain Measurement:** Mechanical devices, optomechanical devices, inductive device, capacitive devices, resistive devices- resistance strain gauge construction of strain gauge, wheat stone bridge, mounting of gauges, method of measurement, Numerical Problems based on measurement of strain with the helpof resistance strain gauge, Introduction to nano measurements.
b) Surface Roughness measurement: elements of surface roughness, types of lays & their representation; evaluation of surface value, Ra value, CLA value RZ value, surface finish measuring instruments-profilometer, profile graph light cross section method, visual inspection methods.

Unit 4: **a) Limits, Fits and Tolerances:** Terminology of limits &fits, types of fits clearance, interference transition, hole basis &shaft-based system of fits, Interchangeability

&selective assembly; limits of tolerance allowance; designation of hole & shaft; ISO system of limits & fits; Design of limits, Tolerances & deviation on the shaft and hole system.

b) Gauge & Gauge Design: Type of gauges, plain &limit gauge; plug &ring gauge; 'Go' and 'No Go' Gauges; Design of 'Go' & 'No-go' gauges for holes & shafts. Manufacturing tolerance, wear allowance, Taylor's principle, advantages & its limitations.

Unit 5: Screw Thread and Gear Measurement: Terminology of screw threads &gears tooth, effect of pitch errors on threads, thread micrometer, effective diameter measurements two wire & three wire methods; best wire size; use of tool maker's microscope in measuring various elements of thread; sources of errors in gear manufacturing, measurement of individual elements of gear, gear tooth caliper base tangential gear tooth caliper, Parkinson gear tester ,tooth thickness measurement constent chord method, base method, test plug method for pitch diameter measurement, two wire method for helical gears, run out, lead& backlash.

Text Book:

1. Engineering Metrology (Khanna) by Jain, R.K.
2. Hand book of Industrial metrology (prentice Hall)-ASTME
3. Engineering metrology (Macdonald) Hume. K.J.
4. Engineering Inspection (Pitman)-Parkinsan, A.C.
5. Fundamentals of Mechanical Inspection, (Graw Hill) Jenkins, R.

References:

1. Mechanical Measurement by Sirohi and Radha Krishan (Unit 1, 6, 7, 8, 10)
2. Mechanical Measurement by Thomas G. Beckwith and N. Lewis Buck (Unit 3, 5)
3. Electrical and Electronics Measurement and Instrumentation (Unit 4) by AK Sawhney.

B.TECH. THIRD YEAR (FIFTH SEMESTER)

Sub. Code: ME-311T **Operations Management** **LTP (310)**
New Code: BME-711C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Understand the role of operations management in organizations.
CO 2: Analyze and design processes for goods and services production.
CO 3: Apply forecasting and capacity planning techniques.
CO 4: Implement inventory and supply chain management strategies.
CO 5: Utilize tools for quality control and improvement.
CO 6: Explore trends and technologies impacting modern operations management.

Unit 1: Introduction to Operations Management:

1. Definition and scope of operations management
2. The role of operations in manufacturing and service sectors
3. Historical development of OM
4. Operations strategy and its alignment with business strategy

Unit 2: Process Design and Analysis:

1. Types of production processes (Job shop, Batch, Continuous, Mass customization)
2. Process flow analysis and improvement
3. Process mapping and workflow optimization
4. Bottleneck analysis

Unit 3: Operations Strategy and Competitiveness:

1. Developing an operations strategy
2. Key performance measures: cost, quality, speed, flexibility
3. Competing through operations
4. Global operations strategy

Unit 4: Demand Forecasting:

1. Importance of forecasting in operations
2. Qualitative and quantitative forecasting methods
3. Time series analysis and regression models
4. Forecast accuracy and measures of error

Unit 5: Inventory Management:

1. Types of inventory (raw materials, WIP, finished goods)
2. Inventory control models: EOQ, ABC analysis
3. Just-In-Time (JIT) and lean inventory management
4. Safety stock and reorder points
5. Inventory in service operations

Unit 6: Aggregate Planning and Scheduling:

1. Purpose and methods of aggregate planning
2. Chase vs. level production strategies
3. Master production schedule (MPS)
4. Job sequencing and scheduling techniques
5. Gantt charts, flowcharts, and workload balancing

Assignments: Lean Operations and Just-In-Time (JIT):

1. Principles of lean operations
2. Waste reduction (7 wastes)
3. Just-In-Time (JIT) philosophy and applications
4. Continuous improvement (Kaizen) and value stream mapping
5. Benefits and challenges of lean systems

Text Book and References:-

1. Operations Management by William J. Stevenson
2. Operations and Supply Chain Management by F. Robert Jacobs and Richard Chase
3. Principles of Operations Management by Jay Heizer and Barry Render
4. Supplementary articles from journals, industry reports, and case studies

Prerequisites:-

1. Basic understanding of management principles
2. Familiarity with business and economics concepts (optional).

B.TECH. THIRD YEAR (SIXTH SEMESTER)

Sub. Code: ME-302T **Computer Aided Design** **LTP (310)**
New Code: BME-702C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Student will be able to understand the basic principles of computer hardware and software requirement, computer graphics, geometric modeling in CAD.
CO 2: Apply these principles to solve the problems on 2D geometric transformation such as translation, rotation, scaling and reflection etc.
CO 3: Analyse different types of curves, surfaces and their applications in CAD.
CO 4: Analyze the problems on Bezier and B-spline curve etc.
CO 5: Solve the problems on analytical surfaces in CAD.
CO 6: Discuss and analyze various aspects of finite element analysis and modeling in CAD.

Unit 1: Introduction to CAD, definition of CAD and its role in product cycle, -significance and importance of CAD. CAD Hardware, Types of systems, CAD systems evaluation criteria, Input devices, Output devices, Hardware Integration & Networking, Hardware trends, IBM PC compatible CAD hardware. CAD software: - Introduction, Graphic Standard, Basic Definitions, Date Structure, Database, Database Management System (DBMS), User Interface, Software Modules, Operating System Modules, Graphic Modules, Applications Modules, Programming Modules, Communication Modules, Modeling & Viewing, Software Documentation & Development..

Unit 2: Microcomputer based CAD system, general features, hardware components and configuration, IBM PC compatible CAD system, microcomputer-based CAD software, operating system, mechanical application 2D drafting, symbol libraries, report generation, parametric design, 3D functions, finite element analysis, kinematics & functions analysis.

Unit 3: **Geometric Modeling**: Types of Curves: Introduction, Wireframe Models, Wireframe Entities, Curve Representation, Analytic & Synthetic Curves, Hermit Cubic Spline, Bezier Curves, B-spline Curves, Types of surfaces:- Introduction, Surface Models, Surface Entities, Surfaces like Plane Surface, Ruled Surfaces, Surface of Revolution, Tabulated Cylinder, Hermit Bicubic Surface, B-spline surface, Coons Surface, Blending Surface, Offset Surface, Triangular Patches, Sculptured Surfaces, Rotational Parametric Surface, Design & Engineering Applications. (Only theory no numerical).

Unit 4: **Types of solids:** Introduction, Solid Models, Solid Entities, Solid Representation, Fundamentals of Solid Modeling, Boundary Representation (B-rep), Constructive Solid Geometry (CSG), Sweep Representation, Other Representations, Organization of Solid Modeler's, Solid Modeling based Applications, Design and Engineering Applications. (Only theory no numerical).

Unit 5: **Two & Three:** Dimensional Graphic Concept, Geometric Transformation, Introduction, Transformation-Translation, Scaling, Reflection, Rotation, Mapping of Geometric

Models, Projection of Geometric Models, Orthographic Projections, Perspective Projection.

Virtual Realism: Introduction, Model Clean Up, Hidden Line Removal, Hidden Surface Removal, Z-Buffer Algorithm, Hidden Solid Removal, Ray Tracing Algorithm, Shading, Shading Models, Coloring, Coloring models.

Graphic Aids: Introduction, Geometric Modifiers, Names Layers, Colours, Grids, Groups, Dragging & Rubber banding, Clipping, Graphic Manipulation Editing: Introduction, Entity Selection Methods, Manipulation Operations, Editing Operators, Design & Engineering Application.

References:-

1. CAD I CAM by Ibrahim Zied.
2. CAD I CAM by Zimmer & Groover

B.TECH. THIRD YEAR (SIXTH SEMESTER)

Sub. Code: ME-330T
New Code: BME-714C

Introduction to Robotics
(Elective-I)

LTP (310)

Course Outcomes (COs)

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

CO 1: This course aim to familiarise student with basic technologies of the robotics science and essential knowledge required to get started in the field of Robotics.

Unit 1: Introduction of robotics: Brief History, Basic concepts of Robotics such as Definition, Three laws, Elements of Robotic System i.e. Robot anatomy, DOF, Misunderstood devices etc., Classification of Robotic system on the basis of various parameters such as work volume, type of drive etc., Associated parameters i,e. resolution, accuracy, repeatability, dexterity, compliance, RCC device etc. Introduction to Principles & Strategies of Automation, Types & Levels of Automations, Need of automation, Industrial application of robot.

Unit 2: Sensors for Robotics: Sensors for Robot Types of sensors used in Robotics, Classification and applications of sensors, Characteristic of sensing devices, Selections of sensors. Need for Sensors and vision systems in the working and control of a robot.

Unit 3: Drives and Control for Robotics: Drive -Types of drive, Types of transmission systems, Actuators and its selection while designing a robot system. Control Systems: Types of Controllers, Introduction to Closed loop control.

Unit 4: Programming and Languages for Robotics: Robot Programming: Methods of robot Programming; WAIT, SIGNAL and DELAY commands, subroutines, Programming Language: Generations of Robotic Languages, Introduction to various types such as VAL, RAIL, AML, Python, ROS etc., Development of Language since WAVE till ROS.

Unit 5: Related Topics in Robotics: Socio-Economic aspect of robotisation. Economical aspects for robot design, safety for robot and standards, Introduction to Artificial Intelligence, Al techniques; Need and application of AI, New trends & recent updates in robotics.

Text Book and References:

1. S.K. Saha, Introduction Robotics 2e, TATA McGraw Hills Education (2014)
2. Asitava Ghoshal, Robotics: Fundamental concepts and analysis, Oxford University Press (2006).
3. Dilip Kumar Pratihar, Fundamentals of Robotics, Nervosa Publishing House, (2019).
4. R. K. Mittal, 1. J. Nagrath, Robotics and Control, TATA McGraw Hill Publishing Co Ltd, New Delhi (2003).
5. S.B. Niku, Introduction to Robotics- Analysis, control, Applications, 3rd edition, John Wiley & Sons Ltd., (2020).
6. J. Angeles, Fundamentals of Robotic Mechanical Systems Theory Methods and Algorithms, Springer (1997).

7. Mikell Groover, Mitchell Weiss, Roger N. Nagal, Nicholas Odrey, Ashish Dutta, Industrial Robotics 2nd edition, SIUE, McGraw Hill Education (India) Pvt. Ltd. (2012).
8. R. D. Clatter, Thomas A. Chmielewski and Michael Negin, Robotic Engineering-An integrated Approach, EEE, Prentice Hall India, Person Education Inc. (2009).

B.TECH. THIRD YEAR (SIXTH SEMESTER)

Sub. Code: ME-332T
New Code: BME-716C

Fundamental of Energy Engineering (Elective-I)

LTP (310)

Course Outcomes (COs)

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

CO 1: Understand energy resources and consumption patterns across sectors.
CO 2: Comprehend power generation technologies and their environmental impacts.
CO 3: Study renewable and unconventional energy technologies.
CO 4: Evaluate energy efficiency and sustainability measures.
CO 5: Assess energy demand, supply, and emerging issues in various sectors.

Unit 1: Energy Resources and Consumption Patterns:

1. Overview of traditional (fossil fuels) and renewable (solar, wind, bioenergy, nuclear) energy resources.
2. Energy consumption across sectors (industry, residential, agriculture, services) and key influencing factors.

Unit 2: Power Generation Technologies and Environmental Impact:

1. Power generation methods: steam turbines, gas turbines, internal combustion engines, and fuel cells.
2. Limitations (efficiency, cost, infrastructure) and environmental challenges (pollution, emissions).

Unit 3: Renewable and Unconventional Energy Technologies:

1. Nuclear, solar (photovoltaic, thermal), hydro, and wind power generation.
2. Emerging technologies: bioenergy, wave, and tidal power.

Unit 4: Energy Efficiency and Sustainability:

1. Energy flow (Sankey diagrams) and improving energy efficiency in thermal and electrical utilities.
2. Role of renewable energy in sustainability and conservation methods.

Unit 5: Energy Demand, Supply, and Emerging Issues:

1. Energy demand-supply analysis and smart grids.
2. Life cycle assessment of energy technologies.
3. Challenges in the built environment and agriculture related to energy.

References:-

1. Cheng J., Biomass to renewable energy processes, CRC press; 1st Edition 2019.
2. Nag P.K., power plant engineering Mc Graw Hill education, 4th Edition .2017.
3. Culp A.W. Jr., principles of energy conversion. McGraw Hill. 1996.
4. Johannsson T.B ., Kelly H., Reddy A.K.N and Williams R.H. (Ed.), renewable energy sources for fueland electricity, Island press, Washington DC, 1993.
5. Twidell J and Weir T., renewable energy resources, 3rd Edition, Routledge, 2015.
6. Fowler J.M., energy and environment, McGraw Hill, 2nd Edition, New York, 1984.
7. Kothari O.P., Sharma D.K., energy engineering, theory and practice, S. Chand publisher, 2000.

B.TECH. THIRD YEAR (SIXTH SEMESTER)

Sub. Code: ME-306T **Production Planning & Control** **LTP (310)**
New Code: BME-706C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Student will be able to understand the basics of production planning and control.
CO 2: Develop the strategy for material requirement planning and material resource planning.
CO 3: Analyze concept of purchase store keeping and replacement analysis.
CO 4: Students will understand the significance of store management.

Unit 1: Introduction to Production Planning and Control:

1. Definitions and scope
2. Objectives of PPC
3. Role of PPC in manufacturing and service industries
4. Types of production systems (Job, Batch, Mass, Continuous)

Unit 2: Master Production Scheduling (MPS):

1. Purpose of MPS in production planning
2. Inputs and outputs of MPS
3. Developing a master production schedule
4. Managing changes and flexibility in MPS

Unit 3: Material Requirements Planning (MRP):

1. Overview of MRP systems
2. Bill of Materials (BOM) and lead time
3. MRP logic: explosion and netting process
4. Lot sizing in MRP
5. MRP II and Enterprise Resource Planning (ERP)

Unit 4: Scheduling Techniques:

1. Types of scheduling (forward, backward, and priority rules)
2. Gantt charts and their use in scheduling
3. Scheduling in job shops and flow shops
4. Sequencing rules: FCFS, SPT, EDD, etc.
5. Theory of constraints and bottleneck management

Unit 5: Lean Manufacturing and JIT:

1. Principles of lean manufacturing
2. Just-In-Time (JIT) production systems
3. Waste elimination (7 wastes) and value stream mapping
4. Kaizen and continuous improvement
5. Benefits and challenges of JIT

Unit 6: Quality Control in Production:

1. Importance of quality control in PPC

2. Statistical Process Control (SPC)
3. Control charts for variables and attributes
4. Six Sigma methodology
5. Total Quality Management (TQM)

Assignments: Modern Trends in Production Planning and Control:

1. Industry 4.0 and the digitalization of manufacturing
2. Advanced production planning software and systems
3. Role of automation and robotics
4. Future trends in PPC (sustainability, customization, etc.)

Text Book and References:

1. Production Planning and Control by S.C. Sharma
2. Manufacturing Planning and Control for Supply Chain Management by Vollmann, Berry, Whybark, and Jacobs
3. Operations Management by William J. Stevenson
4. Supplementary readings from academic journals and case studies.

B.TECH. THIRD YEAR (SIXTH SEMESTER)

Sub. Code: ME-308T **Turbo & Fluid Machinery** **LTP (310)**
New Code: BME-708C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Student will be able to understand working principles of turbo machines and apply it tovarious types of machines.
CO 2: Understand the construction and working & performance of various Pumps.
CO 3: Understand the construction and working & performance of various Turbines.
CO 4: Determine the off-design behavior of turbines and compressors and relate it to changes in the velocity triangles.
CO 5: Recognize typical designs of positive displacement machines

Part (A) Turbo Machines:

Unit 1: Introduction, turbo machines, turbines, pumps, compressors fans, blower, type of incompressible and compressible flow machines, application of turbo machines.
Basic definitions and law of thermodynamics, general steady flow energy equation, poly tropic (small stage efficiency) for turbines and compressors, energy and momentum equation, Euler's work for turbo machines.
Flow through turbo machines cascade, one dimensional, two dimensional and three-dimensional, axial turbine and compressor cascade, radial cascade, cascade tunnel, different type of tunnels (straight cascade tunnel, annular cascade tunnel), different cascade variables

Unit 2: Axial turbine stage: Introduction, stage velocity triangle, work done, enthalpy, entropy diagram, single stage impulse, multistage velocity compounded impulse, multi stage pressure compounded impulse, reaction stages, degree of reaction, losses and efficiency.

Part (B) Hydraulic Machine:

Unit 3: **Turbines:** Classification of hydraulic turbines, impulse and reaction turbines, Pelton wheel, work done and efficiency of Pelton wheel, velocity diagram,Francis turbine, work done and efficiency of Francis turbine, axial flow reaction turbine Kaplan turbine, performance, characteristics curve, draft tube, Unit quantities, specific speed.

Unit 4: **Pumps:**

a) **Centrifugal pump:** Introduction, main parts of centrifugal pump, work done by centrifugal pump on water, different heads and efficiency, minimum speed for starting the centrifugal pump, multi stage centrifugal pump (both for high heads and for high discharge), specific speed of centrifugal pump, priming of centrifugal pump, cavitation phenomenon, NPSH.
b) **Reciprocating pump:** Introduction, main parts, working of reciprocating pump, classification of Reciprocating Pump, single acting and double acting

reciprocating pump, slip of reciprocating pump, percentage slip, air vessel, effect of acceleration on piston

Unit 5: Hydraulic Actuators and Control: Hydraulic accumulator, Hydraulic press, Hydraulic Crane, Hydraulic Lift, Hydraulic Ram, Hydraulic Coupling, Hydraulic torque converter, Air lift Pump, Jet Pump.

Text Book:

1. Fluid mechanics and hydraulic machinery- R. K. Bansal
2. Fluid mechanics and hydraulic machinery- Modi and Seth
3. Hydraulic machines- Jagdish'Lal
4. Turbines, compressors and fans- S.M. Yahya
5. Gas Turbines and propulsive systems- P.R. Khajuria, SP Dubey

Note: - For Turbo Machinery Book of S.M. Yahya is followed and for hydraulicmachinery R.K. Bansal and Jagdish Lal.

B.TECH. THIRD YEAR (SIXTH SEMESTER)

Sub. Code: ME-310T **Operation Research** **LTP (310)**
New Code: BME-710C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Student will be able to understand the meaning, application, scope, development of Operation Research.
CO 2: By applying Northwest corner method, least cost method, VAM.
CO 3: Optimization by Modi method to solve problems on Transportations model.
CO 4: Brief introduction of Assignment model and solve the problems by Hungarian Method.
CO 5: Application of LPP for solving problems.
CO 6: Brief introduction of Queuing Theory-Or waiting line Models and different types of rates, length and time.
CO 7: Introduction, use, types, limitations, scope of Simulation-Introduction, monte Carlo method, generation of random numbers.
CO 8: Introduction of Replacement Model, deteriorative item, non-deteriorative model cash flow diagram, Group replacement Model.

Unit 1: **Introduction:** The Historical development, the nature and meaning of 'OR', Management application of 'OR' scope of 'OR', Development of 'OR' in India.
a) Assignment Models - Introduction, mathematical formulation of Assignment problem, Fundamental theorems, Hungarian Method for assignment problem, Traveling salesman problem by Branch & Bound techniques.
b) Transportation Model - Initial Basic Feasible Solution by North-West corner rule,

Unit 2: **Linear Programming Problem**: Introduction, General formulation of LPP, slack &surplus variables, Simplex Method, Degeneracy prob.

Unit 3: **Replacement Model:** Introduction, replacement Model for deteriorative items, Replacement Model for Non decorative Items, cash flow diagram, Group replacement Model.

Unit 4: **Simulation**: Introduction, Types of Simulation, why to use simulation, limitation of simulation technique, Generation of random Numbers, Monte-Carlo simulation, Scope of simulation techniques.

Unit 5: **Queuing Theory or waiting line Models**: Introduction, Queuing system. Arrival rate, service rate, Queue discipline, Derivation of Average waiting time, Mean queue length, minimum cost service rate.

Text Book:-

1. Operation Research by Taha
2. Operation Research by D.S. Hira

B.TECH. THIRD YEAR (SIXTH SEMESTER)

Sub. Code: ME-316T **New Code: BME-716E**	**Automotive Mechanics (Elective-I)**	**LTP (310)**

Unit 1: **Power Unit:** Engine Classification, engine performance and characteristics, Description ofpower Unit.
Transmission: Transmission requirements; standard transmission system; fluid transmissionsystem; Automatic transmission, performance requirements and gear ratios.

Unit 2: **Tires:** Pneumatic tries, tube; tubeless tries; importance of maintaining tire pressure, Tyre manufacturing, Tyre rethreading.
Steering: Steering geometry, function of steering system, steering gear; types, power steering, steering gear ratio, overall steering ratio, turning ratio, types of steering linkages.

Unit 3: **Braking systems:** General braking requirement; simple break classification of brakes; Hydraulicbrakes vacuum brakes; power brakes.

Unit 4: **Chassis and Suspension, Frames, types of Frames:** Frame, rear end suspension, spring shackles, shock absorbers.
Vehicle Dynamics: Stability analysis of a linearized model of vehicle; stability on a curve.

Unit 5: **Maintenance:** Preventive maintenance; trouble shooting of standard transmission and steeringsystem etc.

Unit 6: **Electrical and Electronic Component:** Advance electrical systems, Electronics fundamentals, computerized engine control, Electronics stability control, Hybrid and electrical vehicle technology.

Text Book:-

1. Automotive Mechanics by Joseph Heitner
2. Automotive Engineering by KM Gupta
3. Automotive Mechanics by Crause & Anglin

B.TECH. THIRD YEAR (SIXTH SEMESTER)

Sub. Code: ME-318T **New Code: BME-718E**	**Statistical Quality Control (Elective-I)**	**LTP (310)**

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Student will be able to understand the basic concept, cost, quality control and inspection of Quality.

CO 2: Brief introduction of Total quality control, total quality management, Employee and Continuous Process Improvement, Supplier partnership Performance Measures, Deming's 14points.

CO 3: Brief Introduction of Basic statistical concept, concept of variance, frequency distribution**.**Theory of probability and probability distribution**:** Normal, Bionomial, Piosson distributions.

CO 4: Introduction of Control charts for variables -Variability, Basis, frequency of sub grouping, chance of making an error, drawing preliminary conclusion from control charts, somecontrolchart pattern, control limit on the chart.

CO 5: Brief introduction of Acceptance sampling, the operation characteristic curve **(**OC-curve**)**, quality indices for sampling plan, sampling plans.

Unit 1: Quality-Definition, Basic concepts of quality, quality control of quality, cost of quality, quality control and inspection**,** Total quality control, total quality management, Employee involvement Continuous Process Improvement, Supplier partnership Performance Measures, Deming's 14 points, JIT, Taguchi Method.

Unit 2: Basic statistical concept, concept of variance, frequency distribution**,** Theory of probability and probability distribution**:** Normal, bionomial, Piosson distributions.

Unit 3: Control charts for variables -Variability, Basis of sub grouping, frequency of sub grouping, chance of making an error, drawing preliminary conclusion from controlcharts, some control chart pattern, control limit on the chart, Control charts for attribute, choice between P-charts for attribute, choice between P- chart and np-chart, control chart for defects, comparison between attribute chart and variable chart.

Unit 4: Acceptance sampling, the operation characteristic curve **(**OC-curve**)**, quality indices for sampling plan, sampling plans**;** Reliability, quality control and reliability, need for reliable product definition for reliability, basic element of reliability, cost of reliability, mean time between failures, mean time between repair, quality and reliability, system reliability.

Unit 5: History of ISO-9000 series standard, need for standardization**,** ISO-9000 series of quality system, need for quality system.

Text Book:-

1. Statistical Quality Control By Grant
2. Statistical Quality Control By M. Mahajan

B.TECH. FOURTH YEAR (SEVENTH SEMESTER)

Sub. Code: ME-433T **Design of Energy Systems** **LTP (400)**
New Code: BME-813C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Understand the scope and formulation of energy system design.
CO 2: Analyse structural design and stress analysis for energy systems.
CO 3: Learn design codes and standards like IBR, BIS, and ASME.
CO 4: Study conventional power generation design components.
CO 5: Explore non-conventional power generation design aspects.

Unit 1: Introduction to Energy System Design and Processes:

1. Scope and formulation of system design.
2. Basic steps in the design process.
3. Features of modelling and material selection in energy systems.
4. Product vs. process design, virtual product design, and prototype development.

Unit 2: Structural Design and Stress Analysis:

1. Effect of operating parameters on structural design.
2. Stresses in thin and thick cylindrical shells under internal pressure.
3. Circumferential and longitudinal stresses, deformation in cylinders and spherical shells.
4. Lame's theorem for pressure vessels.

Unit 3: Design Codes and Regulations:

1. Overview of design codes: Indian Boiler Regulation (IBR), BIS, ASME.
2. Utilization of Data Books in energy system design.

Unit 4: Conventional Power Generation Design Aspects:

1. Design of key components: pumps, boilers, condensers, feed water heaters, chimney.
2. Design of hydropower system components: reservoir, penstock, headrace tunnel, power block.

Unit 5: Non-Conventional Power Generation Design Aspects:

1. Design aspects of renewable systems: solar thermal, solar PV, biomass, small hydro, wind power.
2. Biomass gasifier system design

Recommended Books:-

1. Penoncello G.G., Thermal Energy systems design and Analysis, CRC press, 2nd Edition, 2017.
2. Stoecker W., Design of Thermal Systems, McGraw Hill education; 3rd Education b, 2011.
3. Duffie J.A., Solar Engineering of Thermal Processes, John Wiley and Sons; 4th Edition, 2013.
4. Burmeister L.C., Elements of Thermal- Fluid system design, person, 1997.
5. Jularia Y., Design and Optimization of thermal systems, CRC press, 2nd Edition, 2007.

B.TECH. FOURTH YEAR (SEVENTH SEMESTER)

Sub. Code: ME-431T **Mechanics of Robots** **LTP (310)**
New Code: BME-811C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: This course aims to inculcate through understanding about basic knowledge of mathematics, kinematics and dynamics required for understanding motion programming and operational/ control functionality in robotics.

Unit 1: Mathematical Preliminaries of Robotics: Spatial Descriptions: positions, mappings: changing description from frame to frame, Operations: translations, rotations and transformations, transformation arithmetic, compound Transformations, Inverting a transform, transform equations, Euler Angles, Fixed Angles, Euler Parameters.

Unit 2: Robot Kinematics: Manipulator Kinematics, Link Description. Description, Link to reference frame connection, Denavit-Hartenberg Approach, D-H Parameters, Position Representations. Homogeneous Transformation Matrix, Forward Kinematics, Inverse Kinematics, Geometric and analytical approach.

Unit 3: Velocities & Statics: Cross Product Operator for kinematics, Jacobians Direct Differentiation, Basic Jacobian, Jacobian Jy/Jw, Jacobian in a Frame (0). Kinematic Singularity, Kinematics redundancy. Force balance equation, Forces, Velocity/Force Duality, Virtual Work, Force ellipsoid, Jacobian, Kinematic Singularity Kinematics redundancy, Mechanical Design of robot linkages.

Unit 4: Robot Dynamics: Introduction to Dynamics, Velocity Kinematics, Acceleration of rigid body, mass distribution Newton's equation, Euler's equation, Iterative Newton-Euler's dynamic formulation, closed dynamic, Lagrangian formulation of manipulator dynamic, dynamic simulation, computational consideration.

Text Books and Reference:-

1. S.K. Saha, Introduction to Robotics 2e, TATA McGraw Hills Education (2014). 2. Dileep Kumar Partihar, Fundamental concepts, Nervosa Publishing House, (2019)
2. Asiana Ghoshal, Robotics: Fundamental concepts and analysis, Oxford University Press (2006).
3. M. Sponge, M. Vidyasagar, S. Hutchinson, Robot Modelling and Control, Wiley & Sons, (2005).
4. J. J. Craig, "Introduction to Robotics: Mechanics and Control", 3rd edition, Addison-Wesley (2003).

B.TECH. FOURTH YEAR (SEVENTH SEMESTER)

Sub. Code: ME-403T **Computer Aided Manufacturing** **LTP (310)**
New Code: BME-803C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Student will be able to understand the basic principles of computer hardware, software requirements, part programming etc.
CO 2: Apply these principles to write part programs for machining of different workpieces on CNC machines.
CO 3: Analyse the various Designs and configuration of CNC machines.
CO 4: Analyse different layouts used in group technology to be used on shop floor.
CO 5: Analyse about robotics and flexible manufacturing modules used in industry for ease of material handling and for increasing productive time.
CO 6: Discuss and analyze various aspects of computer integrated manufacturing for changing scenario of manufacturing environment.

Unit 1: Introduction to CAM and its role in Product cycle and importance of CAM. CAD/CAM computer hardware, types of systems. CAD/CAM system evaluation criteria, input devices, output devices, hardware integration and networking. Hardware trends. IBM PC compatible CAD/CAM soft wares. Operating systems. Microcomputer based CAD/CAM systems, general features, hardware components and configuration, IBM PC compatible CAD/CAM system, microcomputer-based CAD/CAM systems.

Unit 2: Numerical Control: Introduction, numerical controls its growth and development, components of NC systems. Digital & analog output, application of NC machine tools, advantages and disadvantages of NC, operation of an NC machine tool system, machine centre, Microprocessor in CNC systems, CNC- DNC and adoptive control. Justification and economics of Numerical control part programming, syntax of part programming, languages, APT.

Unit 3: Part Programming: Introduction, Manual Part Programming. Preparatory functions, feed rate functions, miscellaneous functions, spindle speed functions, tool change function. Data input, labelling of programmers and sub programmers, fixed cycles, Tool length compensation, Do loop, Macros, Verification, Documentation, Computer aided part programs, computer aided part programming languages, APT language structure.

Unit 4: Group Technology: Introduction, concept of group technology, GT loading, how GT works, stages for adopting a plant for GT, benefits of GT, Process planning and GT. Computer aided process planning (CAPP); Process regions for different process planning, integrated process planning systems CAPP implementation. Flexible manufacturing systems (FMS): Objectives and benefits of FMS, Components of FMS. Problems with FMS, different types of FMS Technology required for FMS. Computer Integrated manufacturing (CIM): CIM systems, elements of CIM, different modules and information on flow, design aspect of CIM, CIM planning and implementation process.

Unit 5: Robotics: Introduction propose of robotics, law of Robotics, Basic element, degree of freedom, Work envelope, classification of Robots, Economic and social significances of Robots, Robotics applications.

Text Books:-

1. Computer Aided Manufacturing-Rao, Tiwari & Kundra
2. Principles and Applications by P N Rao

Reference:-

1. CAD/CAM: CAE- Zimmars/ Groover
2. CAD/CAM: CAE- Jha & Surendra Kumar

B.TECH. FOURTH YEAR (SEVENTH SEMESTER)

Sub. Code: ME-415T **Value Engineering** **LTP (310)**
New Code: BME-815C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Student will be able to understand the basics of value analysis.
CO 2: Develop the strategy for development of new product and learn about valueengineering.
CO 3: Apply the concept of brainstorming and creativity.
CO 4: Apply the techniques of value engineering.
CO 5: Student will be able to complete the case study on value engineering.

Course Description:

Value Engineering (VE) is a systematic approach to improving the value of products, projects, or processes by identifying and eliminating unnecessary costs while maintaining or improving performance and quality. This course introduces students to the methodologies, tools, and techniques of value engineering and their application in industries such as manufacturing, construction, and service sectors.

Learning Objectives:

By the end of this course, students will be able to:

1. Understand the fundamental principles of value engineering.
2. Apply value engineering methodologies to improve product or process value.
3. Identify and reduce unnecessary costs while maintaining performance and quality.
4. Use function analysis and cost evaluation to optimize designs and processes.
5. Develop and implement value engineering proposals for real-world projects.

Unit 1: Introduction to Value Engineering:

1. Definition and scope of value engineering
2. History and evolution of VE
3. The concept of value: Value = Function / Cost
4. Benefits of value engineering in industries
5. Difference between value engineering, value analysis, and cost reduction

Unit 2: Value Engineering General Phase:

1. Use Good Human Relations
2. Inspire Teamwork
3. Work on Specifics
4. Overcome Roadblocks
5. Apply Good Business Judgement

Unit 3: Information Phase:

1. General
2. Information Phase
3. Secure the Facts
4. Worksheets
5. Information Worksheet
6. Consultation Summary

7. Determine the Costs
8. Definition of Costs

Unit 4: Function Phase:

1. Functional Approach
2. Define the Function
3. Evaluate Functional Relationships

Unit 5: Creation and Evaluation Phase:

1. Establish Positive Thinking
2. Develop Creative Ideas
3. Life cycle cost analysis
4. Value index and its role in decision-making
5. Refine ad Combine Ideas
6. Establish Cost on All Ideas
7. Develop Function Alternatives
8. Evaluate by Comparison

Unit 6: Investigation Phase:

1. Use Company and Industrial Standards
2. Consult Vendors and Specialists
3. Use Specialty Products, Processes and Materials
4. Final Functional Development of Alternatives

Unit 7: Recommendation Phase:

1. Present Facts
2. Present Cost
3. Team Recommendation
4. Project Implementation

Assignments: Trends and Innovations in Value Engineering:

1. Role of technology and digital tools in value engineering (e.g., BIM in construction)
2. Advanced VE techniques and applications
3. Future trends in value management
4. Case studies on breakthrough innovations driven by VE

Text Books and References:-

1. Techniques of Value Engineering and Value Analysis by Lawrence D. Miles
2. Value Engineering: Practical Applications for Design, Construction, Maintenance & Operations by Richard Park
3. Value Management in Construction and Infrastructure: Valuing the Process by Geoffrey Q. P. Shen
4. Supplementary readings from academic journals, case studies, and industry reports.

Prerequisites:-

1. Basic knowledge of management and cost analysis
2. Familiarity with project management principles (optional)

B.TECH. FOURTH YEAR (SEVENTH SEMESTER)

Sub. Code ME-407T
New Code BME-807E

Power Plant Engineering
(Elective-II)

LTP (310)

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Student will be able to recognize power generation scenario, the components of thermal power plant, improved Rankine cycle, Cogeneration cycle and various standard components.

CO 2: Discuss and analyze the mathematical and working principles of different electrical equipment involved in the generation of power.

CO 3: Analyze the working and layout of steam power plants and the different systems comprising the plant.

CO 4: To study the working principle, construction of power generation using Gas turbine plant.

CO 5: Describe the different power plant electrical instruments and basic principles of economics of power generation.

Unit 1: Steam Power Plant:

1. Cycles for steam power plants- Carnot, Rankine, Reheat, Regenerative and Binary vapor cycle and their analysis, Numerical problems.
2. Fuels for steam power plants: Different types of coals, proximate and ultimateanalysis of coal, coals suitable for power plant, selection of coal for power plant,Indian coals, Liquid fuels and their advantages and disadvantages over solid fuels, Gaseous fuels and their advantages and disadvantages over solid fuels.
3. Coal handling- Preparation of coal at mine, outplant handling of coal, storage of coal at plant site, implant handling of coal, A brief description about coal handling equipment such as coal preparation plant, Unloading equipment, Transfer equipment's such as Belt conveyor, screw conveyor, bucket elevator, Grab bucket conveyor and Flight conveyor.
4. Coal feeding and burning methods-Overfeed stoker, underfeed stoker, Pulverized fuel system, Different types of pulverised fuel burners and their applications; Advantages and disadvantages of pulverised fuel firing over stoker firing.
5. Ash handling systems: - Mechanical handling system, Hydraulic system, Pneumatic system and steam jet system.
6. Dust collection equipment- Brief description about mechanical d408ustcollectors (Dry type) such as Gravitational separators, cyclone separator, and Electrostatic separator.
7. Draught systems- Natural draught, forced draught, induced draught and balanced draught; Chimney and its design.

Unit 2: High Pressure Boilers:

Unique features of high-pressure boilers, advantages of high-pressure boilers, La Mont boiler, Benson boiler, Loeffler boiler, Schmidt Hartman boiler and velox boiler; Location of heating surfaces in water tube boiler, Furnace wall construction such as refractory walls, hollow air-cooled refractory walls and water walls, desirable properties

of refractory material and different types of refractory materials, desirable properties of insulating materials and different types of insulating materials; Feed Water treatment- Necessity of feed water treatment, Different impurities in water and their effects, chemicals used for feedwater treatment.

Unit 3: Nuclear Power Plant:

Basics of Nuclear Engineering, Layout and subsystems of nuclear power plants, Working of nuclear reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and liquidmetal cooled Reactors; Safety Measures for Nuclear Power Plants.

Unit 4: Fluctuating Loads on Power Plants:

Definitions of load curve, load duration curve, connected load, maximum demand, Demand factor, Average load, load factor, Diversity factor, Plantcapacity factor and plant use factor.

Unit 5: Thermal Power Plants:

Co-generation systems. Gas Turbine Power Plants. Combined Cycle Power Plants; Integrated Gasifier based combined cycle systems.

Text Books:-

1. Power Plant Engg. Mahesh Verma
2. Power Plant Engg. PKNAG
3. Power Plant Engg. Domkundwan

References:-

1. Steam Power Station Gaffert
2. Power Plant Engineering F.T.Morse

B.TECH. FOURTH YEAR (EIGHTH SEMESTER)

Sub. Code: ME-440T **Control of Robotics Systems** **LTP (310)**
New Code: BME-806C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Understand the importance and fundamentals of computational analysis in the energy sector.
CO 2: Learn the basics of governing equations, computational techniques, and workflow in computational analysis.
CO 3: Apply different computational methods like finite element analysis for energy system problems.
CO 4: Analyze and optimize processes by varying design and operational parameters in energy systems.
CO 5: Explore recent advances in computational methods and their applications in energy problems.

Unit 1: Introduction to Computational Analysis in Energy:
1. Importance of computational analysis in the energy sector.
2. Basics of computational methods.
3. Introduction to governing equations: partial and ordinary differential equations.
4. Overview of computational workflow: model development, solver, and post-processing.

Unit 2: Computational Techniques and Error Analysis:
1. Different computational techniques for analysis.
2. Validation and verification of computational results.
3. Optimization of processes by varying design and operating parameters.
4. Types of errors: interpolation, approximation, convergence.

Unit 3: Finite Element Analysis (FEA) Methods:
1. Stiffness method, potential energy, Rayleigh-Ritz method, and Galerkin method.
2. FE formulation, element formulation, and coordinate transformation.
3. Isoparametric formulation.

Unit 4: Applications of Computational Analysis:
1. Applications in structural mechanics problems.
2. Flowcharts for computational process workflow.
3. Analysis of computed results at different time scales.

Unit 5: Recent Advances in Computational Methods:
1. Moving mesh and adaptive mesh refinement.
2. High-performance computing and its role in energy.
3. Coupling computational methods with machine learning.
4. Advanced applications of computational analysis in energy sector problems.

References Books:-

1. Sastry S.S., Introductory Methods of Numerical Analysis, PHI Pvt, Ltd, 5th Edition, New Delhi, 2009.
2. Burden R.L and Fairs J.D., Numerical Analysis, 4th Edition, Brooks Cole, 2012.
3. Reddy J.N., An Introduction to the finite Element Method, 2020.
4. Zhu B., The Finite Element Method: Fundamentals and applications in civil Hydraulic, Mechanical andAerospace Engineering, 1st Edition Wiley, 2018.
5. Ghoshdastidar P. S., Computational Fluid Dynamics and Heat Transfer, 1st Edition Cengage IndiaPrivate Limited, 2017.
6. Patankar S.V., Numerical Heat Transfer and Fluid Flow, Special Indian Edition, CRC Press, 2017.

Sub. Code: ME-436T **Computational methods in Energy Systems** **LTP (310)**
New Code: BME-804C

Course Objectives

CO 1: Recognize the importance of computational analysis in optimizing, designing, and improving energy systems.

CO 2: Understand computational workflows, model development, solvers, and post-processors.

CO 3: Use computational methods to optimize the performance of energy systems by varying design and operating parameters.

CO 4: Build a strong foundation for applying computational methods in emerging energy technologies and systems.

Course contents:

Importance of computational analysis in energy sector; basics of different methods in computational analysis; introduction to the governing equations, partial differential equations and ordinary differential equations, computational workflow, model development, Solver and post processors; different computational techniques used for computational analysis, validation and verification of computational results, Optimization of the processes by varying design and operating parameters of energy systems, analysis of the computed results at different time scales; sources and types of error in the computational analysis; interpellation, approximation and convergence; methods of finite element analysis: stiffness method, potential energy and Rayleigh-Ritz method, Galerkin. FE formulation, element formulation and co-ordinate transformation, isoparametric formulation; Applications; problems of structural mechanics; associated flowcharts; Recent advances in computational methods; moving mesh, adaptive mesh refinement. high performance computing, coupling with machine learning, Applications of computational analysis in energy sector problems.

Recommended Books:

1. Sastry S.S.. Introductory Methods of Numerical Analysis. PHI Pvt. Ltd, 5th Edition, New Delhi. 2009.
2. Burden R.L and Faires J.D., Numerical Analysis, 4th Edition, Brooks Cole, 2012.
3. Reddy J.N.. An Introduction to the Finite Element Method. 2020
4. Zhu B.. The Finite Element Method: Fundamentals and Application in Civil, Hydraulic. Mechanical and Aerospace Engineering, Ist Edition Wiley, 2018.
5. Ghoshdastidar P.S.. Computational Fluid Dynamics and Heat Transfer, Ist Edition. Cengage India Private Limited, 2017.
6. Patankar S.V., Numerical Heat Transfer and Fluid Flow, Special Indian Edition, CRC Press, 2017.

B.TECH. FOURTH YEAR (EIGHTH SEMESTER)

Sub. Code: ME-438T **Microprocessor and Embedded Systems** **LTP (310)**
New Code: BME-802C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: This Course aims to teach the detailed functioning of microprocessors and the role of embedded system in a robotic system.

Unit 1: Introduction to Embedded System and microcomputers:
Introduction to Embedded systems, Embedded systems applications, Block diagram of embedded system, Trends in Embedded Industry, Basic Embedded System Models, Embedded System development cycle, Challenges for Embedded System Design, Evolution of computing system and applications. Basic Computer architecture: Von–Neumann and Harvard Architecture. Basics on Computer organizations, Computing performance, Throughput and Latency, Basic high performance CPU architectures, Microcomputer applications to embedded systems and Mechatronic.

Unit 2: Microprocessor:
8086 Microprocessor and its Internal Architecture Pin Configuration and their functions, Mode of Operation. Introduction to I/O and Memory, Timing Diagrams, Introduction to Interrupts.Introduction to C language, Introduction format, C language programming format, Addressing mode, Instruction Sets, Programming 8086 microprocessor.

Unit 3: Microprocessor Interfacing:
Introduction to interfacing Memory Interfacing, Programmable Peripheral Interfacing, Programmable I/O, Programmable Interrupt Controller, Programmable Timers, Programmable DMA Controller, Programmable DMA Controller, Programmable Key Board Controller, Data acquisition Interfacing: ADC, DAC, Serial and parallel data Communication interfacing Microcontroller. Introduction to Microcontroller and its families, Criteria for Choosing Microcontroller. Microcontroller Architecture Programming model, addressing modes, Instruction sets, Assembly and C programming for Microcontroller, I/O programming using assembly and C language, Interrupt Controller, I/O interfacing, Timers, Real Time clock, Serial and Parallel Communication protocols, SPI Controllers. LCD Controller.

Unit 4: Microcontroller Interfacing:
Introduction to Microcontroller Interfacing and applications: case studies: Display Devices, controller and Drivers for DC, Servo and stepper Motor.

Unit 5: Introduction to Advanced Embedded Processor and Software:
ARM Processor, Unified Model Language (UML), Embedded OS, Real Time Operating System (RTOS), Embedded C.

Unit 6: Microprocessor and Embedded System Laboratories:
Basic C language Programming implementation on Microprocessor and Microcontroller. Interfacing Display, Key boards and sensors with Microprocessors and

Microcontroller, Data Acquisition using Microprocessor and Microcontroller, Implementation of Controlling schemes for DC, Servo, Stepper motor using C programming in Microprocessors and Microcontroller.

Text Books and References:-

1. K. V. Shibu, Introduction to Embedded systems, McGraw Hill Publications (2009).
2. Raj Kamal, Embedded System, TATA McGraw Hill Publications (2003).
3. M. Morris Mano, Computer System Architecture, 3rd, Pearson Publication, (20070).
4. D. V. Hall, 8086 Microprocessors and interfacings, TATA McGraw Hill. (2005).
5. B. B. Brey, The Intel Microprocessors, Prentice Hall Publications, 8th ed, (2018).
6. M. A. Mazidi, R.D. McKinlay and D. Casey, PIC Microcontrollers and Embedded systems, PearsonPublications, (2008).
7. M. predoc, Programming and Customizing the PIC Microcontroller, McGraw Hill Publications, 3ed(2017).
8. R. Barnett, L. O' Cull and Cox, Embedded C Programming and Microchip PIC, Cengage Learning,(2003).

B.TECH. FOURTH YEAR (EIGHTH SEMESTER)

Sub. Code: ME-440T **Control of Robotics Systems** **LTP (310)**
New Code: BME-806C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: This Course aims to develop the understanding of control system, its designing and application.

Unit 1: Basis of Control:
Differential Equation, Transfer function, frequency response, Routh-Hurwitz test, relative stability, Root locus design, construction of root loci, phase lead and phase-lag design, lag-lend design, Bode, polar, Nyquist plot..

Unit 2: Linear Control:
Concept of states, state space model, different from, controllability, observability; pole placement by state feedback, observer design, P. PI & PID controller, control law partitioning. modelling and control of a single joint.

Unit 3: Non-Linear Control System:
Common physical non-linear system, phase plane method, system analysis by phase plane method, stability of non-linear system, stability analysis by describing function method, Liapunov's stability criterion, the control problems for manipulators.

Unit 4: Motion Control:
Point to Point Control, trajectory generation, Continuous Path Control, Joint based control, Cartesian Control, Force Control, hybrid position/force control system.

Text Books and References:-

1. M. Gopal, Control system, McGraw-Hill (2012).
2. K. Ogata, "Modern Control Engineering", Prentice Hall India (2009).
3. M. Sponge, M. Vidyasagar, S. Hutchinson, Robot Modelling and Control, Wiley & Sons, (2005).
4. J. J. Craig, "Introduction to Robotics: Mechanics and Control", 3rd edition, Addison-Wesley (2003).
5. S. K. Saha, Introduction to Robotics 2e, TATA McGraw Hills Education (2014).

B.TECH. THIRD YEAR (EIGHTH SEMESTER)

Sub. Code: ME-442T **Energy Efficiency and Economics** **LTP (310)**
New Code: BME-808C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Understand the importance and relevance of energy conservation and efficiency across various sectors.
CO 2: Learn methods to calculate energy efficiency at both component and system levels.
CO 3: Study energy auditing, demand-side management, and smart metering for better energy management.
CO 4: Explore energy conservation regulations, standards, and schemes across different sectors.
CO 5: Analyze the economics of energy supply, pricing, markets, and energy-environment interaction.

Unit 1: Energy Conservation and Efficiency:

1. Relevance of energy conservation and measures of energy efficiency.
2. Efficiency in different sectors: Industry, Agriculture, Commercial, Transportation, Residential, and Service Sector.
3. Energy intensity and calculation of energy efficiency at component and system levels.

Unit 2: Energy Auditing and Demand Management:

1. Energy auditing methods.
2. Demand-side management and smart metering.
3. Energy efficiency schemes in sectors like power, buildings, and electric vehicles.

Unit 3: Energy Conservation Regulations and Standards:

1. Energy conservation acts, standards, and device labeling.
2. Regulations such as Energy Conservation Building Code (ECBC).
3. Carbon mitigation benefits through energy efficiency.

Unit 4: Energy Demand and Management:

1. Introduction to the energy sector: access, security, and externality.
2. Energy demand analysis, management, and forecasting.

Unit 5: Energy Economics and Market Dynamics:

1. Economics of energy supply and energy pricing.
2. Energy markets for solid, liquid, gaseous fuels, and electricity.
3. Energy sector reforms, regulations, and interaction with the environment.

Text Books and References:-

1. Goswami, D.Y., Krieth F. Energy Efficiency and Renewable Energy Handbook, CRC Press, 2017.
2. Martinez D, Ebenhack B., Wanger T., Energy Efficiency Concepts and Calculations. Elsevier Science2019.

3. Kaya, Durmus, Kilsc C, Fatma Ozuturk, Huseyin H., Energy Management and Energy Efficiency andIndustry Practical, Springer International Publishing, 2021.
4. Kanoglu M, Cengel Y. A. energy Efficiency and management for engineers. McGraw Hill Education,2020.
5. Bhattacharyya S.C. Energy Economics, Concept, Issues, Markets governance. Springer, 2011.
6. Peter MSchwarz Energy Economics, Routledge, 2015.
7. Thomas R Sadler, Energy Economics Science Policy and Economic Applications, Lexington Books,2020.
8. Roy, Nersesian, Energy Economics; Markets, History and Policy, Routledge, 2016.

B.TECH. THIRD YEAR (EIGHTH SEMESTER)

Sub. Code: ME-406T **Refrigeration & Air Conditioning** **LTP (310)**
New Code: BME-810C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Student will be able to recognize fundamental principles and applications of refrigerationand air conditioning system.
CO 2: Discuss cooling capacity and coefficient of performance by conducting test on vapor compression refrigeration systems.
CO 3: Discuss cooling capacity and coefficient of performance by conducting test on vaporabsorption refrigeration systems.
CO 4: Discuss the properties, applications and environmental issues of different Refrigerants.
CO 5: Design and analyze component used in refrigeration system.
CO 6: Understanding thermal comfort conditions with respect to temperature and humidity andhuman clothing and activities and its impact on human comfort, productivity, and health.

Unit 1: Unit of refrigeration, difference between engine, refrigerator and heat pump: Classification of refrigeration systems; Air Refrigeration System: Carnot refrigeration cycle or reversed carnot cycle using air as working substance, Bell- coleman cycle, analysis of these cycles, actual Bell Coleman cycle, advantages and disadvantages of the air refrigeration system; Necessity of cooling the aero plane, application of air refrigeration system in aero planes and different types of air refrigeration systems used in aero planes such as simple cooling and simple evaporative type, boot-strap and boot-strap evaporative type, regenerative cooling system and reduced ambient type cooling system, Coefficient of performance (C.O.P).

Unit 2: **Vapor Compression Refrigeration System:**
Single Stage System: Simple system, Carnet vapor-compression cycle, Difference between air refrigeration system and vapor refrigeration system, diagrammatic layout of the components of this system and a brief description, construction of T-s, P-h, and h-s diagrams and their usefulness in solving the problems, Analysis of simple saturated cycle, actual cycle, use of p-h chart, Dry and wet compression,effect of pressure changes on COP & capacity, Sub cooling &superheating, effects of foreign material, advantages and disadvantages over air refrigeration system;Actual Vapor compression cycle.
Multistage vapor compression systems: - Purpose, two stage vapor compression, Multi staging, optimum Inter stage pressure, Cascade refrigeration system.

Unit 3: **Refrigerants:** Desirable properties of refrigerants**;** Common refrigerants such as Ammonia, Carbon Dioxide, Freon-11, Freon-12, Freon-22 and Freon-502 and their applications**;** Secondary refrigerants**:** - Purpose, Theory of brines, Pressure drop and heat transfer**;** Alternative refrigerant; Refrigeration equipment & its design brief description of reciprocating compressor, centrifugal compressor (Design), capillary tube, thermostatic expansion valve, condenser and evaporator (Design); Duct design: - Introduction, Pressure drops in ducts, Methods of duct design.

Unit 4: Vapor Absorption Refrigeration System:
Diagrammatic layout of the components of this system and a brief description, properties of ideal refrigerant, properties of ideal absorbent, properties for ideal refrigerant absorbent combination, best combination, Theory of mixtures, Processes: Adiabatic mixing of two Systems, Diabatic mixing, Throttling process,advantages of vapor absorption system over vapor compression refrigeration system.

Unit 5: Air Conditioning: Definitions of different psychrometric properties such as dry air, moist air, water vapor, dry bulb temperature, wet bulb temperature, dew point temperature, specific humidity or humidity ratio, absolute humidity, degree of saturation, relative humidity, enthalpy of moist air.

Psychometric chart and psychometric processes: Sensible cooling or heating, bypass factor, contact factor, cooling and dehumidification, cooling with adiabatic humidification of air or adiabatic saturation or evaporative cooling, heating and humidification, heating and dehumidification, adiabatic mixing of two air stream, numerical problems based on these process only. Concepts of room sensible heat factor (RSHF), grand sensible heat factor (GSHF) and effective surface temperature.

Requirements of comfort air conditioning: A brief description of comfort chart and its use, diagrammatic layout of year-round air- conditioning system providing summer cooling and winter heating and a brief description.

Text Books:-

1. Refrigeration and Air-Conditioning by-C.P. Arora

References Books:-

1. Refrigeration and Air-Conditioning by- R.Yadav
2. Refrigeration and Air-Conditioning by- S. Domkundwan

B.TECH. THIRD YEAR (EIGHTH SEMESTER)

Sub. Code: ME-414T **Industrial Management** **LTP (310)**
New Code: BME-812C

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Student will be able to understand the work measurement and work sampling techniques.
CO 2: Develop the strategy for market research.
CO 3: Calculate the performance analysis of production system.
CO 4: Student will be able to understand the role of IT in systems.

Course Description:

Industrial Management focuses on the principles and practices essential to managing industrial operations effectively. This course covers various aspects of managing production systems, resource allocation, work design, quality control, and the integration of human, material, and financial resources in industrial settings. Students will explore both theoretical foundations and practical applications of industrial management in today's global and technology-driven environment.

Learning Objectives:

By the end of this course, students will be able to:

1. Understand the core concepts of industrial management and its role in modern industries.
2. Apply techniques to optimize production processes, workforce, and resource allocation.
3. Implement quality control, productivity improvement, and work design strategies.
4. Analyze industrial systems and apply methods for improving efficiency.
5. Integrate supply chain management and lean principles in industrial operations.
6. Explore contemporary trends in industrial management, including sustainability and automation.

Unit 1: Introduction to Industrial Management:

1. Definition and scope of industrial management
2. The role of management in industrial settings
3. Evolution of industrial management practices
4. The industrial manager's role in modern organizations

Unit 2: Work Study and Time Management:

1. Work study techniques: method study and work measurement
2. Motion and time study: improving efficiency
3. Time management in industrial settings
4. Case studies on effective work design

Unit 3: Organisational Structure:

1. Organization structure
2. Centralized & decentralized organizations
3. Manpower planning, requirement & forecasting
4. Recruitment training & placement.

Unit 4: Human Resource Management in Industrial Settings:

1. Role of HR in industrial management
2. Workforce planning, recruitment, and training
3. Job design and job enrichment in industrial environments
4. Labor relations and workplace safety regulations

Unit 5: Industrial Engineering and Ergonomics:

1. Role of industrial engineering in process improvement
2. Ergonomics and workplace design
3. Human factors engineering and its impact on productivity
4. Case studies on ergonomic improvements in industrial settings

Assignments: Modern Trends in Industrial Management

1. Industry 4.0: automation, digitalization, and smart factories
2. Sustainability in industrial management: green manufacturing, energy management
3. Role of innovation and technology in industrial management
4. Case studies on successful industrial transformation

Text Books and References:-

1. **Industrial Engineering and Management** by O.P. Khanna
2. **Introduction to Industrial Engineering** by Gavriel Salvendy
3. **Operations and Industrial Management** by Joseph G. Monks
4. Supplementary readings from industry reports, academic journals, and case studies

Prerequisites:-

1. Basic understanding of management principles and operations
2. Familiarity with economics and business (optional)

B.TECH. FOURTH YEAR (EIGHTH SEMESTER)

Sub. Code: ME-409T **New Code: BME-809E**	**Composite Materials** **(Elective-II)**	**LTP (310)**

Unit 1: Introduction to composite materials, definition, distribution and contiguous classification and characteristics of composite materials, Fibrous Composites, Laminated composites, Particulate composites. Brief description of mechanicalbehavior of composite materials. Basic terminology of laminated fiber- reinforced composite materials, Laminate, laminates, Brief description of manufacturing methods of laminated fiber- reinforced composite materials. Current and potential advantages of composite materials, strength and stiffnessadvantage, cost advantage composite modals-Law of mixtures, Interfaces.

Unit 2: Macro mechanical behavior of a lamina, stress strain relations for an isotropic materials, engineering constants for orthotropic materials, restrictions on elastic constants for isotropic and orthotropic materials, stress-strain relations for plainstress in an orthotropic material, stress-strain relations for a lamina of arbitrary orientation.

Unit 3: Strength of an orthotropic lamina, strength concepts, experimental determination of strength and stiffness. Biaxial strength thesis for an orthotropic lamina, maximum stress theory, maximum strain theory, Tsai-Hill Theory, Effect of variability of fiber strength fracture modes in composites fracture and safety of different composites under static and dynamic loading- mechanism of fracture, fracture mechanics of fiber matrix composite.

Unit 4: Micro mechanical behavior of a lamina, basic approaches to micro mechanics, Mechanics of load transfer from matrix to fiber, load transfer in particulate composites. Mechanics of materials approach to stiffness, determination of E1, E1, Y12, and G12. Elasticity approach to stiffness. Comparison of approaches to stiffness for particulate composite &fiber reinforced composites.Mechanics of materials approach to strength, tensile strength in Fiber direction,and compressive strength in Fiber direction. +.

Text Books:-

1. Mechanics of Composite Materials by R.M. Jones

References Books:-

1. Principles of Composite material mechanics by R.Gibson.
2. Stress Analysis of Fiber Reinforced composite materials by M.Hyer

B.TECH. FOURTH YEAR (EIGHTH SEMESTER)

Sub. Code: ME-412T **New Code: BME-814E**	**Mechanical Vibration (Elective-III)**	**LTP (310)**

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Fully understand and appreciate the importance of vibrations in mechanical design of machine parts that operate in vibratory conditions.
CO 2: Obtain linear vibratory models of dynamic systems with changing complexities **(**SDOF, MDOF**)**.
CO 3: Write the differential equation of motion of vibratory systems.
CO 4: Make free and forced **(**harmonic, periodic, non-periodic**)** vibration analysis ofsingle and multi-degree of freedom linear systems.

Unit 1: Introduction:
Vector representation and addition of harmonic motion, beats phenomenon, harmonic forces, Fourier series and harmonic analysis.

Unit 2: Single degree of freedom system:
Undamped vibration; Derivation of differential equation, energy method, equivalent stiffness of spring in series andparallel, positional vibration..

Unit 3: Single degree freedom system:
Damped Vibration; Force vibration with constant hormonic excitation, force vibration with rotating and reciprocating unbalance force, vibration due to excitation of support vibration isolation and transmissibility vibration, measuring instruments i.e. vibrometer, accelerometer and frequency meter.

Unit 4: Two degree freedom system:
Principal modes, double pendulum tensionalsystems combined sub linear and angular mode damped force system, undamped forced vibration with harmonic excitation system, undamped forcedvibration and harmonic excitation

Unit 5: Multi-Degree vibration:
Principal modes, torsional systems, combined sublinear and angular mode, damped force system, undamped force vibration with harmonic excitation,critical speed of a light shaft having a single disc with and without damping; Critical speed of a shaft with multiple discs; Electrical analogy, Principle of electrical analogy, truly analogous circuits.

Text Book:-

1. Mechanical Vibration: G.K.Groover
2. Mechanical Vibration : S. S. Rao

References Book:-

1. Mechanical vibration: Francis S.Tse, Ivan E. Morse Rollard T. Hunkle.(Theory and application)

B.TECH. THIRD YEAR (SEVENTH SEMESTER)

Sub. Code: ME-475T **New Code: BME-875E**	**Non-Conventional Energy Sources** **(Pool Elective)**	**LTP (310)**

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Student will be able to types of energy source exist in the world and their contribution in global economy.
CO 2: Solve the design parameters wind Turbine power plant.
CO 3: Students can design the biogas power plant for rural area.
CO 4: Students will be able to understand the geothermal energy and power output from geothermal source.
CO 5: Apply the basic Rankine cycle principle to solve the problem of ocean thermal energy efficiency and power output

Unit 1:

a) Introduction to Energy sources Energy consumption as a measure of Prosperity; Energy Sources and their availability, Renewable Energy Resources.
b) Introduction to solar radiations and instruments for Solar Radiation Measurements, solar Energy collectors principles of conversion of Solar Radiation into Heat, Flat Plate collectors, concentrating collectors; Performance evaluation of fled plate and concentratingcollector, Design of flat plate collector, Solar energy storage system, solar ponds, few applications of solar energy

Unit 2: Introduction to wind Energy, basic principles of Wind Energy Conversion, (WEC) wind data and energy estimation, site selection considerations, basic components of wind energy conversion system, Wind turbine operation and control, Classification of WEC System, horizontal & vertical axis type turbines; Application of wind energy.

Unit 3: Introduction to energy from biomass, biomass conversion technologies, fluidized bed combustion of Bio-mass biogas generation, factors affecting generation of gas, classification of biogas plants, material used for biogas generation.

Unit 4: Introduction to geothermal energy, nature of geothermal fields, geothermal sources, hydrothermal resources, geopressured resources, Petro thermal systems, Vapor dominated power plant, Liquid-dominated systems, Hybrid systems, application of geothermal, energy,geothermal energy in Indian Prospects.

Unit 5: Introduction to Energy from ocean, Ocean Thermal Energy Conversion (OTEC), open cycle OTEC system, modifications of open OTEC cycle, closed OTEC system, Prospects of OTEC in India. energy from tides, basic principles of Tidal power, advantages & limitation of tidal power generation, prospects of tidal energy in India ocean waves, introduction, advantages & disadvantages of wave energy, wave energy conversion devices.

Text Book:-

1. Non-Conventional Energy Sources by G.D. Rai
2. Non-Conventional Energy Sources by Dr. R.K.Singa

B.TECH. FOURTH YEAR (EIGHTH SEMESTER)

Sub. Code: ME-416T | **Gas Dynamics** | **LTP (310)**
New Code: BME-816E | **(Elective-III)**

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Formulate and solve problems in one -dimensional steady compressible flow including: isentropic nozzle flow, constant area flow with friction (Fanno flow) andconstant area flow with heat transfer (Rayliegh flow).
CO 2: Derive the conditions for the change in pressure, density and temperature for flow through a normal shock.
CO 3: Determine the strength of oblique shock waves on wedge shaped bodies and concave corners.
CO 4: Determine the change in flow conditions through a Prandtl-Meyer expansion wave.
CO 5: Complete a numerical analysis to solve an unsteady one-dimensional flow problem.

Unit 1: Introduction and Basic Definitions:
Difference between compressible and incompressible flow, assumptions made for the analysis of compressible flow, continuum control volume, bulk modulus of elasticity, adiabatic bulk modulus, isothermal bulk modulus and coefficient of compressibility.

Fundamental equations of one: Dimensional steady flow, equation of continuity or law of conservation of mass, momentum equation, steady flow energy equation, adiabatic energy equation, adiabatic energy transformation, stagnation enthalpy, stagnation temperature, stagnation velocity of sound, stagnation pressure, stagnation density, stagnation- state, various regions of flow. Reference velocities such as velocity of sound, maximum fluid velocity, critical velocity of sound, Mach number M* Crocco number derivation of Bernoulli equation from adiabatic energy equation, equivalent of Bernoulli equation for isentropic compressible flow, effect of Mach No. on compressibility, (Numerical problems).

Unit 2: Wave Motion: Wave propagation in gases or compressible media, wave front, a brief description about various types of waves such as infinitesimal pressure wave or sound wave, non-step pressure wave, steep pressure wave, expansion wave, equation of acoustic velocity in a compressible fluid, Mach Number, Machcone, Mach angle.

Unit 3: Isentropic flow with variable Area: Comparison of isentropic and adiabatic flows on T-S and P-V diagram, Equation for Mach number variation, Expansions in nozzles, compression in diffusers, stagnation and critical states, Area ratio as a function of Mach number, impulse function, mass flow rate flow through convergent nozzle and convergent-divergent nozzle under varying pressure ratios.

Unit 4: Flow with normal shock waves: Formation 'of a normal shock wave. Governing relations of the normal shock, Prandtl L - Meyer-relation, Mach. No. Downstream of the normal shock wave, Static pressure ratio across the shock, temperature ratio across the shock, density ratio across the shock (The Rankine-Hugoniot equation), stagnation pressure ratio across the shock, moving normal shock wave.

Unit 5: Flow through constant area ducts with friction but without heat transfer, governing

equations, Fanno lines. Flow through constant area ducts with heattransfer but without friction, governing equations, Raleigh lines.

Text Book:-

1. Gas dynamics By S M Yaha
2. A text book on compressible flow byRathakrishan
3. Fluid Mechanics and Machines by Modi and Seth

B.TECH. FOUTH YEAR (EIGHTH SEMESTER)

Sub. Code: ME-424T **New Code: BME-818E**	**Total Quality Management (Elective-III)**	**LTP (310)**

Course Objectives

CO 1: To introduce students about the fundamental principles and philosophies of the quality management.

CO 2: To develop students' ability to use various qualitative and quantitative tools and techniques for solving quality related problems.

CO 3: Applications of statistical techniques with emphasis to solve practical problems.

CO 4: Introducing students to quality management systems especially ISO series.

Unit 1: Evolution of Quality and Customer-Orientation, Evolution of quality paradigm, Historical evolution of quality management, Changing quality definitions and expectations, Customer-orientation and satisfaction, Role of customers in quality, Understanding customer needs and feedback in TQM, Quality philosophies, Major quality gurus: Deming, Juran, Crosby, etc. Principles of quality management in manufacturing and services.

Unit 2: Tools and Cycles for Continuous Improvement, TQM tools and improvement cycles, PDCA (Plan-Do-Check-Act) cycle for continuous improvement, Life cycle approach to quality, costs: Prevention, Appraisal, and Failure costs, Seven QC Tools and their applications, Pareto charts, Cause-and-effect diagrams, Histograms, Control charts, etc. Quality Function Deployment (QFD), translating customer requirements into product or service features.

Unit 3: Organizational and Team Dynamics in TQM, Organizational, Communicational, and Team requirements, Building a quality-focused organizational structure, Effective communication in quality management, Group dynamics and Quality circles, Role of teams in process management, High-performance and self-directed teams, Empowerment in TQM practices.

Unit 4: Advanced TQM Strategies and Models, ISO Standards and Six-Sigma, ISO 9000 and ISO 14000: relevance, misconceptions, and implementation, Six-Sigma philosophy and methodologies for quality improvement, Quality strategy and policy, Formulating and executing quality policies, Leadership theories and motivation in TQM, Benchmarking and Quality Awards, Self-assessment models and quality award frameworks, Role of benchmarking in TQM, Environmental and societal implications of quality practices.

Recommended Books:-

1. Juran, J. M. and Gryan, E., Quality Planning and Analysis, Tata McGraw-Hill, 2000.
2. Raja, K., Total Quality Management, Eswar Press, 2005.
3. Lal, H., Total Quality Management: A Practical Approach, New Age International, 2005.
4. Bhatt, K. Shridhar, Total Quality Management, Pearson Education, 2008.James R. Evans and William M. Lindsay, The Management and Control of Quality, Cengage Learning, 8th Edition, 2016.

5. Philip B. Crosby, Quality is Free: The Art of Making Quality Certain, McGraw-Hill, 1979.
6. S. K. Sharma, Total Quality Management, S. Chand & Company, 2008.
7. R. K. Gupta, Total Quality Management: A Practical Approach, Wiley, 2012.
8. S. M. J. Reza, ISO 9000:2000 Quality Systems Handbook, Butterworth-Heinemann, 2001.
9. David Hoyle, ISO 9000 Quality Systems Handbook: Using the Standards as a Framework for Business Improvement, Butterworth-Heinemann, 5th Edition, 2017.

B.TECH. THIRD YEAR (SEVENTH SEMESTER)

Sub. Code: ME-473T **New Code: BME-873E**	**Work Study** **(Pool Elective)**	**LTP (310)**

Course Outcomes (COs)
At the end of the course, the student will be able to:

CO 1: Student will be able to understand the basics about the productivity.
CO 2: Students will understand the concept of work study and application in industries.
CO 3: Apply the concept of motion economy principle.
CO 4: Apply the work measurement techniques.
CO 5: Student will be able to apply the industrial relation and industrial legislation.

Unit 1: Productivity: Factors affecting productivity, causes of low productivity, remedies to increase productivity; Work study and productivity.

Unit 2: Work Study: Definition, purpose & scope, value of work study, human aspects in work study, basic approach; Work study techniques and their comparison.

Unit 3: Method Study: Definition, purpose and scope, basic approach or procedure, recording techniques, outline process charts, flow process charts, theirconstruction and analysis flow diagrams, string diagram photographic aid, models; Critical examination techniques, primary and secondary questions, development, installation and maintenance methods.

Unit 4: Motion Economy Principle: Micro motion study, Therbligs, motion analysis, Simo charts, motion study.

Unit 5: Work Measurement definition, purpose & scope, basic procedure, work measurement techniques, introduction to stop watch time study, work sampling & predetermined motion calculation using rating.

Unit 6: Rating its techniques & scope, application of rating normal time, standard time calculation using rating.

Unit 7: Industrial Relation & Industrial legislation- Introduction, industrial disputes & their causes and their settlement, workers participation management and ways to improve; Industrial harmony, common industrial legislations, Indiaboilers act 1973, payment of wages act 1936, Industrial dispute act 1948, minimumwages act, 1948.

Text Book:-

1. Work study by ILO

B.TECH. THIRD YEAR (EIGHTH SEMESTER)

Material Imperfection and Their Application **LTP (310)**
(Open Electives)

Unit 1: Structure of Crystalline Solids: Fundamental concepts, Unit cell, crystallographic directions and planes, Crystal systems, Metallic crystal structures.

Unit 2: Imperfections in Solids: Introduction, Point defects: Vacancies and self- interstitials colour centers, impurities is solids, Linear defects dislocations, Interfacial defects, Bulk or volume defects.

Unit 3: Diffusion in Solid: Diffusion, diffusion Mechanisms: vacancy diffusion, interstitial diffusion, steady state diffusion: Fick's first law, non-steady state diffusion: Fick's second law, Factors that influence diffusion, Applications.

Unit 4: Amorphous Materials: Definition, types, structure, methods of preparation of amorphous materials, Applications: optical fibers, amorphous semi-conductor, optical memories, solar cells.

Unit 5: Plastic deformation & Strengthening Mechanisms: Plastic deformation, the tensile stress-strain curve, modes of plastic deformation-slip and twinning, the shearstrength of perfect and real crystals, the stress to move a dislocation, mechanisms of strengthening in metals by grain size reduction, solid solution strengthening, strain hardening.

Unit 6: Lasers: Principle, population inversion, Einstein's and B coefficients, types: Rubylaser, he-Ne laser, semiconductor lasers.

Text Book:-

1. Non Crystalline materials by Davis & Mott
2. Amorphous Solids by S.R. Elliot
3. Solid State Physics by M.A. Wahab

B.TECH. THIRD YEAR (EIGHTH SEMESTER)

Polymeric Materials and Their Applications **LTP (310)**
(Open Elective)

Unit 1: Basic Polymer Chemistry: Definition, Classification, Types of polymerization.

Unit 2: Resins and Plastics: Thermoplastic and thermosetting resins, constituents ofplastics, fabrication of plastic materials, Important resins, Cellulose derivatives, Polyethylene, Teflon, Polystyrene, Polyvinylacetate, PVC, Nylons, Phenolic resins Phenol-Formaldehyde, Urea and Malamine-Urea and melamine-Formaldehyde resins, Epoxy resins, Polyester, Silicones, Lon exchange resins.

Unit 3: Rubbers/Elastomers: Natural rubber compounding of rubber, Properties, uses, reclaimed rubber, Synthetic rubber, Buna-S, Nitrile rubbers, Fiber reinforced plastics (FRP).

Unit 4: Biopolymers: Importance and applications of few important biopolymerseg. Proteins, carbohydrates etc.

B.TECH. THIRD YEAR (EIGHTH SEMESTER)

Engineering Economics **LTP (310)**
(Open Elective)

Unit 1: Economics Micro and Macro: Definition, Importance and Uses, Interdependence between Micro and Macro Economics.

Unit 2: Concept in Economics: Law of Demand, Law of Diminishing Marginal Utility, Law of Equimarginal Utility, elasticity of Demand, Indifference Curve Analysis-Price effect. Income effect and substitution effect.

Unit 3: Theory of Production: Production Function, Laws of Variable proportions,Laws of Returns of to Scale, Cost Function-Meaning of Fixed Cost and Variable Cost, Location of Firms, Weber`s theory of Location of the firms.

Unit 4: Theory of the Firm: Perfect Competition, Monopoly and monopolistic Competition: Meaning, Assumptions, Equilibrium of the firm in Short run and Long run period of time.

Unit 5: International Trade: Meaning, Nature and Scope of International Trade, Types and Effects of Tariffs and Quotas, Objective and Functions of International Monetary Fund (I.M.F.)

B.TECH. THIRD YEAR (EIGHTH SEMESTER)

Principle of Management **LTP (310)**
(Open Elective)

Unit 1: **Management as a discipline:** Definition, nature, scope, functions, managerial Skills, Management. Thought-Historical Prospective, Social Responsibility, of Business.

Unit 2: **Planning:** Concept and purpose, planning process, Management, By Objectives (MBO), Decision making.

Unit 3: **Organization:** Concept and purpose of organisation, types of organisation, bases of Depart mentation, concept of Authority and Responsibility, Span of Management, Line and Staff Authority, Functional Authority, Delegation of Authority, Centralization and Decentralization of Authority, CoordinationStaffing.

Unit 4: **Directing:** Leadership Concept, Ingredients, Traits, Styles, Roles Communication Concept. Types, Process Barriers, Making Communication effective, Importance.

Unit 5: **Controlling:** Concept, Provides, Requirements, for adequate control, controlling and earning, Budgeting control Importance, Management Audit, Management in future.

B.TECH. THIRD YEAR (EIGHTH SEMESTER)

Operation Research **LTP (310)**
(Open Elective)

Unit 1: Introduction: Definition of O.R. and it's scope, modeling in O.R. General methods for solving O.R. models. The Monte-carlo technique, main characteristic of O.R. main phases of O.R. Linear programming problems. Graphical method for solve L.P.P., Two phase Method, Big-M Method, problems of tie.

Unit 2: Assignment Model: Mathematical formulation of assignment model, Reduction theorem, problems of maximization & minimization. Hungarian process, travelling salesman problems.

Unit 3: Transportation Model: Mathematical formulation of transportation problem. Definition of BFS, IBFS, Optimum solution. Algorithms of N-W rule, Least-cost & VAM and their problem.

Unit 4: Sequencing: Introduction, principle assumptions processing of jobs through two, three & m machine's.

Unit 5: Game Theory: Characteristic of Games. Basic definitions, mini-max criterion and optimal strategy. Equivalence of rectangular Games, Dominance process, Arithmetic method for solving zero-sum-two person Games. Graphical and simplex methods for solving the games.

Unit 6: Replacement: Replacement of item that fail completely.

Unit 7: Inventory: Elementary Inventory Models, Inventory models with pricebreaks.

List of Pool Elective:

1. EI-402 PCB Design & Technology
2. EI-456 Aircraft Instrumentation
3. EC-458 Digital Image Processing
4. EC-460 Microwave Integrated circuit

B.TECH. THIRD YEAR (EIGHTH SEMESTER)

Futuristic Materials **LTP (310)**
(Open Elective)

Unit 1: Semiconductors: Introduction of semiconductors. intrinsic and extrinsic, II-VI and IIIV semiconductors and its alloys, Advantages and necessity of the tailoring of semiconductor, Semiconductors and it alloys used of LED and other devices, Utility of semiconducting alloys like GaAIAs, GaAIN, GaAIP etc.

Unit 2: Superconductors: Fundamental Phenomena associated with superconductors. Type I & II superconductors, Meissner Ochenfeld effects, Josephon effects, fundamental ofBCS theory. Novel High Temperature Superconductors. Hole superconductors, TIBa CaCuO single and bilayer. Electron superconductors NdCuO etc. Doping effects in superconductors, Organic superconductors, fullerenes. Application of the superconductors in science, medical and commercial sectors.

Unit 3: Material for Magnetic media: Material useful for magnetic recording head, magnetic disk, magnetic tape media, Magneto optic recording materials. Holography, data storage materials.

Unit 4: Holography: Fundamentals of holography, Difference between conventional photography and holography. Techniques to make a hologram. Advantages of holography over other techniques.

Unit 5: Introduction of following with applications: Fiber optics, Lasers, Ceramics, Dielectric Chactrization of Materials.

Text Book:-

1. Superconductivity Today: T.V. Ramakrishnan & C.N.R. RaoWiley astern Pvt. Ltd, New Delhi, 1992
2. Solid State Physics: Ashcrost/Mervin

B.TECH. THIRD YEAR (EIGHTH SEMESTER)

Quantitative Methods in Economics **LTP (310)**
(Open Elective)

Unit 1: Statistics: Definition, Importance, Scope and Limitations of statistics, primary and secondary data. Classification of Meaning objectives and types of classification. Frequency Distribution-Discrete, Grouped and continuous frequency distributions. Fundamentals of frequency distribution.

Unit 2: Measures of Central Tendencies: arithmetic mean, Median, Mode, Geometric Mean and Harmonic Mean, Demerits and Uses of all methods.

Unit 3: Measures of Dispersion: Mean deviation Method about Mean, Median and Mode, Merits and Demerits of Mean Deviation. Coefficient of M.D. Standard Deviation (S.D.) Method with simple short-cut andstep deviation methods. Merits and Demerits of S.D. Coefficient of S.D.

Unit 4: Correlation: Introduction, Types of Correlation, Karl Pearson's Coefficient of Correlation. Interpretation of 'r'. Probable Error, Uses of ProbableError.

Unit 5: Linear Regression Analysis: Introduction, Two method of Linear Regression Analysis:- (1) Line of Regression of Y on X and (2) Lineof Regression and X on Y. Why two lines of regression Coefficient of Regression. Relation between the coefficient of correlation and Regression.

Unit 6: Index Number: Definition, Uses and Types of Index Numbers, Methods of Construction Index Numbers-(1) Simple Aggregate Method (2) Weighted Aggregate Method (3) Fisher's Ideal Index Numbers (4) const of living Index Numbers (5) Chain Base Index Numbers. BaseShifting. Limitations of Index Numbers.

B.TECH. THIRD YEAR (EIGHTH SEMESTER)

Foreign Trade **LTP (310)**
(Open Elective)

Unit 1: Nature of foreign Trade: Meaning, Nature, Scope and Distinct Features of International Transactions.

Unit 2: Theories of International Trade: The Classical Theory: Absolute Advantage Model of Adam Smith, comparative Advantage Model of David Ricardo, the Neo-classical Analysis: International trade Equilibrium under Constant cost, Increasing Cost and Decreasing cost conditions.

Unit 3: Tariffs and Quota:types and Effect of tariffs and Quotas, Quota vs. Tariff.

Unit 4: International Monetary fund (I.M.F.): Nature, Objectives and functions of I.M.F. International Monetary System, since thedemise of Bretton Woods System.

Unit 5: International Financial Institutions: World Bank (IBRD, International Financial Corporation (I.F.C.), International Development Association (I.D.A.).

Unit 6: India's Trade Policy: Trends of Exports and Imports of India sinceindependence, Composition o India's Foreign Trade.