B. Tech. (ME): Syllabus Revision in 2017-18.

S.No	Course Code	Session 2016-17	Session 2017-18	Remark Syllabus Change/ new course
1	**BT 101**	**Engineering Physics-I** UNIT-I Atomic Structure and Solid State: Atomic energy levels and electronic configuration, Intermolecular forces and binding, phases of matter, crystal structure simple cubic , body centered cubic and face centered cubic structures, energy bands in solids , band structure of metals, semiconductors and insulators. UNIT-II Semiconductor Physics: Extrinsic and intrinsic semiconductors, Fermi levels of undoped and doped semiconductors, p-n junction, depletion region, forward and reverse biased p-n junction, volt-Ampere characteristics of a diode , effect of temperature on diode characteristics, Zener diode , tunnel diode, photodiode and LEDs , their structure and characteristics. UNIT-III Theory of Relativity : Absolute and relative frames of reference, Galilean transformations, importance of Michelson-Morley experiment, postulates of special theory of relativity, Lorentz transformations, time dilation and length contraction, velocity addition , mass-energy relationship, elementary ideas about general theory of relativity. UNIT-IV Elementary Quantum Mechanics: Wave particle duality, deBroglie waves, experimental evidence of wave nature of matter, Schrodinger wave equation in One dimension, eigen values and eigen	**ENGINEERING MATHEMATICS-I** Unit-I Differential Calculus: Asymptotes (Cartesian coordinates only), concavity, convexity and point of inflection, Curve tracing (Cartesian and standard Polar curves- Cardioids, Lemniscates of Bernoulli, Limacon, Equiangular Spiral only). Unit-II Limit, continuity and differentiability of functions of two variables, Partial differentiation, Euler's theorem on homogeneous functions, change of variables, chain rule. Unit-III Taylor's theorem (two variables), approximate calculations, Jacobian, maxima & minima of two and more independent variables, Lagrange's method of multipliers. Unit-IV Integral Calculus: Double integral, change of order of integration, Double integral by changing into Polar form, Applications of Double integrals for evaluating areas & volumes, triple integral; Beta function and Gamma function (simple properties). Unit-V Vector Calculus: Scalar and vector field, differentiation & integration of vector functions: Gradient, Directional derivative, Tangent planes and Normals. Divergence, Curl and Differential Operator; Line, Surface and Volume integrals; Green's theorem in a plane, Gauss's and Stoke's theorem (without proof) and their applications.	**Syllabus change** **Title Change** **Code Change**

		functions, physical interpretation of wave function, Heisenberg uncertainty principle, tunneling phenomenon. UNIT-V Oscillation & Waves : Simple harmonic oscillator with example, energy of oscillator, Damping oscillator, viscous & solid friction damping, Qualityfactor, Resonance standing waves, elastic waves.		
2	**BT102**	**INTRODUCTION TO COMPUTER FUNDAMENTAL AND IT** **UNIT-I** **Computer System**: Basics of computer systems, history, types and Generation of computer, capability and limitations of computer systems. Hardware organization: Anatomy of a digital computer, CPU.Internal architecture of CPU.Memory Units: Memory Hierarchy, Primary Memory, Secondary Memory, cache memory. Storage Devices, Input and Output Devices. **UNIT-II** **Operating Systems**: DOS Internal, External commands, Windows (2000 and NT) , Overview of architecture of Windows, tools and system utilities including registry , partitioning of hard disk , Overview of Linux architecture , File system , file and permissions , concept of user and group , installation of rpm and deb based packages. **UNIT-III** **Number system & Conversions:** decimal, binary, octal and hexadecimal	**COMMUNICATION SKILLS** Unit-I Communication: Meaning, Importance and Cycle of Communication, Media and Types of Communication, Formal and Informal Channels of Communication, Barriers to Communication, Division of Human Communication and Methods to Improve Interpersonal Communication, Qualities of Good Communication. Unit-II Grammar: Passive Voice, Indirect Speech, Conditional Sentences, Modal Verbs, Linking Words. Unit-III Composition: Curriculum Vitae Writing, Business Letter Writing, Job Application Writing, Paragraph Writing, Report Writing. Unit-IV Short Stories: 'The Luncheon' by Somerset Maugham, 'How much Land does a Man Need?' by Leo Tolstoy, 'The Night Train at Deoli' by Ruskin Bond. Unit-V Poems: 'No Men are Foreign' by James Kirkup, 'If' by Rudyard Kipling, 'Where the Mind is without Fear' by Rabindranath Tagore.	**Syllabus change** **Title change** **Code change**

		number systems and their inter conversions, 1's and 2's complement representation, negative numbers and their representation, BCD, EBCDIC , ASCII and Unicode. Binary Arithmetic operations: addition, subtraction, multiplication, division. **UNIT-IV** **Networking Basics** - Uses of a Network and Common types of Networks, Network topologies and protocols, Network media and hardware, Overview of Database Management System. **UNIT-IV** **Data Processing:** Introduction to MS office, MS-Power Point and MS-Excel, Introduction to Electronic Spreadsheets, Applications of Electronic Spreadsheets, Types of Spreadsheets, Features of MS-Excel, Starting MS-Excel, Contents of the MS-Excel window, Cell Referencing, Ranges and Functions, Formatting Worksheets and Creating Charts, Data Forms and Printing *Introduction to MS-PowerPoint :* Introduction to MS-PowerPoint, What is a Presentations?, Slides, Working with Slides, Slides Show and Printing Presentation		
3	**BT103**	**Applied Mathematics I** **UNIT-I** Functions of variables: Geometric representation, limit, continuity and	**ENGINEERING PHYSICS** Unit-I Interference of light: Michelson's Interferometer: Production of circular & straight line fringes; Determination of wavelength of light; Determination of wavelength	**Syllabus change** **Code change**

		differentiability of functions of several variables , partial and full derivatives, derivatives of composite functions, Euler's theorem on homogeneous functions, harmonic functions, directional derivatives, Taylor's formula, maxima and minima of functions, Lagrange's multipliers. **UNIT-II** Asymptotes and curvature: Rolle's Theorem, Cauchy's mean value theorem, Taylor and Maclaurin theorems, concavity and convexity of a curve, points of inflexion, asymptotes and curvature. **UNIT-III** Analytical functions: Limit, continuity and differentiability of analytic functions, Cauchy-Reimann equations, complex functions, line integrals, Cauchy's integral theorem, Cauchy's integral formula, power series, zeroes and singularity, residue theorem. **UNIT-IV** Integral calculus: Definite integral as limit of sum, properties of definite integrals, mean value theorem, fundamental theorem, evaluation of definite integrals, reduction formula. **UNIT-V** Differential equations: Order and degree of a differential equation, general and particular solutions, solution of differential equations by separation of variables method, integrating factor method, homogeneous differential equations of first order and their	separation of two nearby wavelengths. Optical technology: Elementary idea of anti-reflection coating and interference filters. Unit-II Diffraction and Polarization of light: Fraunhofer Diffraction at Single Slit. Diffraction grating: Construction, theory and spectrum; Determination of wavelength of light. Resolving power: Raleigh criterion; Resolving power of diffraction grating and telescope. Plane, circularly and elliptically polarized light on the basis of electric (light) vector: Malus law; Double Refraction; Phase retardation plates and their use in production and detection of circularly and elliptically polarized light; Optical activity and laws of optical rotation; specific rotation and its measurement using half-shade device. Unit-III Elements of Material Science: Bonding in solids; covalent bonding and Metallic bonding; Classification of solids as Insulators, Semiconductors and Conductors; X-Ray diffraction and Bragg's Law. Hall Effect: Theory, Hall Coefficient and applications. Unit-IV Quantum Mechanics: Compton effect & quantum nature of light; Derivation of time dependent and time independent Schrodinger's Wave Equation; Physical interpretation of wave function and its properties; boundary conditions; Particle in one dimensional box. Unit-V Coherence and Optical Fibers: Spatial and temporal coherence; Coherence length; Coherence time and 'Q' factor for light; Visibility as a measure of Coherence and spectral purity; Optical fiber as optical wave guide; Numerical aperture; Maximum angle of acceptance and applications of optical fiber. Laser and Holography: Theory of laser action; Einstein's coefficients; Components of laser; Threshold conditions for laser action; Theory,	

		solutions, solution of linear differential equation $dy/dx+f(x)y=Q(x)$ and their application in electrical, nuclear and mechanical systems.	Design and applications of He-Ne and semiconductor lasers; Holography versus photography, Basic theory of holography; basic requirement of a Holographic laboratory; Applications of Holography in microscopy and interferometry.	
4	**BT104**	**Introduction to Electrical and Electronic Engineering** **UNIT-I** **Basic Electrical Quantities:** Electromotive force, Electric Power ,Charge, current, voltage, Energy,Electric potential and field, magnetic flux,resistance, capacitance and inductance. Ohm's law, Voltage and current sources. **UNIT-II** **Network analysis:** Circuit principles, Kirchoff's Laws, Node Voltage and Mesh Current Analysis;Delta-Star and Star-Delta Transformation, Source Conversion. Classification of Network Elements, Superposition Theorem, Thevenin's Theorem.Norton Theorem.,MaximumPower Transfer Theorems. **UNIT-III** **AC circuits**: Alternating Quanitities,Introduction, Generation of AC Voltages, Root Mean Square and Average Value of Alternating Currents and Voltages, Form Factor and Peak Factor, Phasor Representation of Alternating Quantities, Single Phase RLC Circuits, Introduction to 3-Phase AC System.Power in a circuit, reactive power, power factor, impedance in ac circuit, series and parallel resonance, Q factor, Introduction to 3-Phase AC System.	**COMPUTER PROGRAMMING-I** **Unit-I** **Computer Fundamentals:** Flow chart, pseudocode. binary, octal and hexadecimal number system. ASCII, EBCDIC and UNICODE. boolean operations, **Unit-II** primary and secondary memory. Difference among low-level & high-level languages. **Unit-III** **C Programming:** Structure of a 'C' program, Data types, enumerated, assignment statements, input output statements, **Unit-IV** If statement, for loops, while loops, do-while loops, switch statement, break statement, continue statement. Datatype conversion. **Unit-V** Functions & program structure (function call and return), scope of variables, parameter passing methods, recursion v/s iteration.	**Syllabus change** **Title change** **Code change**

		UNIT-IV **Transformers:** Faraday's Law of Electromagnetic Induction Basic principle of operation of transformer, construction, working, voltage and current relations, Phasor Diagram of Ideal Transformer.open circuit and short circuit test, transformer losses and efficiency, ferrite core transformers. **Electrical DC Machine:** Principle of DC Machines, Types, Different Parts ofDC Machines **UNIT-V** **Power Supplies:** Half wave, full wave and bridge rectifiers, ripple factor and reduction by use of inductor,capacitor, L and pie section filters, voltage regulation using Zener diode.		
5	**BT105**	**English and Communication Skills** **UNIT –I** Grammar and Vocabulary: Basic sentence pattern, use of tense, modals, active and passive voice, Direct and Indirect Speech, One word substitution, Synonyms and Antonyms and Common Erros in English. **UNIT-II** Phonetics: IPA symbols, Correct pronunciation of commonly used words, sounds (vowel and consonants) **UNIT-III** Literature : Poetry : where the mind is without fear – Rabindra Nath Tagore, Mending wall – Robert Frost, Night of Scorpion – Nissim Ezekiel Essays: of studies: Francis Bascon, what is science? George Orwell. **UNIT-IV**	**ENVIRONMENTAL ENGINEERING AND DISASTER MANAGEMENT** Unit-I Basics of Environment: Environmental Pollution, Environmental Acts and Regulations, Ecosystem, Hydrological and chemical cycles, Energy flow in ecosystems. Biodiversity, population dynamics. Unit-II Water Pollution: Water pollutants, effects of oxygen demand, water quality in lakes, reservoirs and groundwater, contaminant transport, self cleaning capacity of streams and water bodies, water quality standards, Waste water management, Treatment & disposal of wastewater. Rain water harvesting: Reuse and saving in use of water, methods of rain water harvesting. Unit-III Solid Waste Management: Classification of solid waste, Collection, transportation, treatment,	**New Course**

		Writing skills : Paragraph writing, Letter writing, covering letter and C.V., Writing E-mails. **UNIT-V** Fundamentals of Communication: (A) Communication: definition and meaning of communication, functions of communication, process of communication. (B) Types of communication: Verbal and Non verbal communication, Formal and informal communication. (C) Barriers to communication, qualities of good communication, the art of listening.	and disposal of solid waste. Economic recovery of solid waste. Sanitary landfill, on site sanitation. Energy interaction from solid waste. Unit-IV Air and Noise Pollution: Primary and Secondary air pollutants, Air Pollution, Harmful effects of Air Pollution, Control of Air Pollution. Noise Pollution, Harmful effects of noise pollution, control of noise pollution, Global warming, Acid rain, Ozone depletion, Green House effect Unit-V Natural Disasters: Hydro-meteorological Based Disasters like Flood, Flash Flood, Cloud Burst, Drought, Cyclone, Forest Fires; Geological Based Disasters like Earthquake, Tsunami, Landslides, Volcanic Eruptions. Man made Disasters: Chemical Industrial Hazards, Major Power Break Downs, Traffic Accidents, Fire Hazards, Nuclear Accidents. Disaster profile of Indian continent. Study of recent major disasters. Disaster Management Cycle and its components. Disaster Management: Understanding Disasters and Hazards and related issues social and environmental. Risk and Vulnerability. Types of Disasters, their occurrence/ causes, technical terminology involved, impact and preventive measures.	
6	**BT106**	**Engineering Chemistry** **UNIT -I** **Water:** The sources of water, common Impurities, soft and hard water, Hardness of water, degrees of hardness and its effects, determination of hardness by various techniques, Municipal Water supply, requisites of drinking water, purification of water by sedimentation, filtration, reverse osmosis (RO), sterilization, chlorination. Water for boilers, corrosion, sludge and scale formation, caustic embitterment,		**Syllabus change** **Code change**

		treatment by preheating, lime-soda process, permutit de-ionizer or demineralization. **UNIT- II** **Electrochemistry:** Redox reactions; conductance in electrolytic solutions, specific and molar conductivity variations of conductivity with concentration, Kohlrausch's Law, electrolysis and laws of electrolysis (elementary idea), dry cell – electrolytic cells and Galvanic cells; lead accumulator, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells. Relation between Gibbs energy change and EMF of a cell, fuel cells; corrosion. **Analysis:** Volumetric Analysis, Types of titrations, Theory of indicators. **Spectral Analysis:** Electromagnetic radiation, Lambert-Beer's Law, UV-VIS, IR, NMR instrumentation & applications. **Thermal Methods of Analysis:** principle, working and applications of Thermogravimetry, Differential thermal analysis and Differential scanning calorimetry. **UNIT- III** **Fuels:** The need of fuel, origin and classification of fuels, Solid fuels, coal and its constituents, calorific value and its determination, coke: carbonization process, various types of coke ovens. **Liquid Fuels:** advantages, petroleum and its refining, synthetic petrol, reforming of gasoline, knocking, octane number and anti knocking agents, cracking. Gaseous Fuels advantages, composition and calorific value of coal gas and oil gas and its determination. **Lubricants:** Need of Classification, types		

		of lubricants, their properties and uses, lubricants, viscosity and viscosity index and flash points, cloud and pour point, emulsification **UNIT- IV** **Phase Rule:** Statement, definition of terms involved, application to one component system (water-sulphur system), two component systems (Ag-Pbsystems). **Polymers:** Plastics, preparation, properties and uses of polyethylene, bakelite, terylene and nylon, Rubber; natural rubber, synthetic rubber such as butyl and neoprene rubbers, vulcanization process and its advantages. **Corrosion:** its significance, theories of corrosion, Galvanic cell and concentration cell, pitting and stress corrosion, protection techniques. **UNIT-V** **Explosives:** Introduction, classification of explosives, preparation of commercially important explosives, blasting fuses, uses and abuses of explosives. **Cement:** properties, Portland cement and its manufacture, chemistry of setting and hardening of cement, RCC structures. **Refractories:** definition, classification, properties of silica and fireclay refractories, **Glass:** preparation, properties and uses.		
7	**BT107**	**Electrical and Electronics Lab-I** **List of Experiments** 1. Identification, Study & Testing of various electronic components: (a) Resistances-Various types, Colour coding (b) Capacitors-	**COMMUNICATION SKILLS LAB** 1. Phonetic Symbols and Transcriptions 2. Extempore 3. Group Discussion 4. Dialogue Writing 5. Listening Comprehension 6. Word Formation 7. Synonyms and Antonyms	**Syllabus change** **Title change** **Code change**

		Various types, Coding, (c) Inductors (d) Diodes (e) Transistors (f) SCRs (g) ICs (h) Photo diode (i) Photo transistor (j) LED (k) LDR (l) Potentiometers. 2. Study of symbols for various Electrical & Electronic Components, Devices, Circuit functions etc. 3. Study of Analog & digital multi-meters. 4. Study of Function/ Signal generators. 5. Study of Regulated d. c. power supplies (constant voltage and constant current operations). 6. Study of analog CRO, measurement of time period, amplitude and frequency. 7. Perform half wave rectifier experiment and effect of filters on output. 8. Perform bridge rectifier experiment and measure the effect of filter output. 9. Application of diode as clipper and clamper. 10. Soldering & desoldering practice.	8. Affixes (Note: Wherever appropriate, Language Lab Software is to be used to improve listening comprehension and speaking skills.)	
8	**BT108**	**Engineering Physics Lab-I** **List of Experiments** 1. To study the charging of a condenser to plot a graph of voltage (V) across it against time (T) and to determine the time constant from this graph 2. To study the discharging of a condenser to plot a graph of voltage (V) across it against time (T) and to determine the time constant from this graph.	**ENGINEERING PHYSICS LAB** 1. To determine the wave length of monochromatic light with the help of Michelson's interferometer. 2. To determine the wave length of sodium light by Newton's Ring. 3. To determine the specific rotation of glucose (sugar) solution using polarimeter. 4. To determine the wave length of prominent lines of mercury by plane diffraction grating with the help of spectrometer.	**Syllabus change**

		3. To determine the specific resistance of a material and difference between two small resistances using "Carey Foster's Bridge ". 4. To determine band gap of a semiconductor- diode. 5. To study the Zener diode as a constant voltage regular. 6. To verify Malus Law (Cosine square law) for plane polarized light with the help of a Photo voltaic cell. 7. To determine the transmission coefficient by using Lummer Brodhum Photometer. 8. To determine minimum deviation angle for different light using prism and spectrometer. 9. To determine the profile of He - Ne Laser beam. 10. To study the variation of thermo e.m.f. of iron copper thermo couple with temperature. 11. To determine the wavelength of sodium light using Michelson Interferometer. 12. To determine the curie temperature of Monel metal 13. The determination of viscosity.	5. To study the variation of a semiconductor resistance with temperature and hence determine the band gap of the semi conductor in the form of reverse baised P-N junction diode. 6. To determine the height of water tank with the help of sextant. 7. To determine the dispersive power of material of a prim for violet and yellow colour's of mercury light with the help of spectrometer. 8. To study the charge and discharge of a condenser and hence determine the same constant (both current and voltage graphs are to be plotted. 9. To verify the expression for the resolving power of a Telescope. 10. To determine the coherence length and coherence time of laser using He – Ne laser. 11. To determine the specific resistance of the material of a wire by Carey Froster's bridge.	
98.	**BT109**	**IT FUNDAMENTAL LAB** **LIST OF EXPERIMENTS** 1. Dismantling a PC Part -1. 2. Dismantling a PC Part -2. 3. Internal and External commands of DOS. 4. System utilities of windows.	**COMPUTER PROGRAMMING LAB** The programs shall be developed in C language related with the following concepts: 1. Eight programs using input output statements, if statement, for loops, while loops, do-while loops, switch statement, break statement, continue statement, datatype conversion etc. 2. Check a number- palindrome, prime, etc.	**Syllabus change** **Code change**

		5. Understanding and Working knowledge of Linux/Unix OS. 6. Understanding of File system of Linux. 7. Creating user and group. 8. Understanding and Working knowledge of MS Office, Power Point and Excel: Editing and Reviewing, Drawing, Tables, Graphs, Templates.	3. Eight programs using functions. 4. Two programs using recursion and Iteration.	
10	**BT110**	**Engineering Chemistry Lab** **List of Experiments** 1. To determine the strength of a given unknown copper sulphate solution (Iodometrically) with titrate Hypo (sodium thio sulphate) solution. 2. To determine the strength of a given unknown FAS solution with titrate potassium dichromate solution using N-phenyl anthranilic acid (internal indicator). 3. To determine the strength of a given unknown potassium dichromate solution (Iodometrically) with titrate Hypo (sodium thio sulphate) solution. 4. Determine the percentage of available chlorine in a given sample of bleaching powder. 5. Determine the amount of free chlorine in a given water sample. 6. To determine the viscosity and viscosity index of a given sample of lubricating oil using Redwood viscometer No.1	**COMPUTER AIDED ENGINEERING GRAPHICS** 1.Projections of Point & Lines: Positions of Point, Notation system, systematic Approach for projections of points, Front view & Top view of point, Positions of straight lines, line parallel to Both the RPs, Line perpendicular to either of the RPs, Line inclined to one RP and parallel to the other, Line Inclined to Both the RPs, Traces of a line (One drawing sheet, one assignment in sketch book) 2.Projections of planes: Positions of planes, Terms used in projections of planes, plane parallel to RP, plane inclined to one RP and perpendicular to the other RP, plane perpendicular to Both the RPs, plane Inclined to Both RPs, True shape of the plane, Distance of a point from plane, Angle between two planes (no drawing sheet required, only assignment in sketch book) 3.Projection of solids: Basic solids, Frustums and truncated solids, Positions of the solids, solid with Axis perpendicular to an RP, solid with axis inclined to one RP and parallel to the other solid with axis Inclined to Both the RPs Solid with Axis parallel to Both the RPs (One drawing sheet, one assignment in sketch book) 4.Section of solids: Theory of sectioning, section of prisms and cubes, sections of pyramids and	**Title change** **Code change**

		7. To determine the flash and fire point of a given sample of lubricating oil using Pensky Marten's apparatus. 8. Determine the cloud and pour point of a given sample of lubricating oil. 9. Determination of hardness of water by complexometric method (using EDTA). 10. Determine the pH of an acid (strength of an acid) pH – metrically. 11. Determine the strength of a given unknown HCl solution by titrating it against NaOH solution (Conductometric analysis). 12. To estimation the amount of sodium hydroxide and sodium carbonate in the given alkali mixture solution (or in water sample) by titrating against an intermediate hydrochloric acid using phenolphthalein and methyl orange indicator.	Tetrahedron section of Cylinders, Section of cones, Section of spheres (One drawing sheet, one assignment in sketch book) 5.Development of surfaces: Methods of development, parallel line developments, Radial line Development, Anti- Development (One drawing sheet, one assignment in sketch book) 6.Isometric Projection: Principle of Isometric Projection Isometric scale, Isometric projections and Isometric Views, Isometric Views of standard shapes, Isometric views of standard solids (One drawing sheet, one assignment in sketch book) 7.Computer Aided Drafting: Introduction to CAD, Advantages of CAD software's, Auto CAD, Auto CAD Commands and tool bars, Creating the Drawing, Charging properties, Dimensioning other object, Text editing, Isometric drawing (Four assignments on the computer)	
11	**BT111**	**(Engineering workshop)** **FITTING AND SHEET METAL SHOP** 1. Finishing of two sides of a square piece by filing and to cut a Square notch using hacksaw. 2. To drill three holes and Tapping on the given specimen. 3. Tin smithy for making mechanical joint and soldering of joint **WELDING SHOP**	**MECHANICAL WORKSHOP PRACTICE** 1.Carpentry Shop: 1. T – Lap joint 2. Bridle joint 2. Foundry Shop: 1. Mould of any pattern 2. Casting of any simple pattern 3.Welding Shop: 1. Lap joint by gas welding 2. Butt joint by arc welding 3. Lap joint by arc welding 4. Demonstration of brazing, soldering & gas cutting 4.Machine Shop Practice: 1. Demonstration of various machine tools such as Lathe, Shaper, Milling, Grinding and Drilling 5.Fitting Shop 1. Finishing of two sides of a square	**Title change**

		4. To prepare Lap Joint with the help of Arc welding 5. To prepare Butt Joint with the help of arc Welding 6. Gas welding practice by students on mild steel flat **MACHINE SHOP PRACTICE** 7. Job on lathe M/C with centering and one step turning 8. Job on lathe M/C with grooving and chamfering operations	piece by filing 2. Making mechanical joint and soldering of joint on sheet metal 3. To cut a square notch using hacksaw and to drill a hole and tapping 6.Sheet Metal Shop Making of Funnel using sheet metal	
12	**BT201**	**Engineering Physics II** **UNIT-I** **Electric and Magnetic Fields** :Coulomb's law, Gauss's law, electrostatic potential and field due to discrete and continuous charge distributions, dipole and quadrupole moments, dielectric polarization, electrostatic energy, conductors and capacitors, Biot-Savart law, Ampere's law, magnetic induction due to current carrying conductors, force on a charged particle in electric and magnetic field, Faraday's law of electromagnetic induction. **UNIT-II** **Thermodynamics**: Work-Thermodynamic definition of work, examples, displacement work, path dependence of displacement work, thermal equilibrium, Zeroth law , definition of temperature, heat/work interaction systems , First law and its consequences, isothermal and adiabatic processes, reversible, irreversible and	**ENGINEERING MATHEMATICS-II** Unit-I Linear Algebra: Rank of a matrix, Normal forms, consistency of systems of linear simultaneous equations and its solutions, Linear dependence and independence of vectors, Eigen values and Eigen vectors, Cayley-Hamilton theorem (without proof), orthogonal matrices, diagonalization ofmatrix. Unit-II Fourier Series: Orthogonal functions, periodic functions, Fourier series of periodic functions, Euler formula, change of intervals, Even and Odd functions, half range Fourier sine and cosine series; Harmonic analysis. Unit-III Differential Equations: Linear differential equations of first order, Reducible to linear form, Exact differential equations, reducible to exact form; Linear Differential Equations of Higher order with constant coefficients, Simultaneous linear differential equations.	**Syllabus change** **Title change** **Code change**

		quasi-static processes. Second law and entropy. Carnot engine and cycle. Absolute temperature scale. **UNIT-III** **Optical phenomena** : Principle of superposition, coherent and incoherent sources, temporal and spatial coherence, interference phenomena(Newton's ring and Michelson interferometer), diffraction of waves, diffraction from single and diffraction grating, polarization : types of polarization , Malus law, quarter and half wave plates, optical activity, specific rotation. **UNIT-IV** **Lasers and Holography** : Spontaneous and stimulated emission (Einstein A and B coefficients), population inversion, basic principles of operation of He-Ne, Ruby and semiconductor lasers. **Optical Fibers** : Types of optical fibers and their characteristics, characteristics of step, graded , mono mode and multi mode fibers, numerical aperture and its measurement, fiber optical communication. Principles and applications of holography **UNIT-V** **Magnetic Materials**: Magnetization-origin of magnetic moment, classification of magnetic materials- die, Para and ferromagnetism, hysteresis curve, soft and hard magnetic materials. Superconductivity: General properties of superconductors, Meissonier effect, penetration depth, type I and Type II superconductors, flux quantization, magnetic levitation, high temperature superconductors, superconducting materials, Cooper pairs and postulates of	Unit-IV Second order linear ODE with variables coefficients, Homogenous and exact forms, Change of dependent and independent variables; Variation of parameters, Method of Undetermined coefficients, Euler-Cauchy equations. Unit-V Partial Differential Equations: Order and Degree, Formation; Linear partial differential equations of first order: Lagrange's form, Standard forms, Charpit's method. Solutions of PDE of Second order using separation of variable method.	

		BCS theory.		
13	**BT202**	**INTRODUCTION TO COMPUTER PROGRAMMING** UNIT I Concept of algorithms, Flow Charts, Overview of the compiler (preferably GCC) , Assembler, linker and loader , Structure of a simple Hello World Program in C ,Overview of compilation and execution process in an IDE (preferably Code Block) UNIT II Programming using C: Preprocessor Directive, C primitive input output using get char and put char , simple I/O Function calls from library , data type in C including enumeration , arithmetic, relational and logical operations, conditional executing using if, else, switch and break .Concept of loops , for, while and do-while , Storage Classes: Auto, Register, Static and Extern UNIT III Arrays and Strings: Declaring an array, Initializing arrays, accessing the array elements, working with multidimensional arrays, declaring and initializing string variables, arithmetic operations on	**HUMAN VALUES** Unit-I Course Introduction - Need, Basic Guidelines, Content and Process for Value Education Understanding the need, basic guidelines, content and process for Value Education Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration Continuous Happiness and Prosperity- A look at basic Human Aspirations Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario Method to fulfill the above human aspirations: understanding and living in harmony at various levels Unit-II Understanding Harmony in the Human Being - Harmony in Myself Understanding human being as a co-existence of the sentient 'I' and the material 'Body' Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) Understanding the characteristics and activities of 'I' and harmony in 'I' Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail Programs to ensure Sanyam and Swasthya	**New course**

		characters. Pointers: Declaring and initializing pointers, pointer expressions, pointer increment and scale factor, pointers and arrays, pointers and strings. UNIT IV Functions: Defining functions, passing arguments to functions, returning values from functions, reference arguments, variables and storage classes, static functions, pointers and functions. Structures: Declaring and initializing a structure, accessing the members of a structure, nested structures, array of structures, using structures in functions, pointers and structures. UNIT V: File Handling in C Using File Pointers, fopen( ), fclose( ), Input and Output using file pointers, Character Input and Output with Files , String Input / Output Functions , Formatted Input / Output Functions, Block Input / Output Functions, Sequential Vs Random Access Files , Positioning the File Pointer.	Unit-III Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship Understanding harmony in the Family- the basic unit of human interaction Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship Understanding the meaning of Vishwas; Difference between intention and competence Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals Visualizing a universal harmonious order in society- Undivided Society (AkhandSamaj), Universal Order (Sarvabhaum Vyawastha)- from family to world family! Unit-IV Understanding Harmony in the Nature and Existence - Whole existence as Co- existence Understanding the harmony in the Nature Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation innature Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all- pervasive space Holistic perception of harmony at all levels of existence Implications of the above Holistic Understanding of Harmony on Professional Ethics Natural acceptance of human values Definitiveness of Ethical Human Conduct Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order Unit-V Competence in Professional	

			Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models Case studies of typical holistic technologies, management models and production systems Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers	
14	**BT203**	**ENGINEERING MECHANICS** **Unit I** Force System: Introduction, force, principle of transmissibility of force, resultant of a force system, resolution of a force, moment of force about a line. Varigon's theorem, couple, resolution of force into force and a couple, properties of couple and their application to engineering problems. Lami's theorem. Force body diagram. **Unit II** Centroid & Moment of Inertia: Location of centroid and center of gravity, Moment of inertia, Parallel axis and perpendicular axis theorem, Radius of gyration, M.I of composite section, Polar Moment of inertia, Lifting Machines: Mechanical advantage, Velocity Ratio, Efficiency of machine, Ideal machine, Ideal effort and ideal load, Reversibility of machine, Law of machine, Lifting machines; System of Pulleys, Wheel and differential axle, differential pulley Block,	**ENGINEERING CHEMISTRY** Unit-I Water: Common natural impurities, hardness, determination of hardness by complexometric (EDTA method), degree of hardness. Municipal water supply, requisite of drinking water, purification of water, sedimentation, filtration, sterilization, breakpoint chlorination. Water for steam making and boiler troubles, formation of solids (Scale and Sludge formation), carryover (Foaming and Priming), boiler corrosion and caustic embrittlement, Methods of boiler water treatment(water softening) preliminary treatments, preheating, Lime-Soda process, Zeolite (Permutit) process, Deionization (Demineralization) process. Numerical problems based on hardness, Lime-Soda and zeolite process. Unit-II Organic Fuels: Origin and classification of fuels. Solid fuels-, coal, classification of coal, significance of constituents, proximate and ultimate analyses of coal, gross and net calorific value, determination of calorific value of coal by Bomb Calorimeter. Metallurgical coke, carbonization processes- Beehive coke oven and Hoffmann Oven (by-products oven) method. Liquid fuels- Advantages of liquid fuels, petroleum and refining	**Syllabus change** **Code change**

		Unit III Friction: Types of Friction, Laws of friction, Angle of friction, Angle of repose, Ladder, Wedge, Belt Friction. Belt Drive: Types of belts, Types of belt drives, Velocity ratio, Effect of slip on Velocity ratio, Length of belt, Ratio of tensions and power transmission by flat belt drives. **Unit IV** Kinematics of Particles and Rigid Bodies: Velocity, Acceleration, Types of Motion, Equations of Motion, Rectangular components of velocity and acceleration, Angular velocity and Angular Acceleration, Radial and transverse velocities and accelerations, Projectiles motion on plane and Inclined Plane, Relative Motion. Newton's laws, Equation of motion in rectangular Coordinate, radial and transverse components, Equation of motion in plane for a rigid body, D'Alembert principle. **Unit V** Work, Energy and Power: Work of a force, weight, spring force and couple, Power, Efficiency, Energy, Kinetic energy of rigid body, Principle of work and energy, Conservative and Nonconservative Force, Conservation of energy. Impulse and Momentum: Linear and angular momentum, Linear and angular impulse, Principle of momentum for a particle and rigid body, Principle of linear impulse and	of petroleum, reforming, cracking, synthetic petrol, knocking, octane number, anti-knocking agents. Gaseous fuels-advantages, manufacture, composition and uses of coal gas and oil gas, determination of calorific value of gaseous fuels by Junker's calorimeter, flue gas analysis by Orsat's apparatus. Numerical problems based on determination of calorific value (bomb calorimeter/Junkers calorimeter/Dulongs formula, proximate analysis & ultimate and combustion of fuel. Unit-III Polymers: Classification, constituents, general properties of polymers and their uses. Preparation properties and uses of polyethylene, polyethylene terephthalate (PET), nylon 6, nylon 66, nylon 6, 10, Kevlar, Bakelite. Elastomers – natural rubber and vulcanization, synthetic rubbers viz. Buna-S, Buna –N, Butyl and Neoprene Rubbers. Conducting polymers-. Unit-IV Lubricants: Classification, types of lubrication, properties and uses. Viscosity and viscosity index, flash and fire point, cloud and pour point. Emulsification and steam emulsion number. Corrosion and its control: Definition and its significance. Mechanism of chemical (dry) and electrochemical (wet) corrosion, galvanic corrosion, concentration type corrosion and pitting corrosion. Protection from corrosion- protective coatings-galvanization and tinning, cathodic protection, sacrificial anode and modifications in design. Unit-V Inorganic Engineering Materials: Cement: Manufacture of Portland cement. Rotary kiln technology. Chemistry ofhardening and setting of cement. Role of gypsum. Refractories: Definition properties and classification. Silica and fire clay refractories. Glass: Definition, type and properties of glasses. Manufacture of glass, annealing of	

		momentum for a Particle and rigid body, Principle of angular momentum and Impulse, Conservation of angular	glass. Optical fibre grade glass.	
15	**BT204**	**Digital Electronics** **UNIT I** **BASIC LOGIC GATES & BOOLEAN ALGEBRA:** Features of logic algebra, postulates of Boolean algebra. Theorems of Boolean algebra. Boolean function. Derived logic gates: Exclusive-OR, NAND, NOR gates, their block diagrams and truth tables. Logic diagrams from Boolean expressions and vice-versa. Converting logic diagrams to universal logic. Positive, negative and mixed logic. Logic gate conversion. **UNIT II** **DIGITAL LOGIC GATE CHARACTERISTICS:** TTL logic gate characteristics. Theory & operation of TTL NAND gate circuitry. Open collector TTL. Three state output logic. TTL subfamilies. MOS & CMOS logic families. Realization of logic gates in RTL, DTL, ECL, C-MOS & MOSFET. Interfacing logic families to one another. **UNIT III** **MINIMIZATION TECHNIQUES:** Minterm, Maxterm, Karnaugh Map, K map upto 4 variables. Simplification of logic functions with K-map, conversion of truth tables in POS and SOP form. Incomplete specified functions. Variable mapping. Quinn-Mc Klusky minimization techniques. **UNIT IV** **COMBINATIONAL SYSTEMS:** Combinational logic circuit design, half and full adder, subtractor. Binary serial	**COMPUTER PROGRAMMING-II** Unit-I Computer System Fundamentals: System software, firmware, freeware/open-source, loader, compiler, peripherals. Unit-II Computer Programming: one-dimensional arrays, multi-dimensional arrays, character arrays and strings, Unit-III Pointers ,Pointers arithmetic, Dynamic memory allocation: functions like malloc, calloc, free. Unit-IV Preprocessor, command line arguments, difference between macro and inline function. Structure & Union, typedef. Unit-V File operations and multi-file handling, sscanf()/sprintf(). Graphics using C.	**Syllabus change** **Code change**

		and parallel adders. BCD adder. Binary multiplier. Decoder: Binary to Gray decoder, BCD to decimal, BCD to 7-segment decoder. Multiplexer, demultiplexer, encoder. Octal to binary, BCD to excess-3 encoder. Diode switching matrix. Design of logic circuits by multiplexers, encoders, decoders and demultiplexers. **UNIT V** **SEQUENTIAL SYSTEMS:** Latches, flip-flops, R-S, D, J-K, Master Slave flip flops. Conversions of flip-flops. Counters : Asynchronous (ripple), synchronous and synchronous decade counter, Modulus counter, skipping state counter, counter design. Ring counter. Counter applications, Registers: buffer register, shift register.		
16	**BT 205**	**Applied Mathematics II** **UNIT I** Vector spaces, linear dependence of vectors, basis and linear transformations, scalar and vector fields, level surfaces, directional derivatives, gradient, divergence and curl of fields, Green, Gauss and Stokes theorems. **UNIT II** Matrix algebra, rank of a matrix, adjoint and inverse of a matrix, Solution of algebraic equations using matrix algebra , consistency conditions, eigenvalues and eigenvectors , Hermitian matrices. **UNIT III** Numerical solution of matrix equations using Gauss, Gauss-Seidel, LU decomposition and other iterative methods. **UNIT IV** Convergence of improper integrals, tests	**BT 205.A BASIC ELECTRICAL AND ELECTRONICS ENGINEERING** Unit-I Basic Concepts of Electrical Engineering: Electric Current, Electromotive force, Electric Power, Ohm's Law, Basic Circuit Components, Faraday's Law of Electromagnetic Induction, Lenz's Law, Kirchhoff's laws, Network Sources, Resistive Networks, Series-Parallel Circuits, Node Voltage Method, Mesh Current Method, Superposition, Thevenin's, Norton's and Maximum Power Transfer Theorems. Unit-II Transformers: Construction, EMF equation, ratings, phasor diagram on no load and full load, equivalent circuit, regulation and efficiency calculations, open and short circuit tests, auto-transformers Unit-III Alternating Quantities: Introduction, Generation of AC Voltages, Root	**Syllabus change** **Title change** **Code change**

		of convergence, elementary properties of beta and gamma functions, differentiation under integral sign, Leibnitz rule, integrals dependent on a parameter, trapezoidal and Simpson's integration rules, applications in engineering. **UNIT V** Numerical methods; round off and truncation errors, approximations, order of convergence, Newton's forward and backward interpolation formula, central difference interpolation, solutions of polynomial equations using bisection, Newton-Raphson and Regula-falsi methods.	Mean Square and Average Value of Alternating Currents and Voltages, Form Factor and Peak Factor, Phasor Representation of Alternating Quantities, Single Phase RLC Circuits, Introduction to 3- Phase AC System. Unit-IV Rotating Electrical Machines; DC Machines: Principle of Operation of DC Machine as Motor and Generator, EMF Equation, Applications of DC Machines. AC Machines: Principle of Operation of 3-Phase Induction Motor, 3-Phase Synchronous Motor and 3- Phase Synchronous Generator (Alternator), Applications of AC Machines. Unit-V Basic Electronics: Conduction in Semiconductors, Conduction Properties of Semiconductor Diodes, Behaviour of the PN Junction, PN Junction Diode, Zener Diode, Photovoltaic Cell, Rectifiers, Bipolar Junction Transistor, Field Effect Transistor, Transistor as an Amplifier. Digital Electronics: Boolean algebra, Binary System, Logic Gates and Their Truth Tables. Electrical Measuring Instruments: DC PMMC instruments, shunt and multipliers, multimeters, Moving iron ammeters and voltmeters, dynamometer, wattmeter, AC watthour meter, extension of instrument ranges.	
17			**BT-205.B BASIC CIVIL ENGINEERING** Unit-I Introduction: Specialization of Civil Engineering, scope of Civil Engineering, Role of civil Engineer in Society, Impact of infrastructural development on economy of country. Surveying: Object & principles of Surveying, Unit-II Linear measurements: Direct measurements- Tape & Chain, Ranging out survey lines, taking measurements of sloping ground. Tape correction, conventional symbols. Introduction to Compass	**New course**

			Surveying & Leveling. Introduction to totalstation. Unit-III Building & Building materials: Construction materials: Stone, Brick, Cement, Mortar, Concrete, Steel – their properties & uses. Unit-IV Selection of site for Buildings, types of buildings, plinth area, carpet area, floor space index, Introduction to building byelaws, concept of sun light and ventilation. Components of Buildings & their functions, Basic concept of R.C.C., Introduction to types of foundation. Unit-V Transportation, Traffic and Road Safety: Types and characteristics of various modes of transportation, various road traffic signs, causes of accidents and road safety measures.	
18			**BT-205.C BASIC MECHANICAL ENGINEERING** Unit-I Fundamentals: Introduction to mechanical engineering, concepts of thermal engineering, mechanical machine design, industrial engineering and manufacturing technology. Steam Boilers, Steam Turbines and Power Plants: Introduction, classification and types of steam boilers and steam turbines. Discuss working of steam boilers and steam turbines. Introduction and Classification of power plants. Unit-II Pumps and IC Engines: Applications and working of Reciprocating and Centrifugal pumps. Introduction, Classification of IC Engines, Main Components of IC Engines, Working of IC Engines and its components. Unit-III Refrigeration and Air Conditioning: Introduction, classification and types of refrigeration systems and air-conditioning. Applications of	**New Course**

			refrigeration an Air-conditioning. Transmission of Power: Introduction and types of Belt and Rope Drives. Introduction to Gears and Gear Trains. Unit-IV Primary Manufacturing Processes: Metal Casting Process: Introduction to Casting Process, Patterns, Molding, Furnaces. Metal Forming Processes: Introduction to Forging, Rolling, Extrusion, Drawing. Metal Joining Processes: Introduction to various types of Welding, Gas Cutting, Brazing, and Soldering. Metal Removal or Machining Processes: Introduction to machining process and various machine tools. Unit-V Engineering Materials and Heat Treatment of Steel: Introduction to various engineering materials and their properties. Introduction to Heat Treatment and types of Heat Treatment Processes. Introduction to CAD, CAM, FMS, MEMS and CIM: Introduction to modern manufacturing systems and their applications.	
19			**BT-205.D ENGINEERING MECHANICS** Unit-I Statics of particles and rigid bodies: Fundamental laws of mechanics, Principle of transmissibility, System of forces, Resultant force, Resolution of force, Moment and Couples, Resolution of a force into a force and a couple, Free body diagram, Equilibrium, Conditions for equilibrium, Lami's theorem. Centroid & Moment of inertia (M.I): Location of centroid, Moment of inertia (mass and area), Parallel axis and perpendicular axis theorems, M.I	**Code change**

			of composite section, M.I. of solid bodies, Polar moment of inertia. Unit-II Virtual work: Principle of Virtual Work, Active forces and active force diagram, Stability of equilibrium. Friction: Types of Friction, Laws of friction, Angle of friction, Angle of repose, Ladder, Wedge, Belt Friction. Unit-III Kinematics of particles and rigid bodies: Velocity, Acceleration, Types of Motion, Equations of Motion, Rectangular components of velocity and acceleration, Angular velocity and Angular acceleration, Radial and transverse velocities and accelerations, Projectiles motion on plane and Inclined Plane, Relative Motion. Kinetics of particles and rigid bodies: Newton's second law, Equation of motion in rectangular coordinate, Equation of motion in radial and transverse components, Equation of motion in plane for a rigid body, D'Alembert principle. Unit-IV Work, Energy and Power: Work of a force, weight, spring force and couple, Power, Efficiency, Energy, Kinetic energy of rigid body, Principle of work and energy, Conservative and Non-conservative Force, Conservation of energy. Unit-V Impulse and Momentum: Linear and angular momentum, Linear and angular impulse, Principle of momentum for a particle and rigid body, Principle of linear impulse and momentum for a particle and rigid	

			body, Principle of angular momentum and Impulse, Conservation of angular momentum, Angular momentum of rigid body, Principle of impulse and momentum for a rigid body, Central impact, System of variable mass.	
20	**BT206-**	**Environmental Sciences** **UNIT I** **Ecosystem and Biodiversity:** Components and types of ecosystem, Structure and functions of Ecosystem, Values, Type and levels of Biodiversity, Causes of extension, and Conservation methods of biodiversity. **UNIT II** **Air Pollution:** Definition, different types of Sources, effects on biotic and abiotic components and Control methods of air pollution. **UNIT III** **Water pollution:** Definition, different types of Sources, effects on biotic and abiotic components and treatment technologies of water pollution. **UNIT IV** **Noise Pollution:** Introduction of noise pollution, different Sources, effects on abiotic and biotic environment and Control measures. **UNIT V** **Non Conventional energy sources:** Introduction, Renewable Sources of Energy: Solar energy, wind energy, Energy from ocean, energy from biomass, geothermal energy and Nuclear Energy.	**BT- 206 HUMAN VALUES: ACTIVITIES** PS 1: Introduce yourself in detail. What are the goals in your life? How do you set your goals in your life? How do you diffierentiate between right and wrong? What have been your salient achievements and shortcomings in your life ? Observe and analyze them. PS 2: Now-a-days, there is a lot of talk about many technogenic maladies such as energy and material resource depletion, environemental pollution, global warming, ozone depletion, deforestation, soil degradation, etc. - all these seem to be manmade problems, threatening the survival of life Earth - What is the root cause of these maladies & what is the way out in opinion? On the other hand, there is rapidly growing danger because of nuclear proliferation, arms race, terrorism, breakdown of relationships, generation gap, depression & suicidal attempts etc. - what do you think, is the root cause of these threats threats to human happiness and peace - what could be the way out in your opinion? PS 3: 1. Observe that each of us has the faculty of 'Natural Acceptance', based on which one can verify what is right or not right for him. (As such we are not properly trained to listen to our 'Natural	**New course**

			Acceptance' and may a time it is also clouded by our strong per-conditioning and sensory attractions). Explore the following: (i) What is Naturally Acceptable' to you in relationship the feeling of respect or disrespect for yourself and for others? (ii) What is 'naturally Acceptable' to you - to nurture or to exploit others? Is your living in accordance with your natural acceptance or different from it? 2. Out of the three basic requirements for fulfillment of your aspirations - right understanding, relationship and physical facilities - observe how the problems in your family are related to each. Also observe how much time & effort you devote for each in your daily routine. PS 4: list down all your important desires. Observe whether the desire is related to Self (I) or the Body. If it appears to be related to both, visualize which part of it is related to Self (I) and which part is related to Body. 1. a. Observe that any physical facility you use, follows the given sequence with time: Necessary and tasteful - unnecessary but still tasteful - unnecessary and tasteless - intolerable b. In contrast, observe that	

			any feeling in you is either naturally acceptable or not acceptable at all. If not acceptable, you want it continuously and if not acceptable, you do not want it any moment! 2. List down all your important activities. Observe whether the activity is of 'I' or of Body or with the participation of both or with the participation of both 'I' and Body. 3. Observe the activities within 'i'. Identify the object of your attention for different moments (over a period of sy 5 to 10 minutes) and draw a line diagram connecting these points. Try observe the link between any two nodes. PS 6: 1. Chalk out some programs towards ensuring your harmony with the body - in tearms of nurturing, protection and right utilisation of the body. 2. Find out the plants and shrubs growing in and around your campus, which can be useful in curing common diseases. PS 7: Form small groups in the class and make them carry out a dialogue focusing on the following eight questions related to 'TRUST'; 1a. Do I want to make myself happy? 2a. Do I want to make the other happy? 3a. Does the other want to make himself/herself happy? 4a. Does the other want to make me happy? What is the answer? Intention (NaturalAcceptance)	

			1b. Am I able to always make myself happy? 2b. Am I able to always make the other happy? 3b. Is the other able to always make himself/herself happy? What is the answer? Let each student answer the questions for himself and everyone else. Discuss the difference between intention and competence. Observe whether you evaluate yourself and others on the basis of intention/competence. PS 8: 1. Observe, on how many occasions, you are able to respect your related ones (by doing the right evaluation) and on how many occasions you are disrespecting by way of under-evaluation, over-evaluation or otherwise evaluation. 2. Also, observe whether your feeling of respect is based on treating the other as you would treat youself or on differentiations based on body, physical facilities or belieds. PS 9: 1. Write a narration in the form of a story, poem, skit or essay to clarify a salient Human Value to the children. 2. Recollect and narrate an incident in your life where you were able to exhibit willful adherence to balues in a difficult situation. PS 10: List down some common units (things) of Nature which you come across in your daily life and classify them in the four orders of Nature. Analysis and explain the aspect of mutual fulfillment of each unit with other orders. PS 11:	

			Make a chart to show the whole existence as co-existence. With the help of this chart try to identify the role and the scope of some of the courses of your study. Also indicate the areas which are being either over-emphasized or ignored in the present context. PS 12: Identify any two important problems being faced by the society today and analyze the root cause of these problems. Can these be solved on the basic of natural acceptance of human values. If so, how should one proceed in this direction from the present situation? PS 13: 1. Suggest ways in which you can use your knowledge of Science/Technology/Management etc. for moving towards a universal human order. 2. Propose a broad outline for humanistic Constitution at the level of Nation. PS 14: The course is going to be over now. It is time to evaluate what difference in your thinking it has made. Summarize the core massage of this course grasped by you. How has this affected you in terms of; a. Thought b. Behavior c. Work and d. Relization 3. What practical steps are you able to visualize for the transition of the society from its present state. 4. 5. 6. Project: 7. 8. Every student required to take-up a social project	

			e.g. educating children in needy/weaker section, services in hospitals, NGO's and other such work	
21	**BT207**	**Electrical and Electronics Lab-II** **List of Experiment:** 1. To verify the truth tables of basic logic gates: AND, OR, NOR, NAND, NOR. Also to verify the truth table of Ex-OR, Ex-NOR. 2. To verify the truth table of OR, AND, NOR, Ex-OR, Ex-NOR realized using NAND & NOR gates. 3. To realize an SOP and POS expression. 4. To realize adder and Subtractor using universal gates. 5. To verify the truth table of Encoder and decoder. 6. To verify the truth table of multiplexer and demultiplexer. 7. To study and perform Various types of Flip-Flops. 8. To study and perform various types of counters. 9. To study and perform various types of shift registers. 10. To study and perform various types of Multivibrators. 11. To study and perform Schmitt Trigger.	**ENGINEERING CHEMISTRY LAB** 1. To determine the hardness of water by HCL method. 2. To determine the hardness of water by EDTA method 3. Measurement of conductivity of a given sample by conductivity meter. 4. Study of BombCalorimeter. 5. To determine the strength of Ferrous Ammonium sulphate solution with the help of $K_2Cr_2O_7$ solution. 6. To determine the strength of $CuSO_4$ solution with the help of hypo solution. 7. To determine the strength of NaOH and Na_2CO_3 in a given alkali mixture. 8. To determine the flash and fire point of a given lubricating oil. 9. To determine the viscosity of a given lubricating oil by Redwood viscometer. 10. To determine cloud and pour point of lubricating oil.	**Syllabus change** **Code change**
22	**BT208**	**Engineering Physics Lab-II** **List of Experiments:** 1. Conversion of a Galvanometer in to an ammeter and calibrate it. 2. Conversion of a Galvanometer in to voltmeter and calibrate it. 3. To determine the value of "g" by using compound pendulum. 4. To determine Plank's constant using LED. 5. To measure the Numerical	**COMPUTER PROGRAMMING-II LAB** The programs shall be developed in C language related with the following concepts: 1. Input roll numbers of your friends in an array & print in reverse order. 2. Input names of your friends in an array & print in reverse order. 3. Input two matrices and output third matrix after performing add/subtract the corresponding elements.	**Syllabus change** **Code change**

		Aperture (NA) of an optical fiber. 6. To determine the profile of He-Ne Laser beam. 7. To determine the wavelength of different lights using diffraction grating and spectrometer. 8. To determine the wavelength of sodium light by Newton's ring method. 9. To determine the specific rotation of glucose using Polarimeter. 10. To determine minimum deviation angle for different light using prism and spectrometer. 11. To study of detergent on surface tension of water by observing capillary rise 12. To determine the speed of sound in air at room temperature using a resonance tube by two resonance position.	4. Four programs using malloc, calloc, free & sscanf()/sprintf() functions. 5. Two programs using macro and online functions. 6. Two programs using structure & union. 7. Two programs using pointers. 8. Three programs belonging to file operations and multi-file handling. 9. Three programs belonging to graphics using C.	
23	**BT209**	**COMPUTER PROGRAMMING LAB** **LIST OF EXPERIMENTS** 1 Write a program to calculate the area & perimeter of rectangle. 2 Write a program to calculate the area and circumference of a circle for a given radius. 3 Write a program to calculate simple interest for a given principal/amount. 4 Write a program to convert temperature given in ◦C to temperature in ◦F. 5 Write a program to find profit and loss (in percentage) of a given cost price and selling price. 6 Write a program to find out the maximum among the three given numbers. 7 Write a program to calculate the factorial of a given number. 8 Write a program to print the list of first 100 odd number. 9 Write a program to calculate the sum of the digits of a number and display it in reverse order. 10 Write a program to generate a Fibonacci series.	**COMPUTERS AIDED MACHINE DRAWING** 1.Introduction: Principles of drawing, conventional representation of machine components and materials, lines, types of lines, dimensioning types, rules of dimensioning. 2.Conversion of pictorial views into orthographic views: (1 drawing sheet) Introduction to orthographic projection, concept of first angle and third angle projection, drawing of simple machine elements in first angle projection, missing view problems. 3.Sectional view : (1 drawing sheet) Introduction, cutting plane line, type of sectional views-full section, half section, partial or broken section, revolved section, removed section, offset section, sectioning conventions-spokes, web, rib, shaft, pipes, different types of holes, conventions of section lines for different metals and materials. 4.Fasteners: (1 drawing sheet) Temporary and permanent fasteners,	**New course**

		11 Write a program to generate the following series: 1 2 1 2 3 1 2 3 4 1 2 3 4 5 12 Write a program to generate the following series: 0 1 0 1 0 0 1 0 1 0 1 0 1 0 13 Write a program using a function to check whether the given number is prime or not. 14 Write a program to check whether the given string is a palindrome or not. 15 Write a program to find the length of a string, reverse the string and copy one string to another by using library function. 16 Write a program to swap two variables a & b using pointers. 17 Write a program to enter a line of text from keyboard and store it in the file. User should enter file name. 18 Write a recursive program for tower of Hanoi problem 19 Write a menu driven program for matrices to do the following operation depending on whether the operation requires one or two matrices • Addition of two matrices • Subtraction of two matrices • Finding upper and lower triangular matrices • Transpose of a matrix • Product of two matrices. 20 Write a program to copy one file to other, use command line arguments. 21 Write a program to perform the following operators an Strings without using String functions • To find the Length of String. • To concatenate two string. • To find Reverse of a string. • To Copy one sting to another string. 22 Write a Program to store records of an student in student file. The data must be stored using Binary File.Read the record stored in "Student.txt" file in Binary code.Edit the record stored in Binary File.Append a record in the Student	thread nomenclature and forms, thread series, designation, representation of threads, bolted joints, locking arrangement of nuts, screws, washers, foundation bolts etc., keys, types of keys, cotter and knuckle joints. Riveted joints, rivets and riveting, types of rivets, types of riveted joints etc. 5.Assembly drawing: (1 drawing sheet) Introduction to assembly drawing, assembly drawing of simple machine elements; like rigid or flexible coupling, muff coupling, plummer block, footstep bearing, bracket etc. 6.Free hand sketching: Need for free hand sketching, Free hand sketching of conventional representation of materials, screw fasteners, foundation bolts, studs. 7.Bearing: Ball, roller, needle, foot step bearing. 8.Coupling: Protected type, flange, and pin type flexible coupling. 9.Other components: Welded joints, belts and pulleys, pipes and pipe joints, valves etc. 10.Computer aided drafting: Concepts of computer aided 2D drafting using any drafting software like AutoCAD/ Solid works/Creo/Catia etc., basic drawing and modify commands, making 2D drawings of simple machine parts.	

		file. 23 Write a programmed to count the no of Lowercase, Uppercase numbers and special Characters presents in the contents of File.		
24	**BT210**	**Engineering Drawing** Sheet 1 Orthographic Projections (3 Problems) Sheet 2 Riveted joints: Lap joints, butt joints, chain riveting, zig-zag riveting Sheet 3 Screw fasteners, different threads, Nuts & bolts locking devices, set screws, Sheet 4 Scale, plain scales, diagonal scales, scale of chords Sheet 5 Conic Sections: Construction of ellipse, parabola and hyperbola Sheet 6 Engineering Curves: Cycloid, Epicycloids, Hypo-cycloid, Involutes, Archemedian and logarithmic spirals Sheet 7 Projection of points and lines, True inclinations and true length of straight lines, Traces of straight lines Sheet 8 Projection of planes and solids: Projection of planes, Projection of polyhedra, Pyramids.		**Title change** **Code change**
25	**BT211**	**Communication Skills Lab** 1. Introducing yourself. 2. Role Plays. 3. Word Formation. 4. Listening and Speaking Skills. 5. Words often mis-spelt and Mis-Pronounced. 6. One word for many. 7. Synonyms and Antonyms. 8. Seminar Presentation. 9. Group Discussion. 10. Job Interview.		**Code change**
26	**BTME301**	**BTME301: ADVANCE ENGINEERING MATHEMATICS-I** **UNIT 1 Numerical Methods –** Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Gauss's forward and backward interpolation formulae. Stirling's Formulae. Interpolation with unequal intervals: Newton's divided difference	**ADVANCE ENGINEERING MATHEMATICS-I** **UNIT 1 Numerical Methods –** Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Gauss's forward and backward interpolation formulae. Stirling's Formulae. Interpolation with unequal intervals: Newton's divided difference and	No Change

		and Lagrange's formulae. Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules. **UNIT 2 Numerical Methods – 2:** Numerical solution of ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge- Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods. Solution of polynomial and transcendental equations-Bisection method, Newton-Raphson method and Regula-Falsi method. **UNIT 3 Laplace Transform:** Definition and existence of Laplace transform, Properties of Laplace Transform and formulae, Unit Step function, Dirac Delta function, Heaviside function, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs by Laplace transforms method. **UNIT 4 Fourier Transform:** Fourier Complex, Sine and Cosine transform, properties and formulae, inverse Fourier transforms, Convolution theorem, application of Fourier transforms to partial ordinary differential equation (One dimensional heat and wave equations only). **UNIT 5 Z-Transform:** Definition, properties and formulae, Convolution theorem, inverse Z transform, application of Z-transform to difference equation.	Lagrange's formulae. Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules. **UNIT 2 Numerical Methods – 2:** Numerical solution of ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge- Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods. Solution of polynomial and transcendental equations-Bisection method, Newton-Raphson method and Regula-Falsi method. **UNIT 3 Laplace Transform:** Definition and existence of Laplace transform, Properties of Laplace Transform and formulae, Unit Step function, Dirac Delta function, Heaviside function, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs by Laplace transforms method. **UNIT 4 Fourier Transform:** Fourier Complex, Sine and Cosine transform, properties and formulae, inverse Fourier transforms, Convolution theorem, application of Fourier transforms to partial ordinary differential equation (One dimensional heat and wave equations only). **UNIT 5 Z-Transform:** Definition, properties and formulae, Convolution theorem, inverse Z transform, application of Z-transform to difference equation.	
27	**BTME302**	**Thermodynamics** **UNIT I** **Basic Concepts of Thermodynamics:** Thermodynamic systems, concept of temperature, state and processes, processes and cycle, equality of temperature, Zeroth Law of thermodynamics, temperature scale, laws of perfect gases , Pure substances, vapour-Liquid –solid-phases and equilibrium , equilibrium in pure substances, thermodynamic surfaces **UNIT II** **Work and heat:** Law of conservation of mass and energy, First law of thermodynamics, steady state Processes, Second law of thermodynamics, Heat engine, Carnot cycle, thermodynamic	**MANAGERIAL ECONOMICS AND FINANCIAL ACCOUNTING** **UNIT 1: Basic economic concepts-** Meaning, nature and scope of economics, deductive vs inductive methods, static and dynamics, Economic problems: scarcity and choice, circular flow of economic activity, national income-concepts and measurement. **UNIT 2**: **Demand and Supply analysis**- Demand-types of demand, determinants of demand, demand function, elasticity of demand, demand forecasting – purpose, determinants and methods, Supply-determinants of supply, supply function, elasticity of supply. **UNIT 3**: **Production and Cost analysis**-	New Course

		temperature scale, concepts of order and disorder and entropy, change of entropy for different processes, equivalence of Kelvin Planck and Clausius statements, Clausius inequality. **UNIT III** **Energy Relations:** availability of a non flow and steady flow system, Helmholtz and Gibb's functions, Thermodynamic Relations: Important mathematical relations, Maxwell relations, Joule-Thomson effect and coefficient, Clayperon relation. **UNIT IV** **Air** – standard power cycle, Brayton cycle, Otto cycle, diesel cycle, Dual cycle, Stirling cycle, Ericssion cycle and Atkinson cycle, Mean effective pressure and efficiencies, Four stroke petrol and diesel engine, Two stroke Petrol and diesel engine. **UNIT V** **Steam -** Properties of steam, phase change process, use of steam table & Molier chart. Rankine cycle, Reheat cycle, Regenerative cycle, vapour compression refrigeration cycle.	Theory of production- production function, law of variable proportions, laws of returns to scale, production optimization, least cost combination of inputs, isoquants. Cost concepts explicit and implicit cost, fixed and variable cost, opportunity cost, sunk costs, cost function, cost curves, cost and output decisions, cost estimation **UNIT 4**: **Market structure and pricing theory**-Perfect competition, Monopoly, Monopolistic competition, Oligopoly. **UNIT 5**: **Financial statement analysis**-Balance sheet and related concepts, profit and loss statement and related concepts, financial ratio analysis, cash flow analysis, funds-flow analysis, comparative financial statement, analysis and interpretation of financial statements, capital budgeting techniques.	
28	**BTME 303**	**Electronic Measurements and Instrumentation** **UNIT I** **MEASUREMENTS AND ERRORS -** Measurements - significance of measurements - methods of measurement – instruments and measurement systems - classification of instruments – elements of measurement system. Accuracy and precision - significant figures - types of errors - probability of errors - limiting errors. Repeatability, Systematic & random errors, modeling of errors, standard deviation, Gaussian error analysis, Combination of errors. **UNIT II** **ELECTRONIC INSTRUMENTS FOR MEASUREMENTS -** DC Voltmeter, DC Ammeter, Ohm meter, Multimeter, AC meters, Electrodynamometer , Watt hour meter ,digital voltmeter , component measuring system Q meter , vector impedance meter, frequency meters.RF Power & Voltage Measurements. D'Arsonaval, Vibration and Ballistic galvanometers. Introduction to shielding & grounding	**ENGINEERING MECHANICS** **UNIT 1 Statics of particles and rigid bodies:** Fundamental laws of mechanics, Principle of transmissibility, System of forces, Resultant force, Resolution of force, Moment and Couples, Varignon's theorem, Resolution of a force into a force and a couple, Free body diagram, Equilibrium, Conditions for equilibrium, Lami's theorem. **UNIT Plane trusses:** Types of structures, Trusses, Support Conditions, Types of Loadings, Classification of trusses, Determinacy of trusses, Basic assumptions of truss analysis, Method of joints, Method of sections.Virtual work: Principle of Virtual Work, Active forces and active force diagram, Stability of equilibrium. **UNIT 2 Centroid & Moment of inertia**: Location of centroid and center of gravity, Moment of inertia, Parallel axis and perpendicular axis theorem, Radius of gyration, M.I of composite section, Polar moment of inertia, M.I of solid bodies. **UNIT Lifting machines**: Mechanical advantage, Velocity Ratio, Efficiency of machine, Ideal machine, Ideal effort and ideal load, Reversibility of machine, Law of machine, Lifting machines; System of pulleys, Simple wheel and axle, Wheel and	New Course

		UNIT III **BRIDGE MEASUREMENT -** Introduction, Wheatstone Bridge, Kelvin Bridge, AC Bridges, Maxwell's inductance and capacitance bridges, Hay Bridge, Schering Bridge, unbalanced conditions - Wein Bridge, Wagner ground connection. Sources and Detectors. Anderson bridge, Heaviside bridge, DeSauty bridge Sources of errors in bridge measurements and their minimization. **UNIT IV** **TRANSDUCERS -** Classification of transducers , Selection Criteria, Characteristics, Construction, Working Principles, selecting transducers , strain gauges , displacement transducers , capacitive and inductive transducers, LVDT , oscillation transducer - piezoelectric, potentiometer, velocity transducers temperature transducers , optical transducers, RTD, Thermocouples, Thermistors, RVDT, Bourdon Tubes, Bellows. Diaphragms, Load Cell, Ultrasonic Flow Meters. **UNIT V** **SIGNAL GENERATION AND DISPLAY INSTRUMENTS -** Sine wave generators, Frequency synthesized signal generators, Sweep frequency generators, Frequency - selective wave analyser,harmonic distortion analyzer, spectrum analyzer, logic analyzer, dual trace oscilloscope, digital storage oscillator , XY plotter. CRT Construction, Basic CRO circuits, CRO Probes, Oscilloscope Techniques of Measurement of frequency, Phase Angle and Time Delay, Multi beam, multi trace, sampling Oscilloscopes.	differential axle, Weston's differential pulley block, Worm and worm wheel, Single purchase winch crab, Double purchase winch crab, Screw jack, Differential screw jack. **UNIT 3 Friction**: Types of Friction, Laws of friction, Angle of friction, Angle of repose, Ladder, Wedge, Belt Friction. **Belt and Rope drive**: Types of belts, Types of belt drives, Velocity ratio, Effect of slip on Velocity ratio, Crowing of pulleys, Length of belt, Ratio of tensions in flat belt drive, Power transmission by belt drives, Advantage and disadvantages of V-Belt over Flat Belt. **UNIT 4 Kinematics:** Fundamentals of rectilinear motion and curvilinear motion, applications of general equations, Projectiles motion on plane and on inclined plane, Concept of Relative motion. **Dynamics:** Principles of dynamics, D'Alembert's principle, conservation of momentum and energy, Work and Energy and impulse momentum methods, central impact, oblique impact, system of variable mass. **UNIT 5 Vibrations:** Introduction to vibrations, Free vibrations of particles, Simple, compound and torsional pendulum, Energy Method.	
29	**BTME304**	**Mechanics of Solids** **UNIT I** **Simple Stress & strain:** Tension, compression, shearing stress & strain; Poisson's ratio: Stress-strain relationship, Hooke's law; Elastic constants and their relations for a isotropic Hookean material, anisotropy & orthotropy, thermal stresses, composite bars; simple elastic, plastic & visco-elastic behavior of common materials in tension and compression test, stress-strain curves. Concept of factor of safety & permissible stress. Conditions for equilibrium. Concept of free body diagram; Introduction to mechanics of deformable bodies. **UNIT II**	**ENGINEERING THERMODYNAMICS** **UNIT 1 Basic Concepts and definitions of Thermodynamics**: System, Surroundings, Property, Energy, Thermodynamic Equilibrium, Process, work and modes of work. **Zeroth and First Law of Thermodynamics:** Zeroth of Thermodynamics**,** Temperature scale, First law of thermodynamics, First law analysis of some elementary processes. Steady and unsteady flow energy equations. **UNIT 2 Second Law of Thermodynamics:** Heat engine, Heat pump and refrigerator, Second law of thermodynamics, Equivalence of the Kelvin-Plank and Clausius statements. Reversible and Irreversible Processes, Carnot engine,	Code Change

		Compound Stress I: Solids subjected to flexural loads: Theory of simple bending, bending moment and shear force diagrams for different types of static loading and support conditions on beams. Bending stresses, Section modulus and transverse shear stress distribution in circular, hollow circular, I, Box, T, angle sections etc. **UNIT III** **Compound Stress II:** Principal planes, stresses & strains: Members subjected to combined axial, bending & Torsional loads, maximum normal & shear stresses; Concept of equivalent bending & equivalent twisting moments: Mohr's circle of stress & strain. Theories of Elastic Failures: The necessity for a theory, different theories, significance and comparison, applications. **UNIT IV** **Torsion:** Torsional shear stress in solid, hollow and stepped circular shafts, angular deflection and power transmission capacity. Stability of equilibrium: Instability & elastic stability. Long & short columns, ideal strut, Euler's formula for crippling load for columns of different ends, concept of equivalent length, eccentric loading, Rankine formulae and other empirical relations. **UNIT V** **Bending of beams:** Transverse deflection of beams: Relation between deflection, bending moment, shear force and load, Transverse deflection of beams and shaft under static loading, area moment method, direct integration method: method of superposition and conjugate beam method. Variational approach to determine deflection and stresses in beam. Elastic strain energy: Strain energy due to axial, bending and Torsional loads; stresses due to suddenly applied loads; use of energy theorems to determine deflections of beams and twist of shafts. Castigliano's theorem. Maxwell's theorem of reciprocal deflections.	Efficiency of a Carnot engine, Carnot principle, thermodynamic temperature scale, Clausis Inequality. **Entropy**: Entropy, Calculation of Entropy change, Principle of entropy increase. Temperature-Entropy diagram, Second law analysis of a control volume. **Availability:** Available energy, Loss in available energy, Availability Function, Irreversibility. **UNIT 3 Thermodynamic Properties of Fluids:** Pure substance, Concept of Phase, Graphical representation of p-v-T data, Properties of steam. Steam tables, Mollier chart **Ideal Gas and Real Gas**: Ideal gas, Real gas, Internal energy, enthalpy and specific heats of an ideal gas, equations of state, Dalton's law of partial pressures, Gibbs Dalton law, Thermodynamic properties of gas mixtures. **UNIT 4 Thermodynamic Relations:** Thermodynamic variables, Independent and dependent variables, Maxwell's thermodynamic relations, Thermodynamic relations involving entropy, Thermodynamic relations involving enthalpy and internal energy, Joule-Thomson coefficient, Clapeyron equation. **Power Cycles:** Otto cycle, Diesel cycle, Dual cycle, Brayton cycle and Ericsson cycle. **UNIT 5 Vapour power cycle:** Rankine cycle, effect of operating conditions on its efficiency, properties of ideal working fluid in vapour power cycle Reheat cycle, regenerative cycle, bleeding extraction cycle, feed water heating co-generation cycle.	
30	**BTME 305**	**Production Technology** **UNIT – I** **Moulding:** Cores, Core Prints, Core boxes, Pattern design, Pattern layout and construction, testing of moulding sand. moulding and core making machines, use of chaplets, CO_2 - Process, fluid sand process, shell moulding, cold curing	**MATERIAL SCIENCE AND ENGINEERING** **UNIT 1** Crystal structure – BCC, FCC and HCP, unit cell, crystallographic planes and directions, miller indices. Crystal imperfections, point, line, surface and volume defects. Frank Reed source of dislocation, Elastic & plastic modes of deformation,	Code Change

		process, hot-box method, high pressure and flask less moulding, Design of metal moulds, Die Design for die Casting. **UNIT – II** **Casting:** Directional principles, Solidification, types of gating systems, Pouring time and temperature. Design criteria of pouring basin, screw, runner, gate and riser, gating ratio, chill and its uses. Selection of melting furnaces, Crucible furnaces, Electric furnaces, Induction furnace, Control of melt and Cupola charge calculations. Foundry mechanization and lay out. Casting defects, Causes and remedies. **UNIT – III** **Welding:** Principle, classification, advantages, limitations and applications, Tungsten Inert Gas welding, Metal Inert Gas welding, Electro - slag welding, Electro - Gas Welding, Explosive Welding, Ultrasonic Welding, Electron Bean Welding, Laser Beam Welding, Friction Welding, Cold Welding, Thermit Welding, Codification of Electrodes, Welding Defects-causes and remedies. **UNIT – IV** **Metal Forming:** Introduction to Metal Forming, Hot Forming and Cold Forming, Description of Forging, Wire Drawing, Tube Drawing, Deep Drawing, Rolling Bending, Extrusion Blanking, Piercing. **UNIT V** **Powder Metallurgy:** Definition, advantages, limitations and applications, Powder metallurgy processes and operations, metal powders, their characteristics and manufacture	Bauschinger's effect, slip & twinning, strain hardening, cold/hot working recovery, re-crystallization and grain growth. **UNIT 2** Classification of Engineering Materials: Solidification of metals and of some typical alloys, mechanism of crystallization (I) nuclear formation (ii) crystal growth, general principles of phase transformation in alloys, phase rule and equilibrium diagrams, equilibrium diagram of binary system having complete mutual solubility in liquid state and limited solubility in solid state, binary isomorphous alloy system, Hume- Rothery rule , binary system with limited solid solubility of terminal phase and in which solubility decreases with temperature and also alloy with a peritectic transformation, equilibrium diagram of a system whose components are subject to allotropic change. Iron carbon equilibrium diagram, phase transformation in the iron carbon diagram, eutectic, peritectic, eutectoid and peritectoid reactions and microstructures. **UNIT 3** Isothermal transformation diagrams –cooling curves superimposed on Isothermal Transformation diagram, critical cooling rate. (i) Formation of Austenite from Pearlite (ii) Transformation of Austenite into Pearlite. Full annealing, stress relief, spheroidizing – normalizing, hardening and tempering of steel. Hardenability, Jominey end quench test – Austempering, martempering. Case hardening, carburising, nitriding, cyaniding, carbonitriding. Flame and Induction hardening. **UNIT 4** Non-Metallic Materials- Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO,PPS, PEEK, PTFE Polymers. Urea and Phenol formaldehydes. Constitution of alloys: Solid solutions - substitutional and interstitial. Ferrous and Non Ferrous Metals- Effect of alloying additions on steel (Mn, Si, Cr, Mo, V, Ti & W) - stainless and tool steels – HSLA steel. **UNIT 5** Mechanical Properties and Testing: Types of fracture, testing of materials under tension, compression and shear loads – hardness tests (Brinell, Vickers and Rockwell) Impact test Izod and charpy,fatigue and creep test.	

			Classification of steels and cast iron constitution and properties. BIS standards. Engineering Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ etc. Fiber and particulate reinforced composites and resin plastics. Introduction to Nano materials- Nano structured materials. Nano clusters & Nano crystals.	
31	**BTME306**	**Material Science and Engineering** **UNIT I** **Atomic structure of Metals:** Crystal structure, crystal lattice of (i) Body centred cubic (ii) Face centred cubic (iii) Closed packed hexagonal, crystallographic Notation of atomic planes and Directions (Miller Indices), polymorphism and allotropy, Crystal imperfection. **UNIT II** **Theories of plastic deformation:** Phenomenon of slip, twinning and dislocation. Identification of crystallographic possible slip planes and direction in FCC, BCC, HCP. Recovery and recrystallization, preferred orientation causes and effects on the property of metals. **UNIT III** Engineering materials. Solidification of metals and of some typical alloys: Mechanism of crystallisation (I) nuclear formation (ii) crystal growth. General principles of phase transformation in alloys, phase rule and equilibrium diagrams, Equilibrium diagram of binary system having complete mutual solubility in liquid state and limited solubility in solid state, Binary isomorphous alloy system, Hume-Rothery rule, Binary system with limited solid solubility of terminal phase and in which solubility decreases with temperature and also alloy with a peritectic transformation. Equilibrium diagram of a system whose components are subject to allotropic change. Iron carbon Equilibrium diagram, phase transformation in the iron carbon diagram (I) Formation of Austenite (ii) Transformation of Austenite into pearlite (iii) Martensite transformation in steel, TTT curves. **UNIT IV** Engineering properties of materials. Principles and applications of annealing, normalising, hardening, tempering.	**BTME306 : MECHANICS OF SOLIDS** **UNIT 1 Stress and Strain:** Elementary definition of stress and strain, stressstrain relationship, elastic, plastic and visco-elastic behavior of common materials in tension and compression test, stress-strain curves, Hooke's law, Poisson's ratio, elastic constants and their relations for an isotropic hookean material, anisotropic and orthotropic materials. Tension, compression, shearing stress and strain, thermal stresses, composite bars, equations of static equilibrium, concept of free body diagram. Strain energy due to axial loading. **UNIT 2 Members Subjected to Flexural Loads:** Theory of simple bending, bending moment and shear force diagrams for different types of static loading and support conditions on beams. bending stresses, section modulus and transverse shear stress distribution in circular, hollow circular, I, Box, T, angle sections etc. Strain energy due to bending. **UNIT 3 Principal Planes, Stresses and Strains:** Members subjected to combined axial, bending and torsional loads, maximum normal and shear stresses, concept of equivalent bending and equivalent twisting moments, Mohr's circle of stress and strain. **Theories of Elastic Failures:** The necessity for a theory, different theories, significance and comparison, applications. **UNIT 4 Torsion:** Torsional shear stress in solid, hollow and stepped circular shafts, angular deflection and power transmission capacity. Strain energy due to torsional loads. **Stability of Equilibrium:** Instability and elastic stability, long and short columns, ideal strut, Euler's formula for crippling load for columns of different ends, concept of equivalent length, eccentricloading, Rankine formulae and other empirical relations. **UNIT 5 Transverse Deflection of Beams:** Relation between deflection, bending	Code Change

		Recovery and recrystallization. Hardenability -its measures, variables, effecting Hardenability, methods, for determination of Hardenability. Over-heated and Burnt steel, its causes and remedies. Temper brittleness -its causes and remedies. Basic principles involved in heat treatment of plain carbon steel, alloy steels, cast iron and Non-ferrous metals and their alloys. Chemical Heat treatment of steels: Physical principles involved in chemical heat treatment procedure for carburizing, Nitriding, Cyaniding, carbo-nitriding of steel. **UNIT V** **Alloys & Steel:** Effects produced by Alloying element on the structures and properties of steel Distribution of alloying elements (Si, Mn, Ni, Cr, Mo, Co, W, Ti, Al) in steel, structural classes of steel. Classification of steels, BIS Standards.fibre reinforced plastic composites**:** Various fibres and matrix materials, basic composite manufacturing methods, applications of composite materials.	moment, shear force and load, transverse deflection of beams and shaft under static loading, area moment method, direct integration method. **Thin-walled Pressure Vessels:** Stresses in cylindrical and spherical vessels	
32	**BTME 307**	**MSE Lab** **List of Experiments** 1. Material types and their characteristic properties a. A comparative study – qualitative b. Examples of materials and their applications 2. Common Engineering materials and properties a. A comparative study - quantitative 3. Study of Metallurgical Microscope 4. Preparation of metallographic specimen 5. Study of homogeneous and heterogeneous microstructures a. Study of grain size and shape in homogeneous structures b. Study of heterogeneous structure – number of phases, types of distribution, size and shape of different phases 6. Space lattice and crystal structures – b.c.c., f.c.c. and h.c.p. structures, examples of metals belonging to these structures, co-relation of structure and properties. 7. To calculate the effective number of atoms, co-ordination number,	**MACHINE DRAWING PRACTICE** **CONTENTS** **1.** Assembly drawing with sectioning and bill of materials of the following: Lathe tail stock, shaper tool head, swivel machine vice etc (1 drawing sheet of any assembly) **2.** Detailed part drawings from assembly drawing indicating fits, tolerances and surface finish symbols by referring BIS codes: Check-valve, Junction Valve etc (1 drawing sheet) **3.** Computer Aided Drafting: Introduction to different features of the CAD Software (AutoCAD/ProE/ Creo/Solidworks). At least one drawing problem related to a. 2-D Drafting. b. 3-D Modeling. c. 3-D Advanced Modeling. d. Assembly modeling. e. Feature Modification and Manipulation f. Detailing. g. Surface Modeling	New Course

		packing factors, c/a ratio for hcp structures, stacking sequence in hcp and f.c.c. structures, octahedral & tetrahedral voids in f.c.c. & b.c.c. structures. 8. To study the Iron-Carbon equilibrium diagram and differentiation between steel and cast iron with the help of their microstructures. 9. Study of microstructures of hypo, hyper and eutectoid steel. Effect of carbon percentage on the hardness of steel. 10. Study of microstructure and hardness of the eutectoid steel at different rates of cooling from austenite. 11. Annealing of steel – effect of annealing temperatures and time on hardness. 12. Hardening of steel, effect of quenching medium on the hardness of the same. 13. Study of microstructures of Grey, White, Nodular and Malleable cast irons. 14. Study of dislocations through models. 15. Study of ductile and brittle fracture.		
33	**BTME 308**	**Strength Of Material Lab** **<u>List of Experiments:</u>** 1 .To Study the properties of engineering materials. 2. To determine the hardness of the given specimen using Rockwell hardness test. 3 To determine the hardness of the given specimen using Brinell hardness test. 4 To determine the Impact toughness through Izod and charpy test. 5 To determine the tensile strength of the specimen. 6 To determine the compressive strength of the specimen. 7 To find the modulus of rigidity of the specimen through torsion testing machine. 8 To find the spring stiffness of the specimen through spring testing machine. 9 To find the bending stresses and young's modulus of the specimen. 10. To study the Fatigue testing machine	**BTME308 : MATERIALS TESTING LAB** **1** (a) Study of various crystals structures through models BCC, FCC, HCP, tetrahedral and octahedral voids. Material identification of, say, 50 common items kept in a box. **2** Specimen preparation for metallographic examination /micro structural examination-cutting, grinding, polishing, etching. **3** Comparative study of microstructures of different given specimens (mild steel,gray C.I., brass, copper etc.) **4** Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after. **5** Study of Microstructure and hardness of steel at different rates of cooling. Microstructure examination of white cast iron. **6** To perform Tensile/Compressive/Shear/torsion test on a given material and to determine its various mechanical properties under tensile/compression/Shear/torsional loading **7** To determine Rockwell/ Vickers/Brinell	Course Name Change, Content Change

			hardness of a given material **8** To perform Impact test on a given material and to determine its resilience. **9** To study and perform Fatigue test on a given material and to determine fatigue strength of the material **10** To perform Bending test and to determine the Young's Modulus of Elasticity via deflection of beam. **11** Creep testing on creep testing machine	
34	BTME309	**Production Technology Lab** **List of Experiments:** 1 To prepare mould of a given pattern requiring core and to cast it in aluminum. 2 Moisture test and clay content test. 3. To study different types of casting defects. 4 Strength Test (compressive, Tensile, Shear Transverse etc. in green and dry conditions) and Hardness Test (Mould and Core). 5. Permeability Test. 6. A.F.S. Sieve analysis Test. 7. Prepare a job by Arc WELDING(Single beading) 8. To study different type of welding joints 9. To study different types of welding defects. 10 To prepare a job by using gas welding.	**Basic Mechanical Engineering Lab** Exposure to a wide range of applications of mechanical engineering through a variety of activities, including hands-on assembly and disassembly of machines, such as, bicycle, sewing machine, pumps, engines, air-conditioners, machine-tools, amongst others; observational study of complex systems via cut sections, visits, videos and computer simulations; design of simple machines/systems including specifications formulation; visits to industries.	New Course
35	BTME310	**Electronic Measurements and Instrumentation Lab** **List of Experiment** 1. Measurement of strain/ force with the help of strain gauge load cell 2. Measurement of displacement with the help of LVDT 3. Plot V-I characteristics & measure open circuit voltage & short circuit current of a solar panel. 4. Measure unknown inductance capacitance resistance using following bridges (a) Anderson Bridge (b) Maxwell Bridge 5. To measure unknown frequency & capacitance using Wein's bridge. 6. Measurement of the distance with the help of ultrasonic transmitter & receiver. 7. Draw the characteristics of the following temperature transducers: (a) RTD (Pt-100) (b) Thermistors (c) Thermocouple 8. Study the working of Q-meter and measure Q of coils 9. Measure the speed of a Table Fan using stroboscope.	**Programming Using Matlab** 1. Basics of MATLAB computer programming 2. Use of formulae and inbuilt functions 3. MATLAB scripts and functions (m-files) 4. Loops and nested loops 5. Array, vector and matrices 6. Plotting functions and vector plots 7. Solving differential equations using MATLAB 8. Reading and writing data, file handling 9. Using MATLAB toolboxes 10. MATLAB graphic functions	New Course

		10. Study the working of DIGITAL STORAGE CRO 11. Study of Phase shift Oscillator.		
36	**BTME 311**	**Machine Drawing** **<u>List of Experiments:</u>** **<u>To prepare Drawing Sheets as mentioned below:</u>** **(a)** Machine Tool Parts: Shaper tool head, Lathe Tail Stock (b) IC. Engine parts: connecting rod, crank shaft, etc,	-	
37	**BTME401**	**<u>BTME401: Kinematics of Machines</u>** **Unit 1**. Kinematics: Elements, pairs , mechanisms, four bar chain and its inversions,velocity and acceleration, Klein's construction, coriolis component, instantaneous center method **Unit 2.** Synthesis of mechanisms, pantograph, scott-Russel, Tchbeicheff straight line, indicator diagram mechanisms Automotive vehicle mechanisms: Overhead valve mechanism, Davis and Ackerman steering mechanism, Trifler suspension and Hooke'sjoint. **Unit 3.** Power transmission: Belts and ropes, effect of centrifugal force, creep, chain drive Friction: Laws of static, dynamic and rolling friction, dry and viscous friction, inclined plane and screw jack, pivots and friction axis, bearing, Theory of film lubrication. **Unit 4.** Brakes: Band, block and band & block brakes, braking action, braking system of automobiles. Clutches Dynamometers: absorption and transmission type dynamometers, prony, rope and hydraulic dynamometers **Unit 5.** Cams: Type of cams, displacement, velocity and acceleration curves for different cam followers consideration of pressure angle and wear, analysis of motion of followers for cams with specified contours.	**DATA ANALYTICS** **Unit 1** Introduction: Objective, scope and outcome of the course. Introduction to Multivariate Statistics-Degree of Relationship among Variables-Review of Univariate and Bivariate Statistics-Screening Data Prior to Analysis-Missing Data, Outliers, Normality, Linearity, and Homoscedasticity. **Unit 2** Multiple Regression- Linear and Nonlinear techniques- Backward Forward-Stepwise- Hierarchical regression-Testing interactions (2way interaction) Analysis of Variance and Covariance (ANOVA & ANCOVA)-Multivariate Analysis of Variance and Covariance (MANOVA & MANCOVA). **Unit 3** Logistic regression: Regression with binary dependent variable - Simple Discriminant Analysis-Multiple Discriminate analysis Assessing classification accuracy- Conjoint analysis(Full profile method). **Unit 4** Principal Component Analysis-Factor Analysis- Orthogonal and Oblique Rotation-Factor Score Estimation-Multidimensional Scaling- Perceptual Map-Cluster Analysis (Hierarchical Vs Nonhierarchical Clustering). **Unit 5** Latent Variable Models an Introduction to Factor, Path, and Structural Equation Analysis- Time series data analysis (ARIMA model) – Decision tree analysis (CHAID, CART) - Introduction to Big Data Management.	New Course
38	**BTME402**	**Fluid Mechanics and Machines** **UNIT I** Fluid Properties: Definition of a fluid, Viscosity-dynamic and kinematic, Surface Tension Fluid Statics: Basic equation of fluid statics, Manometers, Force on plane areas and curved surfaces, center of pressure, Buoyant force, Stability of floating and	**TECHNICAL COMMUNICATION** **Unit1**: Introduction- Objective, scope and outcome of the course. Introduction to Technical Communication- Definition of technical communication, **Unit 2:** Aspects of technical communication, formsof technical communication, importance of technical communication, technical communication	New Course

		submerged bodies. Stability of floating and submerged bodies. **UNIT II** Fluid flow concepts and Basic control volume equations: General control equation, conservation of mass, energy equation and its application, Momentum equation and its applications Basic governing differential equation: Reynolds transport equation, continuity equation, momentum equation, energy equation, Bernoulli's equation. **UNIT III** Viscous flow: Laminar flow through pipe and between parallel plate. Turbulent flow: Relation, Prandle mixing length, Losses in open and closed conduit **UNIT IV** Measurements: Pressure, velocity,flow measurement orifices, venturimenter, orificemeter, nozzle meter, notches and weirs. Flow through pipe: Major and minor Losses in pipe, Hydraulic and energy gradient line, Network of pipes-series and parallel. **UNIT V** Hydraulic Turbines: Classification of hydraulic turbines, work done and efficiencies of Pelton, Francis and Kaplan turbines, Draft tube,Specific speed and unit quantities Hydraulic systems: Hydraulic press, Hydraulic accumulator, Hydraulic Intensifier, Hydraulic Ram, Hydraulic lift, Hydraulic coupling, Hydraulic torque convertor Gear pump.	skills (Listening, speaking, writing, reading writing), linguistic ability, style in technical communication. **Unit 3** Comprehension of Technical Materials/Texts and Information Design & development- Reading of technical texts, Reading and comprehending instructions and technical manuals, Interpreting and summarizing technical texts, Note-making. Introduction of different kinds of technical documents, Information collection, factors affecting information and document design, Strategies for organization, Information design and writing for print and online media. **Unit 4** Technical Writing, Grammar and Editing- Technical writing process, forms of technical discourse, Writing, drafts and revising, Basics of grammar, common error in writing and speaking, Study of advanced grammar, Editing strategies to achieve appropriate technical style, Introduction to advanced technical communication. Planning, drafting and writing Official Notes, Letters, E-mail, Resume, Job Application, Minutes of Meetings. **Unit 5** Advanced Technical Writing-Technical Reports, types of technical reports, Characteristics and formats and structure of technical reports. Technical Project Proposals, types of technical proposals, Characteristics and formats and structure of technical proposals. Technical Articles, types of technical articles, Writing strategies, structure and formats of technical articles.	
39	**BTME403**	**Machining & Machine Tools** **UNIT I** Classification of metal removal process and machines: Concept of generatrix and directrix Geometry of single point cutting tool and tool angles, tool nomenclature in ASA, ORS, NRS and interrelationship. Concept of orthogonal and oblique cutting.Mechanism of Chip Formation: Type of chips. Mechanics of metal cutting; interrelationships between cutting force, shear angle, strain and strain rate. Various theories of metal cutting. Thermal aspects of machining and measurement of chip tool interface temperature. Friction in metal cutting. Introduction to tool geometry of milling cutters and drills. **UNIT II** Concept of machinability, machinability	**BTME403: Digital Electronics** **Unit** 1 Introduction: Objective, scope and outcome of the course. Semiconductor Devicesand Applications: Introduction toP-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJTas a single stage CE amplifier, frequency response and bandwidth. **Unit** 2 Operational amplifier and its applications: Introductionto operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-	New Course

		index, factors affecting machinability, Different mechanism of tool wear. Types of tool wear (crater, flank etc), Measurement and control of tool wear, Concept of tool life,Taylor's tool life equation (including modified version). Different tool materials and their applications including effect of tool coating. Introduction to economics of machining. Cutting fluids: Types, properties, selection and application methods **UNIT III** Basic machine tools: Constructional configuration, specifications and estimation of machining time on lathe, drilling, shaping, milling, grinding and broaching machine. Special Purpose Machine Tools: Automatic lathes, capstan and turret lathe machines, operational planning and turret tool layout, sequence of operations. **UNIT IV** Introduction to Grinding-Need and different methods of grinding, Abrasives; natural and synthetic, manufacturing and selection of grinding wheels, Wheel specifications, mounting and dressing. Surface finishing: Honing, lapping, super-finishing, polishing and buffing. Thread Manufacturing: casting; thread chasing; thread cutting on lathe; thread rolling, die threading and tapping; thread milling and thread grinding. **UNIT V** GearManufacturing Processes: hot rolling; stamping; powder metallurgy; extruding etc. Gear generating processes: gear hobbling, gear shaping. Gear finishing processes: shaving, grinding, lapping, shot blasting, phosphate coating, Gear testing. High Velocity Forming Methods: Definition; Hydraulic forming, Explosive forming, Electro-hydraulic forming, Magnetic pulse forming.	amp IC 741, invertingand non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator. **Unit** 3 Timing Circuits and Oscillators: RC-timing circuits, IC 555 and its applications as astable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator. **Unit** 4 Digital Electronics Fundamentals: Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, de- multiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications. **Unit** 5 Electronic Communication Systems:The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless,need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.	
40	**BTME404**	**Design of Machine Elements - I** **UNIT I** Materials: Mechanical Properties and IS coding of various materials, Selection of material from properties and economic aspects Manufacturing Considerations in Design: Standardization, Interchangeability, limits, fits tolerances and surface roughness, BIS codes, Design consideration for cast, forged and machined parts. Design for assembly.	**BTME404: Fluid Mechanics And Fluid Machines** **Unit** 1 Introduction: Objective, scope and outcome of the course. Fluid Properties: Units and dimensions- Properties of fluids-mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Fluid Statics and Flow Characteristics: Basic equation of fluid statics, Manometers, Force on	Code Change

		UNIT II Design for Strength: Modes of failure, Strength and Stiffness considerations, Allowable stresses, factor of safety, Stress concentration: causes and mitigation, fatigue failures. Design of Members subjected to direct stress: pin, cotter and keyed joints. **UNIT III** Design of Members in Bending: Beams, levers and laminated springs. Design for stiffness of beam: Use of maximum deflection formula for various end conditions for beam design **UNIT IV** Design of Members in Torsion Shaft and Keys: Design for strength, rigidity. Solid and hollow shafts. Shafts under combined loading. Sunk keys Couplings: Design of muff coupling, flanged couplings: rigid and flexible **UNIT V** Design of Threaded fasteners: Bolt of uniform strength, Preloading of bolts: Effect of initial tension and applied loads, Eccentric loading Power screws like lead screw, screw jack Design of members which are curved like crane hook, body of C-clamp, machine frame etc.	plane areas and curved surfaces, center of pressure, Buoyant force, Stability of floating and submerged bodies. Flow characteristics – concept of control volume - application of continuity equation, energy equation and momentum equation. **Unit** 2Flow Through Circular Conduits: Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli-Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation –friction factor-Moody diagram-minor losses – Flow through pipes in series and parallel. **Unit** 3 Dimensional Analysis: Need for dimensional analysis – methods of dimensional analysis – Similitude –types of similitude – Dimensionless parameters-application of dimensionless parameters– Model analysis. **Unit** 4 Pumps: Impact of jets - Euler's equation - Theory of roto-dynamic machines – various efficiencies– velocity components at entry and exit of the rotor-velocity triangles - Centrifugal pumps–working principle - work done by the impeller - performance curves - Reciprocating pump- working principle – Rotary pumps –classification. **Unit** 5 Turbines: Classification of turbines – heads and efficiencies – velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working principles - work done by water on the runner – draft tube. Specific speed - unit quantities – performance curves for turbines – governing of turbines.	
41	**BTME 405**	**INDUSTRIAL ENGINEERING** **UNIT I** Concept and definition of Industrial Engineering, Historical development of IE, Role of Industrial Engineer, Applications of IE. Concept of Productivity, Work Study and Productivity, Techniques of work study, basic procedure, approach to method study, method study charts and diagrams, principles of motion economy, **UNIT II** Work measurement; basic procedure, techniques: Stop watch time study and	**BTME405: Manufacturing Processes** **Unit** 1 Introduction: Objective, scope and outcome of the course. General Classification and Introduction to Manufacturing processes. Foundry Technology: Casting: Definition and major classification; Casting materials, Patterns: types, material and pattern allowances. Moulding sands; composition, preparation, properties and testing; Grain fineness; moisture content, clay content and permeability test. Core & core prints; Gating system: types, pouring basin, sprue, runner and risers; Melting, pouring and solidification. Principles and method of floor mould casting, shell	

		work sampling, rating, determination of standard time, Evolutionof Management Theory, scientific management, Contributions of Taylor, Fayol , Mayo to scientific management, Levels of Management Administration and Management, fundamental functions of management, Decision making. **UNIT III** Business Forms and Organization: Forms of Business: Single proprietorship, partnership, joint stock company, co-operative society, State undertakings. Formation of Joint Stock Companies: Registration, issue of Prospectus, Commencement Certificate. Organization: meaning, Types of organization; Line, Functional, Line Staff organization and line Staff Committee organization, span of control. Finance & Financial Statements: Introduction, Needs of Finance, Kinds of Capital, Sources of fixed capital, Shares. Borrow capital, surplus profits. **UNIT IV** Sources of working capital and its management, Profit & Loss Statement, Balance Sheet, Financial ratios: Liquidity ratio, Profits investment ratio, equity ratio, inventory ratio. Time value of money: Simple and compound interest, Time value equivalence, Compound interest factors, Cash flow diagrams, Calculation of time –value equivalences. Present worth comparisons, Comparisons of assets with equal, unequal life, comparison of deferred investments, Time value of money II: Future worth comparison, payback period comparison. Rate of return, internal rate of return, comparison of IRR with other methods **UNIT V** Depreciation: Causes, Basic methods of computing depreciation charges; Straight line, Sinking fund, Declining Balance and Sum of year's digits method. Breakeven analysis: Basic concepts, Linear Breakeven analysis for single product, Breakeven charts, Dumping.	mould casting, pit mould and loam mould casting; centrifugal casting, investment casting; Permanent mould casting. Die casting; Slush casting. Casting defects; types, causes and remedy **Unit** 2 Forming Processes: Classification; Hot working and cold working; principle, advantages, disadvantages and applications. Forging: Classification, drop forging and press forging methods and use; Forging dies; types, materials. Rolling: Characteristics and applications of hot rolling and cold rolling; **Unit** 3 Extrusion; Work materials and products; Press tool works; Basic principles, system, perations and applications. Shearing; Parting, notching, trimming, nibbling, blanking and piercing, Drawing: wire drawing, tube drawing and deep drawing. **Unit** 4 Metal Joining Processes: Welding, Brazing and soldering, classification of welding process, Principle, characteristics and applications of gas welding, thermit welding, electrical arc welding; Submerged arc welding; TIG and MIG welding; Resistance welding; Spot welding; Butt welding; Seam welding; Projection welding. Principles and process details of Forge welding; Friction welding; Diffusion welding; Ultrasonic welding. Explosive welding. Welding defects; Types, causes, effects and remedy. Electrodes and Electrode Coatings **Unit** 5 Powder Metallurgy: Properties of Powder processed materials, Powder manufacturing, mechanical pulverization, sintering, Electrolytic Process, chemical reduction, atomization, properties of metal powders, compacting of powders sintering, advantages and applications of Powder metallurgy.	
42	**BTME406**	**I.C. Engines** **UNIT I**	**BTME406: Theory of Machines** **Unit** 1 Introduction: Objective, scope and	New Course

		History of IC engines: Nomenclature, Classification & Comparison, SI & CI, 4stroke- 2 stroke, First Law analysis, Energy Balance. Fuel-air cycles, Actual cycles. Testing & Performance: Performance parameters, Measurement of operating parameters e.g. speed, fuel & air consumption, Powers, IHP, BHP, FHP, Efficiencies Thermal, Mechanical, Volumetric, Emission Measurement, Indian & International standards of Testing, Emission. **UNIT II** Fuel & Combustion: Combustion in CI & SI engines, Ignition Limits, Stages of combustion, Combustion parameters. Delay period and Ignition Lag, Turbulence and Swirl, Effects of engine variables on combustion parameters, abnormal combustion in CI & SI engines, Detonation & knocking, Theories of detonation, Control of abnormal combustion, Combustion chamber design principles, Types of combustion chamber. Fuel: Conventional Petroleum, structure, Refining Fuels for SI & CI engines, Knock rating, Additives, Fuels for Turbine & Jet Propulsion. Alternative Fuels: Methanol, Ethanol, Comparison with gasoline, Manufacturing, Engine performance with pure Methanol, Ethanol & blends, Alcohols with diesel engine, Vegetable oils, Bio gas. **UNIT III** Engine Systems & Components: Fuel System (SI Engine), Carburetion & Injection, process & parameters, properties of A/F mixture, Requirements of A/F ratios as per different operating conditions, Carburetors, types, Aircraft carburetor, comparison of carburetion & injection, F/A ratio calculations. CI engine: Mixture requirements & constraints, Method of injection, Injection systems, CRDI etc. system components, pumps injectors. Ignition system: Conventional & Modern ignition systems Magneto v/s Battery, CB point v/s Electronic ignition, Fuel Ignition Energy requirements. Spark advance, centrifugal, vacuum Firing order, spark plugs. **UNIT IV** Engine Friction & Lubrication : Determination of friction, Lubrication principles, Types of lubrication, Places of lubrication Bearings and piston rings etc.,	outcome of the course. Introduction to mechanism: Basic concept of machines, links, kinematic pair, kinematic chain and mechanism. Inversions of kinematic chains : four bar chain mechanisms, quick return mechanisms, inversions of double slider crank mechanisms. Velocity and acceleration in mechanism: Velocity and acceleration polygons, relative velocity and instantaneous centre method **Unit** 2 Friction devices: Types and laws of friction. Pivots and collars. Power screws such as lead screw of the lathe. Clutches: Single and multi-plate clutches. Brakes: Band, block and band and block brakes. **Unit** 3 Gears: Laws of gearing, gears terminology; tooth form; interference, undercutting and minimum number of teeth on pinion. Rack and pinion, Spur, helical, basic introduction of bevel, worm and worm gears. Gear Trains: Simple, compound and epicyclic gear trains. **Unit** 4 Cams: Type of cams; displacement, velocity and acceleration curves for different cam followers; consideration of pressure angle and wear. Gyroscope: Principles of gyroscopic couple, effect of gyroscopic couple and centrifugal force on vehicles taking a turn, stabilization of ship. **Unit** 5 Balancing: Balancing of rotating masses in same and different planes, balancing of reciprocating masses, swaying couple, hammer blow and tractive effort	

		Functions of Lubrication, Properties, Rating and Classification of lubricating oil, Additives, Lubrication systems. Engine Cooling: Requirements of cooling, Areas of heat flow, High temperature regions of combustion chamber. Heat Balance, Cooling Systems, Air, Water Cooling, Cooling system components. Supercharging: Objectives, Thermodynamic cycle & performance of super charged SI & CI engines, Methods of super charging, Limitations, Two stroke engines: Comparison of 4s & 2s engines construction & valve lining scavenging. Process parameters, systems, supercharging of 2 stroke engines. **UNIT V** Dual & Multi fuel engines: Principle, fuels, Combustion, performance Advantages, Modification in fuel system. Special Engines: Working principles of Rotary, Stratified charge, Free piston, Variable compression ratio engines.		
43	**BTME407**	**Kinematics of Machine Lab** **List Of Experiments** 1. To study inversions of four bar chain: Coupling Rod, Beam Engine 2. To study Steering Mechanisms; Davis and Ackerman. 3. Study of quick return mechanism and draw velocity and acceleration diagram. 4. Study of inversion of Double slider chain Oldham Coupling, Scotch Yoke and Elliptical Trammel. 5. Study of various cam-follower arrangements. 6. To plot displacement v/s angle of rotation curve for various cams 7. To determine co-efficient of friction using two roller oscillating arrangement. 8. Study of various types of dynamometers, Brakes and Clutches. 9. To determine moment of inertia of the given object using of Trifler suspension. 10. Perform study of the following using Virtual Lab http://www.vlab.co.in/ 11. Position, velocity and acceleration analysis of Grashof four bar mechanism 12. Position, velocity and acceleration analysis of Slider Crank mechanism	**BTME407: Digital Electronics Lab** 1 To verify the truth tables of basic logic gates: AND, OR, NOR, NAND, NOR. Also to verify the truth table of Ex-OR, Ex-NOR (For 2, 3 & 4 inputs using gates with 2, 3, & 4 inputs). 2 To verify the truth table of OR, AND, NOR, Ex-OR. Ex-NOR realized using NAND & NOR gates. 3 To realize an SOP and POS expression. 4 To realize Half adder/ Subtractor & Full Adder/ Subtractor using NAND & NOR gates and to verify their truth tables. 5 To realize a 4-bit ripple adder/ Subtractor using basic half adder/ Subtractor & basic Full Adder/ Subtractor. 6 To verify the truth table of 4-to-l multiplexer and l-to-4 demultiplexer. Realize the multiplexer using basic gates only. Also to construct and 8-to-1 multiplexer and l-to-8 demultiplexer using blocks of 4-to-1 multiplexer and 1-to-4 demulriplexer. 7 Design & Realize a combinational circuit that will accept a 2421 BCD code and drive a TIL -3 l 2 seven-segment display. 8 Using basic logic gates, realize the R-S, J-K and D-flip flops with and without clock signal and verify their truth table. 9 Construct a divide by 2, 4 & 8 asynchronous counter. Construct a 4-bit binary counter and ring counter for a particular output pattern using D flip flop.	New Course

			10 Perform input/output operations on parallel in/parallel out and Serial in/Serial out registers using clock. Also exercise loading only one of multiple values into the register using multiplexer.	
44	**BTME 408**	**Fluid Mechanics Lab** **List of Experiments:** 1. Determination of Meta-centric height of a given body. 2. Determination of Cd, Cv & Cc for given orifice. 3. Calibration of contracted Rectangular Notch and / Triangular Notch and determination of flow rate. 4. Determination of velocity of water by Pitot tube. 5. Verification of Bernoulli's theorem. 6.Calibration and flow rate determination using Venturimeter & Orifice meter and Nozzle meter 7. Determination of head loss in given length of pipe. 8. Determination of the Reynold's number forlaminar, turbulent and transient flow in pipe. 9. Determination of Coefficient for minor losses in pipes. 10. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile. 11. To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.	**Fluid Mechanics Lab** 1 Determination of Meta-centric height of a given body. 2 Determination of Cd, Cv & Cc for given orifice. 3 Calibration of contracted Rectangular Notch and / Triangular Notch and determination of flow rate. 4 Determination of velocity of water by Pitot tube. 5 Verification of Bernoulli's theorem. 6 Calibration and flow rate determination using Venturimeter & Orifice meter and Nozzle meter 7 Determination of head loss in given length of pipe. 8 Determination of the Reynold's number for laminar, turbulent and transient flow in pipe. 9 Determination of Coefficient for minor losses in pipes. 10 To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile. 11To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness. 12 Conducting experiments and drawing the characteristic curves of centrifugal pump/submergible pump. 13 Conducting experiments and drawing the characteristic curves of reciprocating pump. 14 Conducting experiments and drawing the characteristic curves of Pelton wheel. 15 Conducting experiments and drawing the characteristics curves of Francis turbine. 16 Conducting experiments and drawing the characteristic curves of Kaplan turbine.	Content Change
45	**BTME409**	**Production Practice-II** **List of Experiments:** 1. To study of single point cutting tool geometry and to grind the tool as per given tool geometry. 2. To study the milling machine, milling cutters, indexing heads indexing methods	**Production Practice Lab** **Turning Shop** 1 To study lathe machine construction and various parts including attachments, lathe tools cutting speed, feed and depth of cut. 2 To perform step turning, knurling and chamfering on lathe machine as per	Content Change, Course Name Change

		and to prepare a gear on milling machine. 3. To machine a hexagonal / octagonal nut using indexing head on milling machine. 4. To cut BSW/Metric internal threads on lathe machine. 5. a) To cut multi-start Square/Metric threads on lathe machine. b) Boring using a boring bar in a centre lathe. 6. Study of capstan lathe and its tooling and prepare a tool layout & job as per given drawing. 7. Demonstration on milling machine for generation of plane surfaces and use of end milling cutters. 8. Grinding of milling cutters and drills. 9. Exercise on cylindrical and surface grinders to machine surfaces as per drawing. 10. Cylindrical grinding using grinding attachment in a centre lathe	drawing. 3 To cut multi-start Square/Metric threads on lathe machine. 4 Boring using a boring bar in a centre lathe and cut BSW/Metric internal threads on lathe machine. 5To perform taper turning using compound rest. **Machine shop** 1 To study the milling machine, milling cutters, indexing heads and indexing methods and to prepare a gear on milling machine. 2 To machine a hexagonal /octagonal nut using indexing head on milling machine. 3 To study of single point cutting tool geometry and to grind the tool as per given tool geometry. 4 To study shaper machine, its mechanism and calculate quick return ratio. To prepare a job on shaper from given mild steel rod. 5 Cylindrical grinding using grinding attachment in a centre lathe **Demonstration and study** 1 Demonstration for job by eccentric turning on lathe machine. 2 Study of capstan lathe and its tooling and prepare a tool layout & job as per given drawing. 3 Demonstration on milling machine for generation of plane surfaces and use of end milling cutters. 4 Grinding of milling cutters and drills. **Foundry Shop** 1 To prepare mould of a given pattern requiring core and to cast it in aluminium. 2 To perform moisture test and clay content test. 3 To perform permeability test 4 A.F.S. Sieve analysis test. 5Strength Test (compressive, Tensile, Shear Transverse etc. in green and dry conditions) and Hardness Test (Mould and Core). **Welding Shop** 1 Hands-on practice on spot welding.	
46	**BTME410**	**Machine Design Sessional - I** **List of Experiments:** 1. Material selection and relevant BIS nomenclature 2. Selecting fit and assigning tolerances 3. Examples of Production considerations 4. Problems on: (a) Knuckle & Cotter joints	**BTME410 Theory of Machines Lab** 1 To study inversions of four bar chain and slider crank mechanism and their practical applications. 2 To study Steering Mechanisms: Davis and Ackerman. 3 Study of quick return mechanism and its practical applications.	New Course

		(b) Torque: Keyed joints and shaft couplings (c) Design of screw fastening (d) Bending: Beams, Levers etc. (e) Combined stresses: Shafts, brackets, eccentric loading.	4Study of inversion of Double slider chain: Oldham Coupling, Scotch Yoke and Elliptical Trammel. 5 Study of various cam-follower arrangements. To plot displacement v/s angle of rotation curve for various cams 6 To determine co-efficient of friction using two roller oscillating arrangement. 7 Study of various types of dynamometers, Brakes and Clutches. 8 Study of differential gear box. 9 To verify the torque relation for gyroscope. 10 To perform wheel balancing. To perform static and dynamic balancing on balancing set up. 11 Study of a lathe gear box, sliding mesh automobile gear box, planetary gear box.	
47	**BTME 411**	**Thermal Engineering Lab-I** 1. Study of working of four stroke petrol engine and four stroke diesel engine with the help of cut section models. 2. Study of working of two stroke petrol and two stroke diesel engine with the help of cut section models. 3. To draw valve timing diagram for a single cylinder diesel engine. 4. Study of various types of boilers. 5. Study of various types of mountings and accessories. 6. Demonstration of steering system and measurement of steering geometry angles and their impact on vehicle performance. 7. Study of braking system with specific reference to types of braking system, master cylinder, brake shoes. 8 . Study of transmission system including clutches, gear box assembly and differential. 9. Study of fuel supply system of a petrol engine (fuel pump and simple carburetor) 10. Study of fuel supply system of a Diesel engine (fuel pump and fuel injector) 11. Study of Ignition systems of an IC Engine (Battery and Magneto ignition system) and Electronic ignition system. 12. Study of Lubrication system of an IC Engine (mist, splash and pressure lubrication)		Code Change

		13. Study of cooling systems of an IC Engine (air cooling and water cooling)		
48	**BTME501**	**HEAT TRANSFER** **UNIT I:** Introduction: Heat transfer processes, conduction and radiation. Fourier's law of heat conduction, thermal conductivity, thermal conductivity of solids, liquids and gases, effect of temperature on thermal conductivity. Newton's law of cooling, definition of overall heat transfer coefficient. General parameters influence the value transfer coefficient. Conduction: General 3-Dimensoinal conduction equation in Cartesian, cylindrical and spherical coordinates; different kinds of boundary conditions; nature of differential equations; one dimensional heat conduction with and without heat generation; electrical analogy; heat conduction through composite walls; critical thickness of insulation **UNIT II:** Heat transfer from extended surfaces: Governing differential equation of fin, fin efficiency and effectiveness for different boundary conditions. Unsteady state heat conduction for slab, cylinder and sphere, Heisler chart. Convection: Review of Navier – Stokes and energy equation, hydrodynamic and thermal boundary layers; laminar boundary layer equations; forced convection appropriate non dimensional members; effect of Prandtl number; empirical relations for flow over a flat plate and flow through pipes. **UNIT III:** Natural convection: Dimensional analysis, Grashoff boundary layers in external flows (flow over a flat plate only), boundary layer equations and their solutions, heat transfer correlations. Heat transfer with change of phase: Nature of vaporization phenomena; different regimes of boiling heat transfer; correlations for saturated liquid vaporization; condensation on flat plates; correlation of experimental results, drop wise condensation. **UNIT IV:** Heat exchanger: Types of heat exchangers, arithmetic and logarithmic mean temperature differences, heat	**MECHATRONIC SYSTEMS** Unit 1. Introduction: Objective, scope and outcome of the course. Overview of Mechatronics: Historical perspective, Definition, Applications, Block diagram of Mechatronic system, Functions of Mechatronics Systems, Systems Engineering, Verification Vs Validation, Benefits of mechatronics in manufacturing. Electrical and Electronic Systems: Electrical circuits and Kirchhoff's laws, Network Theorems and AC circuit Analysis, Transformers, Analog Devices, Signal Conditioning, Digital Electronics, Data Acquisition systems. Unit2. Modeling, Analysis and Control of Physical Systems: Basics of System Modeling: LTI and LTV systems, Need for modeling, Types of modeling, Steps in modeling, Building blocks of models, Modelling of one and two degrees of freedom systems, Modeling of Electromechanical systems, Mechanical Systems, Fluid systems, Thermal systems; Dynamic Responses, System Transfer Functions, State Space Analysis and System Properties, Stability Analysis using Root Locus Method, Stability Analysis using Bode Plots, PID Controllers (with and without Time Delay) Unit 3. Sensors and Actuators: Static characteristics of sensors and actuators, Position, Displacement and Proximity Sensors, Force and torque sensors, Pressure sensors, Flow sensors, Temperature sensors, Acceleration sensors, Level sensors, Light sensors, Smart material sensors, Micro and Nano sensors, Selection criteria for sensors, Actuators: Electrical Actuators (Solenoids, Relays, Diodes, Thyristors, Triacs, BJT, FET, DC motor, Servo motor, BLDC motor, AC motor, Stepper motors), Hydraulic and Pneumatic actuators, Design of Hydraulic and Pneumatic circuits, Piezoelectric actuators, Shape memory alloys. Unit 4. Microprocessors, Microcontrollers and Programmable Logic Controllers: Logic Concepts and Design, System Interfaces, Communication and Computer Networks, Fault Analysis in Mechatronic Systems,	Code Change

		transfer coefficient for parallel, counter and cross flow type heat exchanger; effectiveness of heat exchanger, N.T.U. method, fouling factor. Constructional and manufacturing aspects of Heat Exchangers. **UNIT V:** Thermal Radiation: Plank distribution law, Kirchhoff's law; radiation properties, diffuse radiations; Lambert's law. Radiation intensity, heat exchange between two black bodies heat exchanger between gray bodies. Shape factor; electrical analogy; reradiating surfaces heat transfer in presence of reradiating surfaces.	Synchronous and Asynchronous Sequential Systems, Architecture, Microcontrollers. Unit 5. Programmable Logic Controllers (PLCs): Architecture, Number Systems Basics of PLC Programming, Logics, Timers and Counters, Application on real time industrial automation systems.Case Studies: Design of pick and place robot, Car engine management system, Automated manufacturing system, Automatic camera, Automatic parking system, Safety devices and systems.	
49	**BTME 502**	**Dynamics of Machines** **UNIT I:** Governors: Comparison between flywheel and governor, Types of governor, Watt, Porter, Proell, Hartnell and spring controlled governors, sensitiveness of governors, stability of governors, isochronous and hunting, governor effort, power, controlling force diagram. **UNIT II:** Gyroscope: Principle of gyroscopic couple, effect of gyroscopic couple and centrifugal force on aero planes, ships and vehicle taking a turn, stabilization of sea vessels, stability of four wheeled vehicle moving in a curved path, curved path with banking, stability vehicle, gyroscopic effect on inclined rotating disc Inertia force analysis: Velocity and acceleration of slider crank and four bar mechanism, inertia force, piston thrust connecting rod, turning moment diagram, and flywheel. **UNIT III:** Gears: Classification, terminology, law of gearing, velocity of sliding, gear tooth profile, comparison of cycloidal and involute tooth profile, standard interchangeable tooth profile, length of path of contact, arc of contact, contact ratio, interference, undercutting, minimum number of teeth on pinion in contact with gear or rack, bevel, helical and spiral gears. **UNIT IV:** Gear Trains: Simple, compound, reverted and epicyclic gear trains, analytical, tabular, graphical and vector methods for finding velocity ratio, gear boxes- sliding and constant mesh, synchromesh and differential gear box.	**HEAT TRANSFER** Unit1. Introduction: Objective, scope and outcome of the course. Introduction: Heat transfer processes, conduction and radiation. Fourier's law of heat conduction, thermal conductivity, thermal conductivity of solids, liquids and gases, effect of temperature on thermal conductivity. Newton's law of cooling, definition of overall heat transfer coefficient. General parameters influence the value of heat transfer coefficient. Conduction: General 3-Dimensoinal conduction equation in Cartesian, cylindrical and spherical coordinates; different kinds of boundary conditions; nature of differential equations; one dimensional heat conduction with and without heat generation; electrical analogy; heat conduction through composite walls; critical thickness of insulation. Unit 2. Heat transfer from extended surfaces: Governing differential equation of fin, fin efficiency and effectiveness for different boundary conditions. Unsteady state heat conduction for slab, cylinder and sphere, Heisler chart. Convection: Review of Navier – Stokes and energy equation, hydrodynamic and thermal boundary layers; laminar boundary layer equations; forced convection appropriate non dimensional members; effect of Prandtl number; empirical relations for flow over a flat plate and flow through pipes. Unit 3. Natural convection: Dimensional analysis, Grashoff number, boundary layers in external flows (flow over a flat plate only), boundary layer equations and their solutions, heat transfer	Code Change

		UNIT V: Balancing: Need of balancing, Balancing of rotating masses, single plane, different planes, balancing of reciprocating cylinder engine, multi-cylinder inline engines, V-engines, concept of direct and reverse cranks, partial balancing of locomotives, IC engines, V engines and balancing machines.	correlations.Heat transfer with change of phase: Nature of vaporization phenomena; different regimes of boiling heat transfer; correlations for saturated liquid vaporization; condensation on flat plates; correlation of experimental results, drop wise condensation. Unit 4. Heat exchanger: Types of heat exchangers, arithmetic and logarithmic mean temperature differences, heat transfer coefficient for parallel, counter and cross flow type heat exchanger; effectiveness of heat exchanger, N.T.U. method, fouling factor. Constructional and manufacturing aspects of Heat Exchangers. Unit 5. Thermal Radiation: Plank distribution law, Krichoff's law; radiation properties, diffuse radiations; Lambert's law. Radiation intensity, heat exchange between two black bodies heat exchanger between gray bodies. Shape factor; electrical analogy; reradiating surfaces heat transfer in presence of reradiating surfaces.	
50	**BTME 503**	**Measurement & Metrology** **UNIT I:** Concept of measurement: General concept of measurement, Need for measurement, Generalized measuring system, Units, Standards, Sensitivity, Readability, Range of accuracy, Precision, Accuracy Vsprecision, Uncertainty. Repeatability and reproducibility, Errors in measurement, Types of error, Systematic and random error, Comparison between systematic error and random error, Correction, Calibration, Interchangeability. **UNIT II:** Linear and angular measurements: Linear measuring instruments: Vernier caliper, Micrometer, Interval measurements:- Slip gauges, Checking of slip gauges for surface quality, Optical flat, Limit gauges:- Gauge design, Problems on gauge design, Application of limit gauges; Comparators:- Mechanical comparators, Electrical comparator, Optical comparator, Pneumatic comparator; Sine bar, Use of sine bar, Limitations of sine bars, Sources of error in sine bars, Bevel protractor, Applications of bevel protractor , Autocollimator, Angle Dekkor **UNIT III:** Form measurement: Introduction, Screw	**MANUFACTURING TECHNOLOGY** Unit1. Introduction: Objective, scope and outcome of the course. Classification of metal removal process and machines: Geometry of single point cutting tool and tool angles, tool nomenclature in ASA, ORS. Conce oblique cutting. Type of chips, Mechanics of metal cutting; interrelationships between cutting force, shear angle, strain and strain rate. Thermal aspects of machining and measurement of chip tool interface temperature. Unit 2. Concept of machinability, machinability index, factors affecting machinability, Different mechanism of tool wear. Types of tool wear (crater, flank etc), Concept of tool life. Taylor's tool life equation. Introduction to economics of machining. Cutting fluids: Types, properties, selection and application methods Unit 3. Basic machine tools: Constructional configuration, estimation of machining time on lathe, drilling, shaping, milling, grinding, Gear cutting on milling, Gear hobbling. Special Purpose Machine Tools: Automatic lathes, capstan and turret lathe machines, operational planning and turret tool layout, sequence of operations. Unit 4 Introduction to Grinding and	New Course

		thread measurement, Thread gauges, Measurement of gears: Gear errors, Spur gear measurement, Parkinson gear tester, Problems on gear measurement. Surface finish measurement:- Introduction, Elements of surface texture, Analysis of surface finish, Methods of measuring surface finish, Straightness measurement, Flatness testing, Roundness measurements **UNIT IV:** Laser and advances in metrology: Laser metrology, Laser telemetric system, Laser and led based distance measuring instruments, pattern formed in a laser, Principle of laser, Interferometry, Use of laser in interferometry, Laser interferometry. Machine tool metrology: Various geometrical checks on machine tool, Laser equipment for alignment testing, Machine tools tests, Alignment tests on lathe, milling machine, pillar type drilling machine, Acceptance tests for surface grinders, Coordinate measuring machine (CMM):- Types of CMM, Features of CMM, Computer based inspection, Computer aided inspection using robots. **UNIT V:** Measurement of power, flow and temperature related properties Measurement of force, Direct methods, Indirect methods:- Accelerometer, Load cells, Bourdon tube. Torque measurement: Prony brake, Torque measurement using strain gauges, Torque measurement using torsion bars, Measurement of power: Mechanical dynamometers, D.C. dynamometer, Eddy current or inductor dynamometers Measurement of flow: Orifice meter, Venturimeter, Flow nozzle, Variable area meters – rotameter, Hot wire anemometer, Pitot tube. Temperature measurement, Bimetallic strip, Calibration of temperature measuring devices, Thermocouples (Thermo electric effects), Thermistors, Pyrometers	different methods of grinding, Abrasives; natural and synthetic, manufacturing and selection of grinding wheels, Wheel specifications. Honing, lapping, superfinishing. Unit 5 High Velocity Forming Methods: Definition; Hydraulic forming, Explosive forming, Electro-hydraulic forming, Magnetic pulse forming.	
51	**BTME 504**	**Quality Assurance and Reliability** **<u>UNIT I:</u>** The meaning of Quality and quality improvement, dimensions of quality, history of quality methodology, quality control, Quality of design and quality of conformance, Quality policy and objectives, Economics of quality.	**DESIGN OF MACHINE ELEMENTS – I** Unit 1 Introduction: Objective, scope and outcome of the course. Materials: Mechanical Properties and IS coding of various materials, Selection of material from properties and economic aspects. Unit 2 Manufacturing Considerations in Design: Standardization,	Code Change

		Modeling process quality: Describing variation, frequency distribution, continuous and discrete, probability distributions, pattern of variation, Inferences about process quality: sampling distributions and estimation of process parameters. Analysis of variance. **UNIT II:** Statistical Quality Control: Concept of SQC, Chance and assignable causes of variation, statistical basis of control chart, basic principles, choice of control limits, sample size and sampling frequency, analysis of patterns on control charts. The magnificent seven Control chart for variables,: X-bar and R charts, X-bar and S charts, control chart for individual measurement. Application of variable control charts. **UNIT III:** Control chart for attributes: control chart for fraction non conforming P-chart, np-chart, c-chart and u-chart. Demerit systems, choice between attribute and variable control chart. SPC for short production runs. Process capability analysis using histogram and probability plot, capability ratios and concept of six sigma. **UNIT IV:** Quality Assurance: Concept, advantages, field complaints, quality rating, quality audit. Acceptance Sampling: Fundamental concepts in acceptance sampling, operating characteristics curve. Acceptance sampling plans, single, double and multiple sampling plans, LTPD, AOQL, AOQ Introduction to Quality systems like ISO 9000 and ISO 14000. **UNIT V:** Reliability and Life Testing- Failure models of components, definition of reliability, MTBF, Failure rate, common failure rate curve, types of failure, reliability evaluation in simple cases of exponential failures in series, paralleled and series-parallel device configurations, Redundancy and improvement factors evaluations. Introduction to Availability and Maintainability Introduction to Taguchi Method of Design of Experiments, Quality loss function.	Interchangeability, limits, fits tolerances and surface roughness, BIS codes, Design consideration for cast, forged and machined parts. Design for assembly. Design for Strength: Modes of failure, Strength and Stiffness considerations, Allowable stresses, factor of safety, Stress concentration: causes and mitigation, fatigue failures. Unit 3 Design of Members subjected to direct stress: pin, cotter and keyed joints. Design of Members in Bending: Beams, levers and laminated springs. Design for stiffness of beam: Use of maximum deflection formula for various end conditions for beam design Unit 4 Design of Members in Torsion Shaft and Keys: Design for strength, rigidity. Solid and hollow shafts. Shafts under combined loading. Sunk keys. Couplings: Design of muff coupling, flanged couplings: rigid and flexible Unit 5 Design of Threaded fasteners: Bolt of uniform strength, Preloading of bolts: Effect of initial tension and applied loads, Eccentric loading Power screws like lead screw, screw jack Design of members which are curved like crane hook, body of Cclamp, machine frame etc.	
52	**BTME505**	**SOCIOLOGY AND ECONOMICS FOR ENGINEERS** **UNIT I:**	**BTME505: PRINCIPLES OF MANAGEMENT** Unit 1 Introduction: Objective, scope and outcome of the course. Basic concepts of	New Course

		Introduction to sociological concepts-structure, system, organization, social institutions, Culture social stratification (caste, class, gender, power).State & civil society. Social change in contemporary India: Modernization and globalization, Secularism and communalism, Nature of development, **UNIT II:** Processes of social exclusion and inclusion, Changing nature of work and organization. Political economy of Indian society. Industrial, Urban, Agrarian and Tribal society; Caste, Class, Ethnicity and Gender; Ecology and Environment **UNIT III:** Basic Principles and Methodology of Economics. Demand/Supply – elasticity –. Theory of the Firm and Market Structure. Basic Macroeconomic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes. **UNIT IV:** Public Sector Economics –Welfare, Externalities, Labour Market. Components of Monetary and Financial System, Central Bank – Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets.Monetary and Fiscal Policy Tools & their impact on the economy – Inflation and Phillips Curve **UNIT V:** Indian economy Brief overview of post independence period – plans. Post reform Growth, Structure of productive activity. Issues of Inclusion– Sectors, States/Regions, Groups of people (M/F), Urbanization. Employment–Informal, Organized, Unorganized, Public, Private. Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors.	management: Definition – Need and Scope – Different schools of management thought – Behavioural, Scientific, Systems, and Contingency Contribution of Management Thinkers: Kautilya, Taylor, Fayol, Peter Drucker and C.K. Prahlad. Unit 2 Functions of Management: Planning: Essentials of Planning and Managing by Objectives; Strategies, Policies and Planning Premises; Decision making.Organizing The Nature of organizing, Entrepreneuring, and Reengineering; Organizational Structure, Departmentation; Line/staff authority, empowerment, and decentralization; Effective organizing and organization culture; Unit 3 Staffing Human resource Management and Selection; Performance Appraisal and Career Strategy; managing change through Manager and Organization Development. Unit 4Leading Human Factors and Motivation; Leadership: Committees, Terms, and Group Decision making; Communication. Controlling The system and process of controlling; Control Techniques and Information Technology; Productivity, Operations Management and Total Quality Management. Unit 5 Management practices of: Dhirubhai Ambani, Narayan Murthy, Premji, Ratan Tata, Steve Jobs, Bill Gates. Studying organizational structures of any 10 companies and classifying them into different types of organizations which are studied above and justifying why such structures are chosen by those organizations. Preparing the leadership profiles of any 5 business leaders and studying their leadership qualities.	
53	**BTME506A**	**Computer Aided Design and Graphics** **UNIT I:** Overview of Computer Graphics: Picture representation, Coordinate Systems, Raster Scan Display, DDA for line generation and Bresenham's algorithm for line and circle generation; Graphics standards: GKS, IGES, STEP,	**BTME506.1: STEAM ENGINEERING** Unit 1 Introduction: Objective, scope and outcome of the course. Steam generators: Classification of Boilers, water and fire tube boilers, High pressure boilers, Advantages of high pressure Boilers, Natural and forced circulation boilers, Water wall. Steam drum internal, steam	Code Change

		DXF. Different types of models. Parametric representation of plane curves: line, circle, ellipse,parabola and hyperbola. **UNIT II:** Parametric representation of Space Curves: Cubic spline curve, Bezier Curve and B Spline Curves. Blending of Curves. Parametric representation of Surfaces: Hermite Bicubic surfaces, Bezier surfaces and Bspline surfaces. **UNIT III:** **Solid Representation:** B-rep. and CSG. Comparison between three types of models. **UNIT IV:** **Two and Three Dimensional Transformation of Geometric Models:** Translation, Scaling Reflection, Rotation and Shearing, Homogeneous Representation, Combined Transformation. **Projection of Geometric models**: Parallel and Perspective Projection. **UNIT V:** **Clipping:** Point clipping, Line clipping, Cohen- Sutherland algorithm etc., Viewing transformation. **Hidden line and surface removal**: Techniques and Algorithms. Shading and Rendering.	super heaters, Economizers, air preheater, induced, forced and balanced draught boilers, Fluidized bed boilers Unit 2 Definition and type of nozzle and diffuser equation of continuity, sonic velocity, mach no. and stagnation properties, the steady flow energy equation for nozzles, momentum energy equation for flow through steam nozzles nozzle efficiency, effect of friction, nozzle for uniform pressure drop, throat pressure for maximum discharge or chock flow, critical pressure ratio, design of nozzle and diffuser. Unit 3 Steam Turbines: Principle and working of steam turbines, type of turbines, compounding for pressure and velocity. Overview and difference of various type of turbine, different types of governing of turbines. Impulse turbine: The effect of blade friction on velocity diagram. Force, work and power, Blade or diagram efficiency, Gross stage efficiency, steam speed to blade, speed ratio for optimum performance, turbine performance at various loads Unit 4 Impulse reaction turbine: Velocity diagram and work done, degree of reaction, Parson turbine, blade efficiency, gross stage efficiency comparison of enthalpy drop in various stages, size of blades in impulse reaction turbines for various stages of impulse reaction and impulse turbine. Regenerative Feed Heating Cycles: Introduction, Ideal regenerative feed heating cycle, Regenerative heating cycles and their representation on T-s and h-s Diagram, Representation of actual process on T-s and h-s Diagram Regenerative cycles, types of feed heating arrangements, Optimum feed water temperature and saving in Heat Rate. direct contact and surface heaters. Unit 5 Reheating of steam: Practical reheating and Non- reheating cycles, advantage and disadvantages of reheating, reheat regenerative cycle, regenerative water extraction cycles. Process heat and by product power cycle, pass out turbine, Binary vapour cycle. Condensers.	
54	**BTME 506B**	**AUTOMOBILE ENGINEERING** **UNIT I.** **Frame & Body:** Layout of chassis, types of chassis frames and bodies, their constructional features and materials.	**AUTOMOBILE ENGINEERING** Unit 1 Introduction: Objective, scope and outcome of the course. Frame & Body: Layout of chassis, types of chassis frames and bodies, their constructional features	No Change

		Clutches: single plate, multi-plate, cone clutch, semi centrifugal, electromagnetic, vacuum and hydraulic clutches. Fluid coupling. **Brakes:** Classification and function; Mechanical, hydraulic, vacuum air and self engineering brakes; Brake shoes and lining materials. **UNIT II.** **Gear Boxes**: Sliding mesh, constant mesh, synchromesh and epicyclic gear boxes, Automatic transmission system; Hydraulic torque converter; **Drives**: Overdrive, Propeller shaft, Universal joints, Differential; Rear axle drives. Hotchkiss and torque tube drives; Rear axle types; Front wheel and All wheel drive. **UNIT III** **Wheels and Tyres**: Tyre types, Tyre construction; Tyre inflation pressure, Tyre wear and their causes; Re-treading of the tyre, **Steering system:** steering gear boxes, Steering linkages, Steering mechanism, Under and Over steering. Steering Geometry, Effect of Camber, caster, king pin inclination, toe in and toe out; Power steering; Integral and linkage types **Suspension system:** objective and requirements, Suspension spring, front and rear suspension systems, Independent suspension system Shock absorbers. **UNIT IV** **Automotive Electrical System:** Battery construction, Charging and testing, battery types, Starting and Battery Charging System: Starter motor construction, types of drive, Alternator construction, regulation and rectification. **Ignition System:** Magneto and coil ignition systems, System components and requirements, Automotive lighting: Wiring systems Electrical instruments; head lamp, electric horn, fuel level indicator. **UNIT V** **Automotive Air Conditioning:** Introduction, Loads, Air conditioning system Components, Refrigerants, Fault Diagnosis. **Automotive Safety:** Safety requirements, Safety Devices, Air bags, belts, radio ranging, NVS (Night Vision	and materials. Clutches: single plate, multi-plate, cone clutch, semi centrifugal, electromagnetic, vacuum and hydraulic clutches. Fluid coupling. Brakes: Classification and function; Mechanical, hydraulic, vacuum air and self engineering brakes; Brake shoes and lining materials. Unit 2 Gear Boxes: Sliding mesh, constant mesh, synchromesh and epicyclic gear boxes, Automatic transmission system; Hydraulic torque converter; Drives: Overdrive, Propeller shaft, Universal joints, Differential; Rear axle drives. Hotchkiss and torque tube drives; Rear axle types; Front wheel and All wheel drive. Unit 3 Wheels and Tyres: Tyre types, Tyre construction; Tyre inflation pressure, Tyre wear and their causes; Re-treading of the tyre, Steering system: steering gear boxes, Steering linkages, Steering mechanism, Under and Over steering. Steering Geometry, Effect of camber, caster, king pin inclination, toe in and toe out; Power steering; Integral and linkage types , Suspension system: objective and requirements, Suspension spring, front and rear suspension systems, Independent suspension system Shock absorbers. Unit 4 Automotive Electrical System: Battery construction, Charging and testing, battery types, Starting and Battery Charging System: Starter motor construction, types of drive, Alternator construction, regulation and rectification. Ignition System: Magneto and coil ignition systems, System components and requirements, Automotive lighting: Wiring systems Electrical instruments; head lamp, electric horn, fuel level indicator. Unit 5 Automotive Air Conditioning: Introduction, Loads, Air conditioning system Components, Refrigerants, Fault Diagnosis. Automotive Safety: Safety requirements, Safety Devices, Air bags, belts, radio ranging, NVS (Night Vision System) GPS (Global Positioning System)	

		System) GPS (Global Positioning Systems)		
55	**BTME506C**	**STATISTICS FOR DECISION MAKING** **UNIT I** Introduction - Statistical Terminology: Descriptive statistics or exploratory data analysis, inferential statistics, population, sample, variable, parameter, statistic, random sample. Collecting Data: Historical data, types of studies (comparative,descriptive or noncomparative, observational, experimental), samplesurveys, sampling and nonsampling errors, bias, representative sample, judgment sampling, quota sampling, simple random samples, sampling rate, sampling frame, stratified random sampling, multistage cluster sampling, probability-proportional-to-size sampling, systematicsampling. **UNIT II** Summarizing and Exploring Data: Variable types (categorical,qualitative, nominal, ordinal, numerical, continuous, discrete, interval, ratio), summarizing categorical data (frequency table, bar chart, Pareto chart, pie chart), summarizing numerical data (mean, median), skewness, outliers, measures of dispersion (quantiles, range, variance, standard deviation, interquartile range, coefficient of variation) s tandardized z-scores, histogram, bivariate numerical data (scatter plot, simple correlation coefficient, sample covariance), straight line regression, summarizing time-series data, data smoothing, forecasting techniques. Basic Concepts of Inference: Estimation, hypothesis testing, pointestimation, confidence interval estimation, estimator, estimate, bias and variance of estimator, mean square error, precision and standard error, confidence level and limits, null and alternative hypothesis, type I and II error, probabilities of type I and II error, acceptance sampling, simple and composite hypothesis, P-value, one-sided and two –sided tests. **UNIT III** Inference for Single Samples: Inference for the mean (large samples), confidence intervals for the mean, test for the mean, sample size determination for the z-interval, one-sided and two -sided z-test, inference for the mean (small samples), t	**NON DESTRUCTIVE EVALUATION AND TESTING** Unit 1 Introduction: Objective, scope and outcome of the course. ACOUSTICAL METHODS: Ultrasonic testing- Generation of ultrasonic waves, Horizontal and shear waves, Near field and far field acoustic wave description, Ultrasonic probes-Straight beam, direct contact type, Angle beam, Transmission/reflection type, and delay line transducers, acoustic coupling and media. ULTRASONIC TESTS: Transmission and pulse echo methods, A-scan, B-scan, C-scan, F- scan and P-scan modes, Flaw sizing in ultrasonic inspection: AVG, Amplitude, Transmission, TOFD, Satellite pulse, Multi-modal transducer, zonal method using focused beam. Flow location methods, Signal processing in Ultrasonic NDT; Mimics, spurious echo's and noise. Ultrasonic flaw evaluation. Unit 2 ELECTRO-MAGNETIC METHODS-magnetic particle inspectionintroduction to electrical impedance, principles of eddy current testing, flaw detection using eddy currents Unit 3 RADIOGRAPHIC METHODS: Introduction to x-ray radiography, the radiographic process, X-ray and Gamma ray sources, Geometric principles, Factors governing exposure, radio graphic screens,scattered radiation, arithmetic of exposure, radiographic image quality and detail visibility, industrial X-ray films.X-RAY RADIOGRAPHY PROCESES: Fundamentals of processing techniques, process control, the processing room, special processing techniques, paper radiography, sensitometric characteristics of X-ray films, film graininess signal to noise ratio in radiographs. The photographic latent image, radiation protection. Unit 4 OPTICAL METHODS: holography-Principles and practices of Optical holography, acoustical, microwave, x-ray and electron beam holography techniques. Unit 5 APPLICATIONS: NDT in flaw analysis of Pressure vessels, piping NDT in Castings, Welded constructions, etc., Case studies.	Code Change

		distribution. Inference for Two Samples: Independent sample design, matched pair design, pros and cons of each design, side by side box plots, comparing means of two populations, large sample confidence interval for the difference of two means, large sample test of hypothesis for the difference of two means, inference for small samples (confidence intervals and tests of hypothesis). **UNIT IV** Inference for Proportions and Count Data: Large sample confidence interval for proportion, sample size determination for a confidence interval for proportion, Large sample hypothesis test on proportion, comparing two proportions in the independent sample design (confidence interval and test of hypothesis), chi-square statistic **UNIT V** Simple Linear Regression and Correlation: Dependent and independent variables, probability model for simple linear regression, least squares fit, goodness of fit of the LS line, sums of squares, analysis of variance, prediction of future observation, confidence and prediction intervals, Multiple Linear Regression: Probability model for multiple linear regression, least squares fit, sums of squares. Use Excel, R, and MATLAB®_in the class.		
56	**BTME507**	**Heat Transfer Lab** 1.To Determine Thermal Conductivity of Insulating Powders. 2. To Determine Thermal Conductivity of a Good Conductor of Heat (Metal Rod). 3. To determine the transfer Rate and Temperature Distribution for a Pin Fin. 4. To Measure the Emissivity of the Test plate Surface. 5. To Determine Stefan Boltzmann Constant of Radiation Heat Transfer. 6. To Determine the Surface Heat Transfer Coefficient For Heated Vertical Cylinder in Natural Convection. 7. Determination of Heat Transfer Coefficient in Drop Wise and Film Wise condensation. 8. To Determine Critical Heat Flux in Saturated Pool Boiling. 9. To Study and Compare LMTD and Effectiveness in Parallel and Counter Flow Heat Exchangers.	**MECHATRONICS LAB.** NAME OF EXPERIMENT 1 Using Transducers Kit :- ➢ Characteristics of LVDT ➢ Principle & Characteristics of Strain Gauge ➢ Characteristics of Summing Amplifier ➢ Characteristics of Reflective Opto Transducer 2 Mobile Robot ➢ Program for Operating Buzzer Beep ➢ Program for Operating Motion control ➢ Program for Operating Direction control ➢ Program for Operating White line follower for the given arena 3 PLC PROGRAMMING ➢ Ladder programming on Logic gates ,Timers & counters ➢ Ladder Programming for digital &	New Course

		10. To Find the Heat transfer Coefficient in Forced Convection in a tube. 11. To study the rates of heat transfer for different materials and geometries 12.To understand the importance and validity of engineering assumptions through the lumped heat capacity method.	Analogy sensors ➢ Ladder programming for Traffic Light control, Water level control and Lift control Modules 4 MATLAB Programming ➢ Sample programmes on Mat lab ➢ Simulation and analysis of PID controller using SIMULINK Important Note: It is mandatory for every student to undertake a Mini project. Mini project shall be a group activity. A group shall consist of maximum five students. Final evaluation of sessional component shall include 30% weight age to mini project. Mini project can be integration of sensor, actuator and transduction units for various home and office applications.	
57	**BTME 508**	**Dynamics of Machines Lab** 1.To verify the torque relation for gyroscope. 2. To plot force vs. radius and lift vs. speed curves for governors. 3. To plot pressure distribution curves on a journal bearing. 4. To perform wheel balancing. 5. To perform static and dynamic balancing on balancing set up. 6. To determine mass moment of inertia of a flywheel. 7. Study of a lathe gear box. 8. Study of a sliding mesh automobile gear box. 9. Study of a planetary gear box.	**HEAT TRANSFER LAB.** NAME OF EXPERIMENT 1 To Determine Thermal Conductivity of Insulating Powders. 2 To Determine Thermal Conductivity of a Good Conductor of Heat (Metal Rod). 3 To determine the transfer Rate and Temperature Distribution for a Pin Fin. 4 To Measure the Emissivity of the Test plate Surface. 5 To Determine Stefan Boltzmann Constant of Radiation Heat Transfer. 6 To Determine the Surface Heat Transfer Coefficient For Heated Vertical Cylinder in Natural Convection. 7 Determination of Heat Transfer Coefficient in Drop Wise and Film Wise condensation. 8 To Determine Critical Heat Flux in Saturated Pool Boiling. 9 To Study and Compare LMTD and Effectiveness in Parallel and Counter Flow Heat Exchangers. 10 To Find the Heat transfer Coefficient in Forced Convection in a tube. 11 To study the rates of heat transfer for different materials and geometries 12 To understand the importance and validity of engineering assumptions through the lumped heat capacity method. Important Note: It is mandatory for every student to undertake a Mini project. Mini project shall be a group activity. A group shall consist of maximum five students. Final evaluation sessional component shall include 30%	Code Change

			weight age to mini project. Heat exchanger design for different applications, designing for thermal insulation, Use of relevant BIS codes for designing	
58	**BTME 509**	**PRODUCTION ENGINEERING LAB** 1. Study of various measuring tools like dial gauge, micrometer, Vernier caliper and telescopic gauges. **2.** Measurement of angle and width of a V-groove by using bevel protector.. **3.** (a) To measure a gap by using slip gauges (b) To compare & access the method of small-bore measurement withthe aid of spheres. **4.** Measurement of angle by using sine bar. **5.**(a) Measurement of gear tooth thickness by using gear tooth Vernier caliper. (b) To check accuracy of gear profile with the help of profile projector. **6.**To determine the effective diameter of external thread by using threewire method. **7.**To measure flatness and surface defects in the given test piece with the help of monochromatic check light and optical flat. **8.**To check the accuracy of a ground, machined and lapped surface - (a)Flat surface (b) Cylindrical surface. **9.**Find out Chip reduction co-efficient (reciprocal of chip thickness ratio) during single point turning. **10.** Forces measurements during orthogonal turning. **11.** Torque and Thrust measurement during drilling. **12.** Forces measurement during plain milling operation. **13.**Measurement of Chip tool Interface temperature during turning using thermocouple technique.	**PRODUCTION ENGINEERING LAB.** NAME OF EXPERIMENT 1 Study of various measuring tools like dial gauge, micrometer, vernier caliper and telescopic gauges. 2 Measurement of angle and width of a V-groove by using bevel protector.. 3 (a) To measure a gap by using slip gauges (b) To compare & access the method of small-bore measurement with the aid of spheres. 4 Measurement of angle by using sine bar. 5 (a) Measurement of gear tooth thickness by using gear tooth vernier caliper. (b) To check accuracy of gear profile with the help of profile projector. 6 To determine the effective diameter of external thread by using three- wire method. 7 To measure flatness and surface defects in the given test piece with the help of monochromatic check light and optical flat. 8 To check the accuracy of a ground, machined and lapped surface - (a) Flat surface (b) Cylindrical surface. 9 Find out Chip reduction co-efficient (reciprocal of chip thickness ratio) during single point turning. 10 Forces measurements during orthogonal turning. 11 Torque and Thrust measurement during drilling. 12 Forces measurement during plain milling operation. 13 Measurement of Chip tool Interface temperature during turning using thermocouple technique. Important Note: It is mandatory for every student to undertake a Mini project. Mini project shall be a group activity. A group shall consist of maximum five students. Final evaluation shall include 30% weight age to mini project. Fabrication of an assembly in which parts shall be machined and standard parts shall be procured.	No Change
59	**BTME 510**	**Professional Ethics and Disaster Management**	**BTME510: MACHINE DESIGN PRACTICE - I** Sessional Work	Code Change

		1.Human values: Effect of Technological Growth and Sustainable Development. Profession and Human Values: Values crisis in contemporary society. Nature of values. Psychological Values, Societal Values and Aesthetic Values. Moral and Ethical values. **2.Professional ethics:** Professional and Professionalism-Professional Accountability, Role of a professional, Ethic and image of profession; Engineering Profession and Ethics: Technology and society, Ethical obligations of Engineering professionals, Roles of Engineers in industry, society, nation and the world; Professional Responsibilities: Collegial_Loyalty, Confidentially, Conflict of Interest, Whistle Blowing. **3 Disaster management:** Understanding Disasters and Hazards and related issues social and environmental. Risk and Vulnerability. Types of Disasters, their occurrence/ causes, impact and preventive measures: Natural Disasters-Hydro-meteorological Based Disasters like Flood, Flash Flood, Cloud Burst, Drought, Cyclone, Forest Fires; Geological Based Disasters like Earthquake, Tsunami, Landslides, Volcanic Eruptions. **Man made Disasters:** Chemical Industrial Hazards, Major Power Break Downs, Traffic Accidents, Fire Hazards, Nuclear Accidents. Disaster profile of Indian continent. Case studies. Disaster Management Cycle and its components. **4** In order to fulfill objectives of course, a) The institute shall be required to organize at least 3 expert lectures by eminent social workers/professional leaders. b) Each student shall compulsorily be required to: i. Visit a social institution/NGO for at least 7 days during the semester and submit a summary report. ii. Perform a case study of a disaster that has occurred in last decade and submit a summary report.	1 Material selection and relevant BIS nomenclature 2 Selecting fit and assigning tolerances 3 Examples of Production considerations 4 Problems on: (a) Knuckle & Cotter joints (b) Torque: Keyed joints and shaft couplings (c) Design of screw fastening (d) Bending: Beams, Levers etc. (e) Combined stresses: Shafts, brackets, eccentric loading.	
60	**BTME601**	**BTME601: DESIGN OF MACHINE ELEMENTS- II** **I** **Fatigue Considerations in Design:** Variable load, loading pattern, endurance stresses, Influence of size, surface finish,	**Measurement & Metrology** **Unit 1:** Introduction: Objective, scope and outcome of the course. Concept of measurement: General concept of measurement, Need for measurement, Generalized measuring system, Units, Standards, Sensitivity, Readability, Range	Code Change

		notch sensitivity and stress concentration. Goodman line, Soderberg line, Design of machine members subjected to combined, steady and alternating stresses. Design for finite life, Design of Shafts under Variable Stresses, Bolts subjected to variable stresses. **II** **Design of IC Engine components:** Piston, Cylinder, Connecting Rod and Crank Shaft. **III** Design of helical compression, tension, torsional springs, springs under variable stresses. **4** Design of belt, rope and pulley drive system, **Design of gear teeth:** Lewis and Buckingham equations, wear and dynamic load considerations. Design and force analysis of spur, helical, bevel and worm gears, Bearing reactions due to gear tooth forces. **V** **Design of Sliding and Journal Bearing:** Methods of lubrication, hydrodynamic, hydrostatic, boundary etc. Minimum film thickness and thermal equilibrium. **Selection of anti-friction bearings** for different loads and load cycles, Mounting of the bearings, Method of lubrication.	of accuracy, Precision, Accuracy Vs precision, Uncertainty. Repeatability and reproducibility, Errors in measurement, Types of error, Systematic and random error, Calibration, Interchangeability. **Unit 2:** Linear and angular measurements: Linear measuring instruments: Vernier caliper, Micrometer, Interval measurements:- Slip gauges, Checking of slip gauges for surface quality, Optical flat, Application of limit gauges Comparators:- Mechanical comparators, Electrical comparator, Optical comparator, Pneumatic comparator; 2 Sine bar, Use of sine bar, Limitations of sine bars, Sources of error in sine bars, Bevel protractor, Applications of bevel protractor. **Unit 3:** Form measurement: Introduction, Screw thread measurement, Thread gauges, Measurement of gears: Gear errors. Surface finish measurement:- Introduction, Elements of surface texture, Analysis of surface finish, Methods of measuring surface finish, Straightness measurement, Flatness testing, Roundness measurements **Unit 4:** Coordinate measuring machine (CMM):-Types of CMM, Features of CMM, Computer based inspection, 2 Measurement of power, flow and temperature related properties Measurement of force, Accelerometer, Load cells, Bourdon tube. Torque measurement: Torque measurement using strain gauges, Torque measurement using torsion bars, Mechanical dynamometers. **Unit 5:** Measurement of flow: Variable area meters – Rotameter, Hot wire anemometer, Pitot tube. Temperature measurement, Bimetallic strip, Thermocouples (Thermo electric effects), Thermistors, Pyrometers	
61	**BTME 602**	**NEWER MACHINING METHODS** **I** Introduction and classification of advanced machining process, consideration in process selection, difference between traditional and non-traditional process, Hybrid process. **Abrasive finishing processes**: AFM, MAF (for Plain and cylindrical surfaces). **II** **Mechanical advanced machining process**: Introduction, Mechanics of	**Computer Integrated Manufacturing Systems** **Unit 1:** Introduction: Objective, scope and outcome of the course. Introduction to CIM:Overview of Production Systems, the product cycle, Automation in Production Systems, computer's role in manufacturing, sources and types of data used in manufacturing. The Beginning of CAM: Historical Background, Numerical Control (NC): Basic components of an NC system, coordinate system and motions control systems. Computer Numerical	

		metal removal, process principle, Advantages, disadvantages and applications of AJM,USM,WJC. **III** **Thermo electric advanced machining process**: Introduction, Principle, process parameters,advantages, disadvantages and applications about EDM, EDG, LBM, PAM, EBM **IV** **Electrochemical and chemical advanced machining process**: ECM, ECG, ESD, Chemical machining, Anode shape prediction and tool design for ECM process. Tool (cathode) design for ECM Process. **V** Intorduction to Micro and nanomachining, Nanoscale Cutting, Diamond Tools in Micromachining, Conventional Processes: Microturning, Microdrilling and Micromilling, Microgrinding, Non-Conventional Processes: Laser Micromachining, Evaluation of Subsurface Damage in Nano and Micromachining, Applications of Nano and Micromachining in Industry.	Control (CNC): features of CNC, machine control unit, CNC software. Direct Numerical Control and Distributed Numerical Control. Applications, advantages and disadvantages of NC. Adaptive control of machining system. **Unit 2:** NC Part programming: Manual and computer assisted part programming, Part programming with APT. NC part programming using CAD/CAM software. NC cutter path verification. **Unit 3:** Computer Aided Process Planning: Traditional Process Planning, Retrieval process planning system, Generative Process Planning, Machinability data systems, computer generated time standards. Group Technology: Introduction, part families, part classification and coding, coding system and machining cells. **Unit 4:** Computer Aided Production Management Systems: Introduction to computer aided PPC, Introduction to computer aided inventory management, manufacturing resource planning (MRPII), computer process monitoring and shop floor control, and computer process control. Computer Aided Quality Control; Computer in quality control, contact inspection methods, Non contact inspection methods, optical and non optical computer aided testing. **Unit 5:** Computer Aided Material Handling; Computer control on material handling, conveying, picking. Ware house control, computerized material handling for automated inspection and assembly. Computer Integrated Manufacturing Systems: Introduction, type's special manufacturing systems, flexible manufacturing systems (FMS). Collaborative Engineering; Introduction, Faster Design throughput, Web based design, Changing design approaches, extended enterprises, concurrent engineering, Agile and lean manufacturing.	
62	**BTME 603**	**MECHATRONICS** **I** **Introduction:** Introduction, scope and applications of Mechatronics systems. Process control automation, FMS and CNC Machines. **MEMS:** Basics of Micro- and Nanotechnology, microprocessor-based	**Mechanical Vibrations** Unit 1: Introduction: Objective, scope and outcome of the course. Introduction to Sound: Frequency dependent human response to sound, Sound pressure dependent human response, Relationship among sound power, sound intensity and sound pressure level. Introduction to Noise: Auditory and Non auditory effects	Code Change

		controllers and Microelectronics **II** **Introduction to Sensors:** Linear and Rotational Sensors, Acceleration, Force, Torque, Power, Flow and Temperature Sensors, Light Detection, Image, and Vision Systems, Integrated Micro-sensors, **Introduction to Actuators:** Electro-mechanical Actuators, Electrical Machines, Piezoelectric Actuators, Hydraulic and Pneumatic Actuation Systems, MEMS: Micro-transducers Analysis, Design and Fabrication. **III** **Systems and Controls:** The Role of Controls in Mechatronics, Role of Modelling in Mechatronics Design, Signals and Systems: Continuousand Discrete-time Signals, Z-Transforms and Digital Systems, Continuous- and Discrete-time State-space Models. **Advanced Control Systems:** Digital Signal Processing for Mechatronics Applications, Control System Design, Adaptive and Nonlinear Control Design, Neural Networks and Fuzzy Systems, Design Optimization of Mechatronics Systems. **IV** **Data Acquisition and related Instrumentation:** Introduction to Data Acquisition Measurement Techniques: Sensors and Transducers, Quantizing theory, Analog to Digital Conversion, Digital to Analog (D/A) conversation, Signal Conditioning. **Real time Instrumentation:** Computer-Based Instrumentation Systems, Software Design and Development, Data Recording and Logging. **V** **Design of Mechatronics systems:** Introduction of mechatronics systems: Home appliances, ABS (anti-lock braking system) and other areas in automotive engineering, Elevators and escalators, Mobile robots and manipulator arms, Sorting and packaging systems in production lines, Computer Numerically Control (CNC) production machines, Aeroplanes and helicopters, Tank fluid	of Noise, Major sources of the noise, Industrial noise sources, Industrial noise control strategies. Introduction to Vibration: Importance and scope of vibrations, terminology and classification, Concept of Degrees of freedom, Harmonic motion, vectorial representation, complex number representation, addition. Unit 2: Undamped Single Degree of Freedom System: Derivation of equation of motion for one dimensional longitudinal, transverse and Torsional vibrations without damping using Newton's second law, D' Alembert's principle and Principle of conservation of energy, Compound pendulum and centre of percussion. Damped vibrations of single degree of freedom systems: Viscous damping, under-damped, critically damped and over-damped systems, Logarithmic decrement. Vibration characteristics of Coulomb damped system and Vibration characteristics of Hysteretic damped systems. Unit 3: Forced Vibrations of Single Degree of Freedom Systems: Forced vibration with constant harmonic excitation, Steady state and transient parts, Frequency response curves and phase angle plot, Forced vibration due to excitation of support. Vibration Isolation and Transmissibility: Force transmissibility, Motion transmissibility, Forced vibration with rotating and reciprocating unbalance, Materials used in vibration isolation. Unit 4: System with Two Degrees of Freedom: principle mode of vibration, Mode shapes, Undamped forced vibrations of two degrees of freedom system with harmonic excitation, Vibration Absorber, Undamped dynamic vibration absorber and centrifugal pendulum absorber Critical Speed of Shaft: Critical speed of a light shaft without damping, critical speed of shaft having multiple discs, secondary critical speed. Unit 5: Many Degrees of Freedom Systems (Exact analysis): Equation of Motion, The matrix method, Eigen Values and Eigen Vectors, Method of influence Coefficients and Maxwell's reciprocal theorem. Torsional vibrations of multi rotor system, vibrations of geared system, Generalized coordinates and coordinate coupling Many Degrees of Freedom Systems (approximate methods): Rayleigh's, Dunkerley's, Stodola's and Holzer's	

		level and temperature control systems.	methods Vibrations of continuous systems: Transverse vibration of a string, Longitudinal vibration of a bar, Torsional vibration of a shaft.	
63	**BTME604**	**VIBRATION ENGINEERING** **I** **Introduction to Sound:** Frequency dependent human response to sound, Sound pressure dependent human response, Relationship among sound power, sound intensity and sound pressure level. **Introduction to Noise:** Auditory and Non auditory effects of Noise, Major sources of the noise, Industrial noise sources, Industrial noise control strategies. **Introduction to Vibration:** Importance and scope of vibrations, terminology and classification, Concept of Degrees of freedom, Harmonic motion, vectorial representation, complex number representation, addition. **II** **Undamped Single Degree of Freedom System:** Derivation of equation of motion for one dimensional longitudinal, transverse and torsional vibrations without damping using Newton's second law, D' Alembert's principle and Principle of conservation of energy, Compound pendulum and centre of percussion. **Damped vibrations of single degree of freedom systems:** Viscous damping, under-damped, critically damped and over-damped systems, Logarithmic decrement. Vibration characteristics of Coulomb damped system and Vibration characteristics of Hysteretic damped systems. **III** **Forced Vibrations of Single Degree of Freedom Systems:** Forced vibration with constant harmonic excitation, Steady state and transient parts, Frequency response curves and phase angle plot, Forced vibration due to excitation of support. **Vibration Isolation and Transmissibility:** Force transmissibility, Motion transmissibility, Forced vibration with rotating and reciprocating unbalance, Materials used in vibration isolation. **IV** **System with Two Degrees of Freedom:** principle mode of vibration, Mode shapes, Undamped forced vibrations of	**BTME604: Design of Machine Elements II** **Unit 1 :** Introduction: Objective, scope and outcome of the course. Fatigue Considerations in Design: Variable load, loading pattern, endurance stresses, Influence of size, surface finish, notch sensitivity and stress concentration. **Unit 2:** Goodman line, Soderberg line, Design of machine members subjected to combined, steady and alternating stresses. Design for finite life, Design of Shafts under Variable Stresses, Bolts subjected to variable stresses. **Unit 3:** Design of IC Engine components: Piston, Cylinder, Connecting Rod and Crank Shaft. Design of helical compression, tension, torsional springs, springs under variable stresses. **Unit 4:** Design of belt, rope and pulley drive system, Design of gear teeth: Lewis and Buckingham equations, wear and dynamic load considerations. Design and force analysis of spur, helical, bevel and worm gears, Bearing reactions due to gear tooth forces. **Unit 5:** Design of Sliding and Journal Bearing: Methods of lubrication, hydrodynamic, hydrostatic, boundary etc. Minimum film thickness and thermal equilibrium. Selection of anti-friction bearings for different loads and load cycles, Mounting of the bearings, Method of lubrication.	Code Change

		two degrees of freedom system with harmonic excitation, Vibration Absorber, Undamped dynamic vibration absorber and centrifugal pendulum absorber **Critical Speed of Shaft:** Critical speed of a light shaft without damping, critical speed of shaft having multiple discs, secondary critical speed. **V** **Many Degrees of Freedom Systems (Exact analysis)**: Equation of Motion, The matrix method, Eigen Values and Eigen Vectors, Method of influence Coefficients and Maxwell's reciprocal theorem. Torsional vibrations of multi rotor system, vibrations of geared system, Generalized coordinates and coordinate coupling **Many Degrees of Freedom Systems (approximate methods**): Rayleigh's, Dunkerley's, Stodola's and Holzer's methods **Vibrations of continuous systems:** Transverse vibration of a string, Longitudinal vibration of a bar, Torsional vibration of a shaft.		
64	**BTME 605**	**STEAM ENGINEERING** **I** **Steam generators:** Classification of Boilers, water and fire tube boilers, High pressure boilers, Advantages of high pr. Boilers, Natural and forced circulation boilers, Water wall. Steam drum internal, steam super heaters, Economizers, air preheater, induced, forced and balanced draught boilers, Fluidized bed boilers **II** Definition and type of nozzle and diffuser equation of continuity, sonic velocity, mach no. and stagnation properties, the steady flow energy equation for nozzles, momentum energy equation for flow through steam nozzles nozzle efficiency, effect of friction, nozzle for uniform pressure drop, throat pressure for maximum discharge or chock flow, critical pressure ratio, design of nozzle and diffuser. **III** **Steam Turbines:** Principle and working of steam turbines, type of turbines, compounding for pressure and velocity. Overview and difference of various type of turbine, different types of governing of turbines. **Impulse turbine:** The effect of blade friction on velocity diagram. Force, work	**Quality Management** **Unit 1 :** Introduction: Objective, scope and outcome of the course. The meaning of Quality and quality improvement dimensions of quality, history of quality methodology, quality control, Quality of design and quality of conformance, Quality policy and objectives, Economics of quality. Modeling process quality: Describing variation, frequency distribution, continuous and discrete, probability distributions, pattern of variation, Inferences about process quality: sampling distributions and estimation of process parameters. Analysis of variance. **Unit 2 :** Statistical Quality Control: Concept of SQC, Chance and assignable causes of variation, statistical basis of control chart, basic principles, choice of control limits, sample size and sampling frequency, analysis of patterns on control charts. The magnificent seven. **Unit 3 :** Control chart for variables,: X-bar and R charts, X-bar and S charts, control chart for individual measurement. Application of variable control charts. Control chart for attributes: control chart for fraction non conforming P- chart, np-chart, c-chart and u-chart. Demerit systems, choice between attribute and variable control chart. SPC for short	

		and power, Blade or diagram efficiency, Gross stage efficiency, steam speed to blade, speed ratio for optimum performance, turbine performance at various loads **IV** **Impulse reaction turbine:** Velocity diagram and work done , degree of reaction, Parson turbine, blade efficiency, gross stage efficiency comparison of enthalpy drop in various stages, size of blades in impulse reaction turbines for various stages of impulse reaction and impulse turbine. **Regenerative Feed Heating Cycles**: Introduction, Ideal regenerative feed heating cycle, Regenerative heating cycles and their representation on T-s and h-s Diagram, Representation of actual process on T-s and h-s Diagram Regenerative cycles, types of feed heating arrangements, Optimum feed water temperature and saving in Heat Rate. directcontact and surface heaters. **V** **Reheating of steam**: Practical reheating and Non- reheating cycles, advantage and disadvantages of reheating, reheat regenerative cycle, regenerative water extraction cycles. Process heat and by product power cycle, pass out turbine, Binary vapour cycle. Condensers.	production runs. Process capability analysis using histogram and probability plot, capability ratios and concept of six sigma. **Unit 4 :** Quality Assurance: Concept, advantages, field complaints, quality rating, quality audit. Acceptance Sampling: Fundamental concepts in acceptance sampling, operating characteristics curve. Acceptance sampling plans, single, double and multiple sampling plans, LTPD, AOQL, AOQ. Introduction to Quality systems like ISO 9000 and ISO 14000. **Unit 5 :** Reliability and Life Testing- Failure models of components, definition of reliability, MTBF, Failure rate, common failure rate curve, types of failure, reliability evaluation in simple cases of exponential failures in series, paralleled and series-parallel device configurations, Redundancy and improvement factors evaluations. Introduction to Availability and Maintainability Introduction to Taguchi Method of Design of Experiments, Quality loss function.	
65	**BTME606.A**	**NON DESTRUCTIVE EVALUATION AND TESTING** **I** **Introduction**: An Overview, Factors influencing the Reliability of NDE, Defects in materials, Defects in composites. NDT methods used for evaluation of materials and composites. **Visual Inspection:** Basic Principle and Applications. **Liquid Penetrant Testing:** Principle, Procedure and Test Parameters, Materials, Limitations and Applications. **II** **Radiographic Inspection:** Principles of X – ray radiography, equipment, Absorption, Scattering, X-ray film processing, General radiographic procedures, Reading and Interpretation of Radiographs, Industrial radiographic practice, Limitations and Applications, Welding defects detection. Gamma ray radiography. **III**	**Refrigeration and Air Conditioning** Unit1: **Introduction:** Refrigeration and second law of Thermodynamics, Refrigeration effect and unit of Refrigeration, Heat pump, reversed Carnot cycle. **Vapour Compression Refrigeration System:** Analysis of simple vapour compression Refrigeration cycle by p-h and T-S diagram. Effect of operating conditions **Multiple Evaporator and compressor system:** Application, air compressor system, Individual compressor, compound compression, cascade system. Application, air compressor systems, individual compressor, compound compression, cascade system. **Unit 2:** **Gas Cycle Refrigeration:** Limitation of Carnot cycle with gas, reversed Brayton cycle, Brayton cycle with regenerative heat exchanger. Air cycle for air craft: Necessity of cooling of air craft, Basic cycle, boot	Code Change

		Ultrasonic Testing: Principle of wave propagation, Ultrasonic equipment, Variables affecting an ultrasound test, Basic methods: Pulse Echo and Through Transmission, Types of scanning. **Applications of UT:** Testing of products, Welding Inspection, Tube Inspection, Thickness Measurement, Elastic Constant Determination, Ultrasonic testing of composites. **IV** **Magnetic Particle Inspection:** Methods of generating magnetic field, Demagnetization of materials, Magnetic particle test: Principle, Test Equipment and Procedure, Interpretation and evaluation. Introduction to Accostic Emission Testing and Thermography. **V** **Eddy Current Testing:** Principle of eddy current, Factors affecting eddy currents, Test system and test arrangement, Standardization and calibration, Application and effectiveness. Comparison and Selection of NDT Methods, Codes and Standards	strap, regenerative type air craft refrigeration cycle. **Unit 3:** **Other refrigeration systems** (description only): Vapour absorption refrigeration system, Electrolux refrigerator, Lithium Bromide – Water system, Water vapour refrigeration system, Vortex tube refrigeration system, thermo electric refrigeration system. **Refrigerants:** Classification, Nomenclature, selection of Refrigerants, global warming potential of CFC Refrigerants. Refrigeration Equipments: Compressor, condenser, evaporator, expansion devices, types & working. **Unit 4:** **Psychrometry:** Psychrometric properties, psychometric relations, pyschrormetric charts, psychrometric processes, cooling coils, By-pass factor, Apparatus Dew point temperature and air washers. **Human Comfort:** Mechanism of body heat losses, factors affecting human comfort, effective temperature, comfort chart. **Unit 5:** **Cooling load calculations:** Internal heat gain, system heat gain, RSHF, ERSHF, GSHF, cooling load estimation, heating load estimation, psychrometric calculation for cooling. **Selection of air conditioning:** Apparatus for cooling and dehumidification, Air conditioning system, year round air conditioning.	
66	**BTME 606B**	**DESIGN AND MANUFACTURING OF PLASTIC PRODUCTS** **I** Plastics Materials: An Overview, Classification, Thermoplastics, Thermosets, Crystalline, Amorphous, and Liquid, Crystalline Polymers, Copolymers, Alloys, Elastomers, Additives, Reinforcements, and Fillers, Physical Properties and Terminology. Mechanical Properties, Thermal Properties, Electrical Properties, Environmental Considerations. **II** **Design Considerations for Injection-Molded Parts**: Injection Molding Process, Design Strategy, Efficient and Functional Design, Material Selection, Nominal Wall Thickness, Normal Ranges of Wall Thickness, Structural	**NON CONVENTIONAL MACHINING METHODS** **Unit1**: Introduction and classification of advanced machining process, consideration in process selection, difference between traditional and non-traditional process, Hybrid process. Abrasivefinishingprocesses:AFM,MAF(forPlainandcylindricalsurfaces). **Unit2:** Mechanical advanced machining process: Introduction, Mechanics of metal removal, process principle, Advantages, disadvantages and applications of AJM, USM,WJC. **Unit3:** Thermoelectric advanced machining process: Introduction, Principle ,process parameters ,advantages, disadvantages and applications about EDM,EDG, LBM,PAM,EBM **Unit4:** Electrochemical and chemical advanced machining process: ECM, ECG,	Code Change

		Requirements of the Nominal Wall, Insulation Characteristics of the Nominal Wall, Impact Response of the Nominal Wall, Draft, Structural Reinforcement, Ribs, Other Geometric Reinforcement, Bosses, Coring, Fillets and Radii, Undercuts **III** Polymer processing techniques such as extrusion, compression and transfer moulding. Injection moulding, blow moulding, thermoforming, rotational moulding, calendaring. **IV** Assembly: General Types of Assembly Systems, Molded-In Assembly Systems, Snap-Fit Assembly, Molded-In Threads, Press-Fits, Chemical Bonding Systems, Solvent Welding, Adhesive Bonding, Thermal Welding Methods. Spin Welding, Radio Frequency (RF) Welding, Electromagnetic or Induction Welding, Assembly with Fasteners, Bolted Assembly, Threaded Metal Inserts, Self-Tapping Screws, Riveted Assembly, SheetMetal Nuts, Specialty Plastic Fasteners **V** Machining of Plastics: Drilling and Reaming,Thread Tapping, Sawing, Milling, Turning, Grinding. Finishing and Decorating of Plastics: Painting, Vacuum Metallizing and Sputter Plating, Electroplating, Flame Spraying/Arc Spraying, Hot Stamping	ESD, Chemical machining, Anode shape prediction and tool design for ECM process. Tool (cathode) design for ECM Process. **Unit5:** Introduction to Micro and nano machining	
67	**BTME606.C**	**MAINTENANCE MANAGEMENT** **I** Introduction -Fundamentals of Maintenance Engineering. Maintenance Engineering its importance in material & energy conservation, inventory control, productivity, safety, pollution control etc. Safety Regulations, pollution problems, human reliability, total quality management (TQM), total productivity maintenance (TPM), environmental issues in maintenance, ISO 9000. **II** Maintenance Management - types of maintenance strategies, Planned and unplanned maintenance, breakdown, preventive & predictive maintenance. Their comparison, advantages & disadvantages. Limitations. Computer aided maintenance, maintenance scheduling, spare part management, inventory control, organisation of maintenance	**MICRO ELECTRO AND MECHANICAL SYSTEMS (MEMS) and MICROSYSTEMS** **Unit 1:** Over view of MEMS and Microsystems: Micro electromechanical Systems(MEMS) and Microsystems, Typical MEMS and Micro system products, Evaluation of Micro fabrication, Micro system and microelectronics, the multidisciplinary nature of micro system design and manufacture, Microsystems and miniaturization, Application of Microsystems in the automotive industry, applications of Microsystems in other industries. Working Principles of Microsystems: Introduction, Micro sensors, Micro actuation, MEMS with Microactuators, Micro accelerometers, Micro fluidics. **Unit2:** Engineering Science for Micro system Design and Fabrication: Introduction, atomic structure of matter, ions and ionization, molecule theory of matter and intermolecular forces, doping	New Course

		department. **III** Tribology in Maintenance, friction wear and lubrication, friction & wear mechanisms, prevention of wear, types of lubrication mechanisms, lubrication processes. Lubricants - types, general and special purpose, additives, testing of lubricants, degradation of lubricants, seal & packings. Repair methods for basic machine elements: Repair methods for beds, slideways, spindles, gears, lead screws and bearings–Failure analysis–Failures and their development–Logical fault location methods– Sequential fault location. **IV** Machine Health Monitoring - Condition based maintenance, signature analysis, oil analysis, vibration, noise and thermal signatures, on line & off line techniques, Instrumentation & equipment used in machine health monitoring. Instrumentation in maintenance, signal processing, data acquisition and analysis, application of intelligent systems, data base design. **V** Reliability, availability & maintainability (RAM) Analysis – Introduction to RAM failure mechanism, failure data analysis, failure distribution, reliability of repairable and non repairable systems. Improvement in reliability, reliability testing, reliability prediction, utilisation factor, system reliability by Monte Carlo Simulation Technique.	of semiconductors, the diffusion process, plasma physics, electrochemistry, quantum physics. Engineering Mechanics for Micro system design: Introduction, static bending of thin plates, mechanical vibration, thermo mechanics, fracture mechanics, thin-film mechanics, overview of finite element stress analysis. **Unit3:** Thermo fluid Engineering and Micro system design: Introduction, overview of the basics of fluid mechanics in Macro and mesoscales, Basic equations in continuum fluid dynamics, laminar fluid flow in circular conduits, computational fluid dynamics, Incompressible fluid flow in micro conduits, fluid flow in sub micrometer and nano scale, overview of heat conduction in solids, heat conduction in multilayered thin films, heat conduction in solids in sub micrometer scale. Scaling laws in Miniaturization: Introduction to scaling, scaling in geometry, scaling in rigid-body dynamics, scaling in electrostatic forces, scaling in electromagnetic forces, scaling in electricity, scaling in fluid mechanics, scaling in heat transfer. **Unit4:** Materials for MEMS and Microsystems: Introduction, substrate and wafers, active substrate materials, silicon as a substrate material, silicon compounds, silicon piezo resistors, gallium arsenide, quartz, piezo electric crystals, polymers, packaging materials.5Microsystem Fabrication Processes: Introduction, Photolithography, Ion implantation, diffusion, oxidation, chemical vapor deposition, physical vapor deposition-sputtering, deposition by epitaxy, etching. **Unit5:** Overview of Micro manufacturing: Introduction, bulk micro manufacturing, surface micro machining, LIGA. Micro system Design: Introduction, design consideration, process design, mechanical design, mechanical design using finite element method, design of silicon die for a micro pressure sensor, design of micro fluidic network systems, design case: capillary electrophoresis network system.	
68	**BTME607**	**MACHINE DESIGN SESSIONAL-II** **Problems on:** **1** Fatigue loading. **2** Helical compression, tension and	**CIMS Lab** **List of Experiments** 1. To prepare part programming for plain turning operation.	New Course

		torsional springs design. **3** Curved Beams. **4** Preloaded bolts and bolts subjected to variable stresses. **5** Belt, Rope and Chain drive system. **6** Gear Design. **7** Sliding contact bearing design. **8** Anti-friction bearing selection	2. To prepare part program for turning operations using turning cycle. 3. To prepare part program for threading operation. 4. To prepare part program for gear cutting using mill cycle. 5. To prepare part program for multiple drilling in X and Z axis using drilling cycle.	
69	**BTME608**	**INDUSTRIAL ENGINEERING LAB-I** **1** Case study on X bar charts and process capability analysis **2** P Chart: (a)Verify the Binomial Distribution of the number of defective balls by treating the balls with a red colour to be defective. (b) Plot a P-chart by taking a sample of n=20 and establish control limits **3** To plot C-chart using given experimental setup **4** Operating Characteristics Curve: (a) Plot the operating characteristics curve for single sampling attribute plan for n = 20 ; c = 1 , 2 , 3 Designate the red ball to defective. (b) Compare the actual O.C. curve with theoretical O.C. curve using approximation for the nature of distribution **5** Distribution Verification: (a) Verification of Normal Distribution. (b) To find the distribution of numbered cardboard chips by random drawing one at a time with replacement. Make 25 subgroups in size 5 and 10 find the type of distribution of sample average in each case. Comment on your observations **6** Verification of Poisson distribution **7** Central Limit Theorem: (a) To show that a sample means for a normal universe follow a normal distribution (b) To show that the sample means for a non normal universe also follow a normal Distribution. **8** Solve problems using available Statistical Process Control software in lab	**Vibration Lab (BTME608)** **List of Experiments** 1. To verify relation T = 2π√(l/g) for a simple pendulum. 2. To determine radius of gyration of compound pendulum. 3. To determine the radius of gyration of given bar by using bifilar suspension. 4. To determine natural frequency of a spring mass system. 5. Equivalent spring mass system. 6. To determine natural frequency of free torsional vibrations of single rotor system. i. Horizontal rotor ii. Vertical rotor 7. To verify the Dunkerley's rule. 8. Performing the experiment to find out damping co-efficient in case of free damped torsional vibration 9. To conduct experiment of trifler suspension. 10. Harmonic excitation of cantilever beam using electro-dynamic shaker and determination of resonant frequencies. 11. Study of Vibration measuring instruments. 12. Perform study of the following using Virtual Lab http://www.vlab.co.in/ 13. Forced Vibration of a Cantilever Beam with a Lumped Mass at Free End: To calculate the natural freq and damping ratio for forced vibration of a single DOF cantilever beam system, experimentally; and compare the results with theoretical values. 14. Harmonically Excited Forced Vibration of a Single DOF System: To analyze the forced vibration response of a single DOF system at diff damping ratio and frequency ratio. 15. Perform study of the following using Virtual Lab http://www.vlab.co.in/ 16. Forced Vibration of a Cantilever Beam with a Lumped Mass at Free End: To calculate the natural freq and damping ratio for forced vibration of a single DOF cantilever beam system, experimentally; and compare the results with theoretical values.	Code Change

			17. Harmonically Excited Forced Vibration of a Single DOF System: To analyze the forced vibration response of a single DOF system at diff damping ratio and frequency ratio. **Important Note:** It is mandatory for every student to undertake a Mini project. Mini project shall be a group activity. A group shall consist of maximum five students. Final evaluation shall include 30% weight age to mini project. • Design of vibration system, measurement of vibration, FFT analysis using MATLAB	
70	**BTME609**	**MECHATRONICS LAB** **1**Study the following devices (a) Analog & digital multimeter (b) Function/ Signal generators (c) Regulated d. c. power supplies (constant voltage and constant current operations) **2** Displacement Measurement using Capacitive & inductive Pick –ups. **3** Study of Speed Measurement System: (a) Magnetic Pick-up (b) Stroboscope **4** Study of Load Measurement System Load Cell **5** Measurement of temperature using thermocouple, thermistor and RTD **6** Measurement of displacement using POT, LVDT & Capacitive transducer **7** Torque measurement using torque measuring devices **8** Strain Measurement using strain gauge **9** Frequency to Voltage Converter and vice versa **10** Position and velocity measurement using encoders **11**Study on the application of data acquisition system for industrial purposes **12** Speed control of DC motor using PLC. **13** Study of Load Measurement System Load Cell	**Machine Design Practice II Lab (BTME609)** Problems on: Use data hand book by Mahadevan and Reddy 1. Fatigue loading. 2. Helical compression, tension and torsional springs design. 3. Curved Beams. 4. Preloaded bolts and bolts subjected to variable stresses. 5. Belt, Rope and Chain drive system. 6. Gear Design. 7. Sliding contact bearing design. 8. Anti-friction bearing selection Important Note: It is mandatory for every student to undertake a Mini project. Mini project shall be a group activity. A group shall consist of maximum five students. Final evaluation shall include 30% weight age to mini project. • Design of assembly (mechanical systems) using various BIS codes/databook	Code Change
71	**BTME610**	**VIBRATION ENGINEERING LAB.** **1** To verify relation T = 2R□□(l/g) for a simple pendulum. **2** To determine radius of gyration of compound pendulum. **3** To determine the radius of gyration of given bar by using bifilar suspension. **4** To determine natural frequency of a spring mass system. **5** Equivalent spring mass system. **6** To determine natural frequency of free torsional vibrations of single rotor	**Thermal Engineering Lab (BTME610)** **List of Experiments** 1.Study of working of four stroke petrol engine and four stroke diesel engine with the help of cut section models 2. Study of working of two stroke petrol and two stroke diesel engine with the help of cut section models. 3. To draw valve timing diagram for a single cylinder diesel engine. 4. Study of various types of boilers. 5. Study of various types of mountings and	Code Change,

		system. i. Horizontal rotor ii. Vertical rotor **7** To verify the Dunkerley's rule. **8** Performing the experiment to find out damping co-efficient in case of free damped torsional vibration **9** To conduct experiment of trifler suspension. **10** Harmonic excitation of cantilever beam using electro-dynamic shaker and determination of resonant frequencies. **11** Study of Vibration measuring instruments. **12** Perform study of the following using Virtual Lab http://www.vlab.co.in/ **13** Forced Vibration of a Cantilever Beam with a Lumped Mass at Free End: To calculate the natural frequency and damping ratio for forced vibration of a single DOF cantilever beam system, experimentally; and compare the results with theoretical values. **14** Harmonicaly Excited Forced Vibration of a Single DOF System: To analyze the forced vibration response of a single DOF system at different damping ratio and frequency ratio. **15** Perform study of the following using Virtual Lab http://www.vlab.co.in/ **16** Forced Vibration of a Cantilever Beam with a Lumped Mass at Free End: To calculate the natural frequency and damping ratio for forced vibration of a single DOF cantilever beam system, experimentally; and compare the results with theoretical values. **17** Harmonicaly Excited Forced Vibration of a Single DOF System: To analyze the forced vibration response of a single DOF system at different damping ratio and frequency ratio.	accessories. 6. Demonstration of steering system and measurement of steering geometry angles and their impact on vehicle performance. 7. Study of braking system with specific reference to types of braking system, master cylinder, brake shoes. 8. Study of transmission system including clutches, gear box assembly and differential box	
72	BTME 701	**BTME701: FINITE ELEMENT METHODS** **I** Introduction to FEM and its applicability, Review of :Matrix algebra, Gauss elimination method, Uniqueness of solution, Banded symmetric matrix and bandwidth. Structure analysis: Two-force member element, Local stiffness matrix, coordinate transformation, Assembly, Global stiffness matrix, imposition of Boundary conditions, Properties of stiffness matrix **II** One-dimensional Finite Element Analysis:	**BTME701.A: INTERNAL COMBUSTION ENGINE** **Unit-I** **Introduction:** Objective, scope and outcome of the course. **History of IC engines:** Nomenclature, Classification & Comparison, SI & CI, 4stroke- 2 stroke, First Law analysis, Energy Balance. Fuel air cycles, Actual cycles. **Testing & Performance:** Performance parameters, Measurement of operating parameters e.g. speed, fuel & air consumption, Powers, IHP, BHP, FHP, Efficiencies Thermal, Mechanical, Volumetric, Emission Measurement,	Code Change

		Basics of structural mechanics, stress and strain tensor, constitutive relation, Principle of minimum Potential, General steps of FEM, Finite element model concept / Discretization, Derivation of finite elements, equations using potential energy approach for linear and quadratic 1-D bar element, shape functions and their properties, Assembly, Boundary conditions, Computation of stress and strain. **III** Two Dimensional Finite Element Analysis: Finite element formulation using three nodded triangular (CST) element , Plane stress and Plain strain problems, Shape functions, node numbering and connectivity, Assembly, Boundary conditions, Isoparametric formulation of 1-D bar elements, Numerical integration using gauss quadrature formula, computation o tress and strain. **IV** Finite Element Formulation from Governing Differential Equation: Method of Weighted Residuals, Collocation, Sub domain method, Least Square method and Galerkin's method, Application to one dimensional problems, one-dimensional heat transfer, etc. introduction to variational formulation (Ritz Method.) **V** Higher Order Elements: Lagrange's interpolation formula for one and two independent variable, Convergence of solution, compatibility, element continuity, static condensation, p and h methods of mesh refinement, Aspect ratio and element shape, **5** Application of FEM, Advantages of FEM, Introduction to concept of element mass matrix in dynamic analysis.	Indian & International standards of Testing, Emission. **Unit-II** **Fuel & Combustion:** Combustion in CI & SI engines, Ignition Limits, Stages of combustion, Combustion parameters. Delay period and Ignition Lag, Turbulence and Swirl, Effects of engine variables on combustion parameters, abnormal combustion in CI & SI engines, Detonation & knocking, Theories of detonation, Control of abnormal combustion, Combustion chamber design principles, Types of combustion chamber. **Unit-III** **Alternative Fuels:** Methanol, Ethanol, Comparison with gasoline, Manufacturing, Engine performance with pure Methanol, Ethanol & blends, Alcohols with diesel engine, Vegetable oils, Bio gas. **Engine Systems & Components:** Fuel System (SI Engine), Carburetion & Injection, process & parameters, properties of A/F mixture, Requirements of A/F ratios as per different operating conditions, Carburettors, types, Aircraft carburettor, comparison of carburetion & injection, F/A ratio calculations. **Unit-IV** **CI engine:** Mixture requirements & constraints, Method of injection, Injection systems, CRDI etc. system components, pumps injectors. **Ignition system:** Conventional & Modern ignition systems Magneto v/s Battery, CB point v/s Electronic ignition, Fuel Ignition Energy requirements. Spark advance, centrifugal, vacuum Firing order, spark plugs. **Unit-V** **Engine Friction & Lubrication:** Determination of friction, Lubrication principles, Types of lubrication, Places of lubrication Bearings and piston rings etc., Functions of Lubrication, Properties, Rating and Classification of lubricating oil, Additives, Lubrication systems. Engine Cooling: Requirements of cooling, Areas of heat flow, High temperature regions of combustion chamber. Heat Balance, Cooling Systems, Air, Water Cooling, Cooling system components.	
73	**BTME702**	**REFRIGERATION AND AIR CONDITIONING**	**BTME702.A: Non Destructive System**	Code Change

		I **Introduction:** Refrigeration and second law of Thermodynamics, Refrigeration effect and unit of Refrigeration, Heat pump, reversed Carnot cycle. **Vapour Compression Refrigeration System:** Analysis of simple vapour compression Refrigeration cycle by p-h and T-S diagram. Effect of operating conditions **Multiple Evaporator and compressor system:** Application, air compressor system, Individual compressor, compound compression, cascade system. Application, air compressor systems, individual compressor, compound compression, cascade system. **II** **Gas Cycle Refrigeration:** Limitation of Carnot cycle with gas, reversed Brayton cycle, Brayton cycle with regenerative heat exchanger. Air cycle for air craft: Necessity of cooling of air craft, Basic cycle, boot strap, regenerative type air craft refrigeration cycle. **III** **Other refrigeration systems** (description only): Vapour absorption refrigeration system, Electrolux refrigerator, Lithium Bromide – Water system, Water vapour refrigeration system, Vortex tube refrigeration system, thermo electric refrigeration system. **Refrigerants:** Classification, Nomenclature, selection of Refrigerants, global warming potential of CFC Refrigerants. Refrigeration Equipments: Compressor, condenser, evaporator, expansion devices, types & working. **IV** **Psychrometry:** Psychrometric properties, psychometric relations, pyschrormetric charts, psychrometric processes, cooling coils, By-pass factor, Apparatus Dew point temperature and air washers. **Human Comfort:** Mechanism of body heat losses, factors affecting human comfort, effective temperature, comfort chart. **V** **Cooling load calculations:** Internal heat gain, system heat gain, RSHF, ERSHF, GSHF, cooling load estimation, heating load estimation, psychrometric calculation for cooling. **Selection of air conditioning:** Apparatus	**Unit-I** Introduction: Objective, scope and outcome of the course Overview of NDT: NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT, Visual inspection, Unaided and aided. **Unit-II** Surface Non Destructive Evaluation (NDE) Methods: Liquid Penetrant Testing, Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods. Testing Procedure, Magnetic Particle Testing, Theory of magnetism, inspection materials. Magnetisation methods, Interpretation and evaluation, Principles and methods of demagnetization, Residual magnetism. **Unit-III** Thermography and Eddy Current Testing (ET): Thermography, Principles, Contact and non contact inspection methods, Advantages and limitation, Instrumentations and methods, applications. Eddy Current Testing, Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation. Ultrasonic Testing (UT) and Acoustic Emission (AE): Ultrasonic Testing, Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A-Scan, B-scan, C-scan. Acoustic Emission Technique, Principle, AE parameters, Applications. **Unit-IV** Radiography (RT): Principle, Interaction of X-Ray with matter, imaging, film and film less techniques, Types and use of filters and screens, Geometric factors, Inverse square, law, characteristics of films, Interpretation/ Evaluation, Fluoroscopy, Xero Radiography, Computed Radiography, Computed Tomography.	

		for cooling and dehumidification, Air conditioning system, year round air conditioning.	**Unit-V** Special Techniques and Applications: Phased array ultrasonic time of flight diffractions, Automated and remote ultrasonic testing, Acoustic pulse reflectometry, Alternative current field method, Case studies on NDT techniques used in aircrafts.	
74	**BTME703**	**OPERATIONS RESEARCH** **I** **Overview of Operations Research** **Linear Programming**: Applications and model formulation, Graphical method, Simplex method, duality and Sensitivity analysis. Transportation Model and Assignment Model including travelling salesman problem. **II** **Integer Linear Programming:** Enumeration and cutting Plane solution concept, Gomory's all integer cutting plane method, Branch and Bound Algorithms, applications of zero-one integer programming. **Replacement Models:** Capital equipment replacement with time, group replacement of items subjected to total failure. **III** **Queuing Theory**: Analysis of the following queues with Poisson pattern of arrival and exponentially distributed service times, Single channel queue with infinite customer population, Multichannel queue with infinite customer population, **Competitive Situations and Solutions**: Game theory, two person zero sum game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy, approximate solution, and simplified analysis for other competitive situations. Application of linear programming **IV** Theory of Decision making: Decision making under certainty, risk and uncertainty. Decision trees. **Deterministic Inventory control models:** functional role of inventory, inventory costs, model building, Single item	**BTME702.B:Environmental Engineering and Disaster Management** **Unit-I** Introduction: Objective, scope and outcome of the course. (This compulsory for all course) **Unit-II** Importance of safe water supply system. Domestic water requirements for urban and rural areas. Sources of Water supply. Intakes and transportation of water. **Unit-III** Drinking water quality. Indian Standards of drinking water. Introduction to water treatment for safe drinking, Importance of sanitation. **Unit-IV** Domestic waste water: quantity, characteristics, disposal in urban and rural areas. Sewer: types, design discharge and hydraulic design. Introduction to domestic wastewater treatment. **Unit-V** Solid waste: quantity, characteristics and disposal for urban and rural areas. Introduction to air pollution. Types of pollutants, properties and their effects on living beings. BIS standards for pollutants in air and their abetments. Introduction to various disaster, Importance of disaster management.	New Course

		inventory control model without shortages, with shortage and quantity discount. Inventory control model with uncertain demand, service level, safety stock, P and Q systems, two bin system. Single period model. Selective Inventory control techniques. **V** **Probabilistic Inventory control models:** Instantanoues demand without setup cost and with setup cost, Continuous demand without setup cost **Simulation**: Need of simulation, advantages and disadvantages of simulation method of simulation. Generation of Random numbers, Generation of Normal Random numbers. Use of random numbers for system simulation. , Monte Carlo simulation, simulation language ARENA, Application of simulation for solving queuing Inventory Maintenance, Scheduling and other industrial problems		
75	**BTME704**	**TURBOMACHINES** **I** **Basic Concepts of Turbo Machines:** Definition & classification of Turbo machine, Basic laws and governing equations: continuity equation, steady flow energy equation(1st law of thermodynamics),2^{nd} law of thermodynamics applied to turbo machines, Newton's 2nd law of motion applied to turbomachines - Euler's pump equation and Euler's turbine equation Dimensional analysis applied to hydraulic machines, power coefficient, flow coefficient, head coefficient, non-dimensional specific speed, Range of specific speeds for various turbo machines, Dimensional analysis applied to compressible flow machines, pressure ratio as a Function of temperature ratio, mass flow rate parameter and speed parameter **II** **Centrifugal Compressors and Fans:** Components and description, velocity iagrams, slip factor, energy transfer, power input factor, stage pressure rise and loading coefficient, pressure coefficient, degree of reaction, Centrifugal compressor characteristic, surging, rotating Stalland Choking **Axial Flow Compressors and Fans:** Basic constructional features, Advantages of	**BTME702.C: Power Generation Sources** **Unit-I** INTRODUCTION: World energy status, Current energy scenario in India, Environmental aspects of energy utilization, Environment - Economy - Energy and Sustainable Development, Energy planning. Conventional Energy Generation Methods: Thermal Power plants: Basic schemes and working principle. Gas Power Plants: open cycle and closed cycle gas turbine plants, combined gas & steam plants-basic schemes. Hydro Power Plants: Classification of hydroelectric plants. Basic schemes of hydroelectric and pumped storage plants. Nuclear Power Plants: Nuclear fission and nuclear fusion. Fissile and fertile materials. Basic plant schemes with boiling water reactor, heavy water reactor and fast breeder reactor. Efficiencies of various power plants. **Unit-III** SOLAR ENERGY: Basic concepts, Solar radiation – Measurement, Solar thermal systems – Flat plate and concentrating collectors, Solar passive space - Solar heating and cooling techniques – Solar desalination – Solar Pond - Solar cooker - Solar dryers-Solar furnaces - Solar pumping, Solar green house- Solar thermal electric power plant – Solar photo voltaic conversion – Solar cells – PV applications, Hybrid systems.	Code Change

		axial flow compressors, working principle, velocity triangle, elementary theory, stage work, work done factor, stage loading, degree of reaction; vortex theory, simple design calculations, introduction to blade design, cascade test, compressibility effects, operating characteristics **Reciprocating Compressors:** Basic constructional features, working principle, work done calculation, single and double acting compressors **III** **Centrifugal Pumps:** Main parts, work done and velocity triangles, slip and slip factor, pump losses and efficiencies, minimum starting speed,net positive suction head, performance curve. **Axial Flow Pumps:** Description, velocity triangles, work done on the fluid, energy transfer, axial pump characteristics, cavitation. **Reciprocating Pumps:** Classification, component and working, single acting and double acting, discharge, work done and power required, coefficient of discharge, indicator diagram, slip, effect of friction and acceleration, theory of air vessels. **IV** **Gas power cycles**: Ideal and practical gas turbine cycle, heat exchange cycle, reheat cycle, intercooled cycle, Comparison of various cycles. **Thermodynamic Cycles**: Advantages, disadvantages and performance characteristics of Ram jet engine, pulse jet engine, turbo prop engine, turbo jet engine, turbo fan engine, Calculation of specific thrust and efficiency **V** **Gas Turbines:** impulse and reaction type gas turbines, Velocity triangles and calculation of work done, efficiency etc.	**Unit-IV** WIND ENERGY: Introduction-Availability-Wind power plants , Power from the wind, Wind energy conversion systems, site characteristics, Wind turbines types – Horizontal and vertical axis-design principles of wind turbine – Blade element theory, Magnus effect- Performance. Wind energy Applications – Hybrid systems, Wind energy storage, Safety and environmental aspects. **Unit-V** BIOMASS ENERGY: Biomass – usable forms- composition- fuel properties – applications, Biomass resources, Biomass conversion technologies - direction combustion - pyrolysis – gasification - anaerobic digestion, Bioethanol and Biodiesel Production - Economics - Recent developments. Energy farming, Biogas technology - Family biogas plants, Community and institutional biogas plants – design consideration – applications. OTHER RENEWABLE ENERGY SOURCES: Tidal energy – Wave energy – Open and closed OTEC Cycles – Small hydro – Geothermal energy – Social and environmental aspects.Fuel cell technology - types, principle of operation – applications. Hydrogen energy production - Storage – transportation – utilization.	
76	**BTME705**	**OPERATIONS MANAGEMENT** **I** Introduction to operations management (OM), the scope of OM; Historical evolution of OM; Trends in business; the management process. Operations Strategy, Competitiveness and Productivity Demand Forecasting: components of forecasting demand, Approaches to forecasting: forecasts based on judgment and opinion, Time series data.	**BTME703: FEA Lab** 1. Laboratory work for the solution of solid mechanics problems, heat transfer problems, and free vibration problems A: by using FE packages such as NASTRAN/ANSYS/SIMULIA/ABAQUS 2. Introduction of GUI of the software in the above mentioned areas' realistic problems. 3. Analysis of beams and frames (bending and torsion problems)	Code Change

		Associative forecasting techniques, Accuracy and control of forecasts, Selection of forecasting technique. **II** Product and Service design, Process selection, Process types, Productand process matrix, Process analysis.Capacity Planning: Defining and measuring capacity, determinants of effective capacity, capacity strategy, steps in capacity planning process, determining capacity requirements, Capacity alternatives, Evaluation of alternatives; Cost-Volume analysis. **III** Facility Location: Need for location decisions, factors affecting location, qualitative and quantitative techniques of location. Facilities layout: Product, Process, Fixed position, combination and cellular layouts; Designing product and process layout, line balancing. Material Handling Planning levels: long range, Intermediate range and Short range planning, Aggregate planning: Objective, Strategies, and techniques of aggregate planning. Master scheduling; Bill of materials, MRP; inputs processing and outputs, and overview of MRPII , use of MRP to assist in planning capacity requirements, Introduction to ERP **IV** Production Control: Capacity control and priority control, production control functions; Routing, scheduling, dispatching, expediting and follow up. Techniques of production control in job shop production, batch production and mass production systems. sequencing: priority rules, sequencing jobs through two work centers, scheduling services Introduction to Just-in-time (JIT) and Lean Operations: JIT production, JIT scheduling, synchronous production, Lean operations system **V** Supply Chain Management (SCM): Need of SCM, Bullwhip effect, Elements of SCM, Logistics steps in creating effective supply chain, Purchasing and supplied management. **Project Management:** Nature of projects, project life cycle, Work breakdown structure, PERT and CPM, Time-Cost trade-offs: Crashing. Resource allocation, leveling	4. Plane stress and plane strain analysis problems 5. Problems leading to analysis of axisymmetric solids 6. Problems leading to analysis of three dimensional solids (a) Heat transfer problems (b) Modal analysis problem B: by writing own code for finite element analysis using MATLAB for: 7. Plane stress and plane strain analysis problems 8 Modal Analysis problem.	
77	**BTME70**	**MICRO AND NANO MANUFACTURING**	**BTME704: Thermal Engineering Lab-II**	Code Change

	6.A	**I** Nanoscale Cutting:- Introduction, Material representation and microstructure, Atomic interaction; Nonomachining:- Introduction, Nanometric machining, Theoretical basis of machining; Meso-micromcahining:- Introduction, size effects in micromachining, mechanism for large plastic flow, origin of the size effect, Mesomachining processes. Product quality in micromachining, Burr formation in micromachining operations. **II** Microturning:- Characteristic features and applications, Microturning tools and tooling systems, Machine tools for microturning **Microdrilling:** Characteristic features and applications, Microdrills and tooling systems, Machine tools for microdrilling Micromilling:- Characteristic features and applications, Micromills and tooling systems, Machine tools for micromilling, Micro machining high aspect ratio microstructures, micromolding, micromolding processes, micromolding tools, micromold design, micromolding applications, limitations of micromolding. **III** **Microgrinding and Ultra-precision Processes:** Introduction, Micro and nanogrinding, Nanogrinding apparatus, Nanogrinding procedures, Nanogrinding tools, Preparation of nanogrinding wheels, Bonding systems, Vitrified bonding **Non-Conventional Processes:** Laser Micromachining:- Introduction, Fundamentals of lasers, Stimulated emission, Types of lasers, Laser microfabrication, Nanosecond pulse microfabrication, Shielding gas, Effects of nanosecond pulsed microfabrication, Picosecond pulse microfabrication, Femtosecond pulse microfabrication, Laser nanofabrication. **IV** **Diamond Tools in Micromachining:** Introduction, Diamond technology, Hot Filament CVD (HFCVD), Preparation of substrate, Selection of substrate material, Pre-treatment of substrate, Modified HFCVD process. Deposition on complex substrates, Diamond deposition on metallic (molybdenum) wire, Deposition on WC-	1. To perform constant speed load test on a single cylinder diesel engine and to plot performance curves: indicated thermal efficiency, brake thermal efficiency, mechanical efficiency Vs. Brake power and heat balance sheet. 2. To estimate the Indicated Power, Friction Power and Mechanical Efficiency of a multi-cylinder Petrol Engine. (Morse Test) 3. Analysis of engine exhaust gases using Orsat apparatus /Engine gas analyzer. 4. Determination of coefficient of performance of Refrigeration cycle and tonnage capacity of refrigeration unit. 5. To determine the COP and tonnage capacity of a Mechanical heat pump. 6. To study various controls used in Refrigeration and Air conditioning system. 7. Study of commercial Refrigeration equipments like cooling towers, hermetically sealed compressors, automotive swash plate compressor etc. 8. To study automotive air conditioning system. 9. Determination of dryness fraction of steam. 10. Study and Performance of Simple Steam Turbine 11. Performance characteristics of Hydraulic turbines. 12. Study and Performance of Gas Turbine Plant. 13. Performance characteristics of variable and rated speed centrifugal pump.	

		Co microtools, Diamond deposition on tungsten carbide, (WC-Co) microtool, Performance ofdiamond-coated microtool **V** **Evaluation of Subsurface Damage in Nano and Micromachining:** Introduction, Destructive evaluation technologies, Cross-sectional microscopy, Preferential etching, Angle lapping/angle polishing, X-ray diffraction, Micro-Raman spectroscopy. **Applications of Nano and Micromachining in Industry:** Introduction, Typical machining methods, Diamond turning, Shaper/planner machining, Applications in optical manufacturing, Aspheric lens, Fresnel lens, Microstructured components, Semiconductor wafer production.		
78	**BTME706.B**	**ROBOTICS** **I** **Introduction to Robotics:** Evolution of Robots and Robotics, Laws of Robotics, What is and What is not a Robot, Progressive Advancement in Robots. Robot Anatomy, Human Arm Characteristics, Design and Control Issues, Manipulation and Control, Sensors and Vision, ProgrammingRobots, The Future Prospects, Notations. **II** **Robot End Effectors:** Classification of end effectors, drive system for grippers, Mechanical, Magnetic, Vaccum, Adhesive grippers, Hooks, Scoops, Miscellaneous devices, Gripper force analysis and Design, Active and Passive Gripeers **Coordinate Frames, Mapping and Transforms:** Coordinate Frames, Description of Objects in Space, Transformation of Vectors, Inverting a Homogeneous Transform, Fundamental Rotation Matrices. **III** **Symbolic Modeling of Robots:** Direct Kinematic Model, Mechanical Structure and Notations, Description of Links and Joints, Kinematic Modeling of the Manipulator, Denavit – Hartenberg Notation, Kinematic Relationship between Adjacent Links, Manipulator Transformation Matrix. Introduction to Inverse Kinematic model, Solvability of	**BTME705: Quality Control Lab** 1. Case study on X bar chart and R chart of an industrial process output and process capability analysis of the process. The charts are to be drawn and calculations of process capability analysis to be reported. 2. P Chart: (a) To verify the Binomial Distribution of the number of defective balls by treating the balls with a red colour to be defective. (b) To plot a p -chart by taking a sample of n=20 and establish control limits. 3. Case study on C-chart of a product and establish control limits . 4. Operating Characteristics Curve: (a) To plot the operating characteristics curve for single sampling attribute plan for n = 20; c = 1, 2, 3. Designate the red ball as defective. (b) To compare the actual O.C. curve with theoretical O.C. curve using approximation for the nature of	New Course

		Inverse Kinematics model, Solution techniques. **IV** **Robotic Sensors:** The Meaning of Sensing, Sensors in Robotics, Kinds of Sensors used in Robotics, Choosing the right sensors **Robotic vision:** Introduction to Robotic Vision, Industrial Applications of Vision-Controlled Robotic Systems, Process of Imaging, Architecture of Robotic Vision Systems, Image Acquisition, Image Representation and Image Processing **V** **Robot Applications:** Industrial Applications, Material Handling, Processing Applications, Assembly Applications, Inspection Application, Principles for Robot Application and Application Planning, Justification of Robots, Robot Safety, Non-Industrial Applications. **Robot Programming:** Robot languages, Classification of Robot language, Computer control and robot software, VAL system and language	distribution. 5. Distribution Verification: (a) To verify Normal Distribution using the experimental setup. (b) To find the distribution of numbered cardboard chips by random drawing one at a time with replacement. Make 25 subgroups in size 5 and 10 find the type of distribution of sample average in each case. Comment on your observations. 6. To carry out verification of Poisson distribution using experimental set up. 7. Central Limit Theorem: (a) To show that a sample means for a normal universe follow a normal distribution (b) To show that the sample means for a non normal universe also follow a normal Distribution. 8. Solve quality control problems using SPC software like STATGRAPHICS/MINITAB/SIGMA XL /SYSTAT/EXCEL etc.	
79	**BTME706.C**	**CNC MACHINES AND PROGRAMMING** **I** Introduction: Definition of NC, Applications of NC ,Historical Developments in Automation, Classification of NC Systems, Comparison of NC and Conventional Machines, Advantages of NC **II** NC Hardware: Architecture of NC Systems, Design Considerations, Mechanical Elements, Structure, Guideways and Slides, Guideway Elements, Transmission Systems, Spindle Unit, Coolant system, Lubrication System, Tool and work Changing Mechanisms, Electrical Elements, Drives, Sensors, Control Loops, Computing Elements/ Firmware, Interpolators **III**	-	

		NC Software: Introduction, Manual Part Programming, Computer- Assisted Part Programming, Language Based , Geometric ModelingBased, Automatic Part Program Generation, **IV** CAPP Systems , 5 Axis Programming, Post-Processing, Programming Robots and CMMs NC Simulation, Kinematic simulation, Volumetric simulation, Applications of Volumetric NC Simulation, Verification **V** Advanced Topics:, Adaptive Control, Off-line adaptive control, Various optimisation criteria, Hardware Based AC, Software Based AC, Tooling and Instruments for NC Special Considerations in High Speed Cutting (HSC) and Die Sinking, Rapid Product Development, CAM, FMS, CIM		
80	**BTME707**	**THERMAL ENGINEERING LAB-II** **1** To perform constant speed load test on a single cylinder diesel engine and to plot performance curves: indicated thermal efficiency, brake thermal efficiency, mechanical efficiency Vs. Brake power, and heat balance sheet. **2** To estimate the Indicated Power, Friction Power and Mechanical Efficiency of a multi-cylinder Petrol Engine. (Morse Test) **3** Analysis of engine exhaust gases using Orsat apparatus / gas analyzer. **4** To study refrigeration cycle, determination of coefficient of performance of cycle and tonnage capacity of refrigeration unit. **5** To determine the COP and tonnage capacity of a Mechanical heat pump. **6** To study various controls used in Refrigeration and Air conditioning system. **7** Determination of dryness fraction of steam. **8** Study and Performance of Simple Steam Turbine **9** Performance characteristics of Pelton wheel turbine. **10** Performance characteristics of Francis turbine. **11** Performance characteristics of Kaplan turbine. **12** Performance characteristics of variable speed centrifugal pump.	-	

		13 Performance characteristics of rated speed centrifugal pump.		
81	**BTME708**	**FINITE ELEMENT LAB.** **1** Laboratory work for the solution of solid mechanics problems, heat transfer problems, and free vibration problems **A: by using FE packages such as NASTRAN/ ANSYS/ SIMULIA/ ABAQUS** **2** Introduction of GUI of the software in the above mentioned areas realistic problems. **3** Analysis of beams and frames (bending and torsion problems) **4** Plane stress and plane strain analysis problems **5** Problems leading to analysis of axisymmetric solids **6** Problems leading to analysis of three dimensional solids (a) Heat transfer problems (b) Modal analysis problem **B: by writing own code for finite element analysis using MATLAB for:** **7** Plane stress and plane strain analysis problems **8** Modal Analysis problem	-	-
82	**BTME801**	**BTME801: COMPUTER INTEGRATED MANUFACTURING SYSTEMS** **I** **Introduction to CIM:** Overview of Production Systems, the product cycle, Automation in Production Systems, computer's role in manufacturing, sources and types of data used in manufacturing. The Beginning of CAM: Historical Background, Numerical Control (NC): Basic components of an NC system, coordinate system and motions control systems. Computer Numerical Control (CNC): features of CNC, machine control unit, CNC software. Direct Numerical Control and Distributed Numerical Control. Applications, advantages and disadvantages of NC. Adaptive control of machining system. **II** NC Part programming: Manual and computer assisted part programming, Part programming with APT. NC part programming using CAD/CAM software. NC cutter path verification. **III** Computer Aided Process Planning:	**BTME801.A: Hybrid and Electric Vehicles** **Unit 1:** **Introduction:** Objective, scope and outco **Introduction to Hybrid Electric Vehicles:** hybrid and electric vehicles, impact of modern drive-trains o **Unit 2:** **Conventional Vehicles:** Ba power source characterizatio models to describe vehicle performance. **Hybrid Electric Drive-trains:** Basic conce topologies, power flow control in hybrid **Unit 3:** **Electric Drive-trains:** Basic concept of el power flow control in electricdrive-train **Unit 4:** **Electric Propulsion unit:** Introduction to Configuration and control of DC Motor c	

		Traditional Process Planning, Retrieval process planning system, Generative Process Planning, Machinability data systems, computer generated time standards. Group Technology: Introduction, part families, part classification and coding, coding system and machining cells. **IV** Computer Aided Production Management Systems: Introduction to computer aided PPC, Introduction to computer aided inventory management, manufacturing resource planning (MRPII), computer process monitoring and shop floor control, computer process control. Computer Aided Quality Control; Computer in quality control, contact inspection methods, Non contact inspection methods, optical and non optical computer aided testing. **V** Computer Aided Material Handling; Computer control on material material handling for automated inspection and assembly. Computer Integrated Manufacturing Systems: Introduction, types special manufacturing systems, flexible manufacturing systems (FMS). Collaborative Engineering; Introduction, Faster Design throughput, Web based design, Changing design approaches, extended enterprises, concurrent engineering, Agile and lean manufacturing.	**Unit 5:** **Energy Storage:** Introduction to Energy Storage Requireme energy storage and its analysis, Fuel Cell based energy sto different energy storage devices. **Sizing the drive system:** Matching the electric machine and propulsion motor, sizing the power electronics, selecting	
83	**BTME802**	**BTME802: LAWS FOR ENGINEERS** **I** **Constitutional Law***:* The Preamble; Fundamental Rights; Directive principles of State policy; Fundamental Duties; Emergency provisions – kinds, legal requirements and legal effects. **General Principles of Contract under Indian Contract Act, 1872:** General principles of contract – Sec. 1 to 75 of Indian Contract Act and including Government as contracting party, Kinds of government contracts and dispute settlement, Standard form contracts; nature, advantages, unilateral character, principles of protection against possibility of exploitation, judicial approach to such contracts, exemption clauses, clash between two standard form contracts. **II** **Introduction to Human Rights:**	**BTME801.B: Supply and Operations Management** **Unit 1:** **Introduction:** Objective, scope and outco Introduction to operations management (Historical evolution of OM; Trends in busi Productivity Demand Forecasting: components of fore judgment and opinion, Time series data. A Selection of forecasting technique. **Unit 2:** Product and Service design, Process selec Capacity Planning: Defining and measurin capacity planning process, determining ca	New Course

		Theoretical foundation, Historical development of human rights; Human Rights in Indian tradition and Western tradition; Covenant on Civil & Political Rights 1966 including Optional Protocol – I (Individual Complaint Mechanism) & Optional Protocol – II (Abolition of Death Penalty); Covenant on Economic, Social and Cultural Rights 1966 including Optional Protocol – I (2002); Enforcement of Human Rights in India including Supreme Court, High Courts, Statutory Commissions – NHRC, NCW, NCM, NC-SC/ST etc. **Labour Laws:** Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Workmen Compensation Act, 1923. **III** **Right to Information Act, 2005:** Evolution and concept; Practice and procedures; Official Secret Act, 1923; Indian Evidence Act, 1872; Information Technology – legislation and procedures, Cyber crimes – issues and investigations. **Law relating to Intellectual property:** Introduction–meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; International instruments on IP – Berne convention, Rome convention, TRIPS, Paris convention and international organizations relating IPRs, WTO etc; **IV** Law relating to Copyright in India, Meaning of copyright – literary, dramatics and musical works, sound records and cinematographic films, computer programs, Ownership of copyrights, Criteria of infringement, Piracy in Internet – Remedies and procedures in India; Law relating to Trademarks under Trademark Act, 1999 including Rationale of protection of trademarks as Commercial aspect and Consumer rights, Trademarks, registration, procedures, Distinction between trademark and property mark, Doctrine of deceptive similarity, Passing off an infringement and remedies; Law relating to Patents under Patents Act, 1970, Patentable inventions with special reference to biotechnology	Facility Location: Need for location d qualitative and quantitative techniques o Facilities layout: Product, Process, Fixed position, combinatio **Unit 3:** Planning levels: long range, Intermediate range and Short ra and techniques of aggregate planning. Master scheduling; Bi inputs processing and outputs, and overview of MRPII , use o Introduction to ERP **Unit 4:** Techniques of production control in job shop production, ba sequencing: priority rules, sequencing jobs through two work centers, scheduling servic Introduction to Just-in-time (JIT) production, JIT scheduling, operations system **Unit 5:** Supply Chain Management (SCM): Need of SCM, Bullwhip ef effective supply chain, Purchasing and supplied managemen	

		products, Patent protection forcomputer programs, Process of obtaining patent – application, examination, opposition and sealing of patents, Patent cooperation treaty and grounds for opposition, Rights and obligations of patentee, Duration of patents – law and policy considerations, Infringement and related remedies. **V** **Corporate Law**: Meaning of corporation; Law relating to companies, public and private (Companies Act, 1956) general provisions; Law and multinational companies – International norms for control, FEMA 1999, Corporate liability, civil and criminal. **Election provisions under Indian Constitution** (Art.324–329): Representation of Peoples Act and Prevention of Corruption Act, 1988; Superintendence, directions and control of elections to be vested in Election Commission; Election to the house of people and to the legislative assemblies of States to be on the basis of adult suffrage. Candidate electoral rights.		
84	**BTME 803**	**BTME803: POWER GENERATION** **I Introduction to economics of power generation:** Load duration curves, location of power plants, power plant economics. **II** **Analysis of Steam Power Plants (SPP):** Components of steam power plants, Effect of variations, variation of steam condition on thermal efficiency of steam power plant. Typical layout of SPP. Efficiencies in a SPP. **III** **Analysis of Hydroelectric Power Plants (HEPP):** Components of HEPP, Typical layout of HEPP, Performance of turbines and comparison. **Analysis of Diesel and Gas Turbine Power Plants:** General layout of Diesel and Gas Turbine power plants, Performance of Diesel and Gas Turbine power plants, comparison with other types of power plants. **IV** **Wind Energy:** Wind energy potential measurement, general theories of wind	**BTME801.C: Additive Manufacturing** **Unit-I** **Introduction:** Objective, scope and outcome of the course. Overview of Rapid Product Development (RPD): Need for the compression in product development, history of RP systems, Definition of RPD; Components of RPD. Rapid Prototyping (RP); Principle of RP; Technologies and their classifications. **Unit-II** **Stereo Lithography Systems**: Principle, Process parameter, Process details, Data preparation, data files and machine details, Application. **Selective Laser Sintering& Fusion Deposition Modelling:** Selective Laser Sintering: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications. Fusion Deposition Modeling: Principle, Process parameter, Path generation, Applications. **Unit-III** **Solid Ground Curing**: Principle of operation, Machine details, Applications. Laminated Object Manufacturing:	New Course

		machines, basic laws and concepts of aerodynamics, aerofoildesign; wind mill and wind electric generator. Description and performance of the horizontal–axis wind machines. Description and performance of the vertical–axis wind machines. The generation of electricity by wind machines, **V** **Solar radiation:** its measurement and prediction. Flat plate collectors, liquid and air type. Theory of flat plate collectors, advanced collectors, optical design of concentrators, selective coatings, solar water heating, thermal storage. Conversion of heat into mechanical energy. Solar cells, photovoltaic effect, performance of a solar cell, P-V material, performance of solar cells, P-V modules. Solar P-V plants, Economies of solar photovoltaic's	Principle of operation, LOM materials. Process details, application. Selection of RP process; Issues in RP; Emerging trends. **Rapid Tooling (RT):** Introduction to RT, Indirect RT process-Silicon rubber molding, Epoxy tooling, Spray metal tooling and Investment Casting, Cast kirksite, 3Q keltool, etc. **Unit-IV** **Direct RT processes**: Laminated Tooling, Powder Metallurgy based technologies, Welding based technologies, Direct pattern making (Quick Cast, Full Mold Casting), Emerging Trends in RT, Reverse Engineering: Geometric data acquisition, 3D reconstruction, Applications and Case Studies, Engineering applications, Medical applications. **Unit-V** Processing Polyhedral Data: Polyhedral B-Rep modeling, STL format, Defects and repair of STL files, Introduction to software for RP : Brief overview of Solid view, magics etc.	
85	**BTME 804**	**BTME804 A: PRODUCT DEVELOPMENT AND LAUNCHING** **I** **Importance of New Product:** Definition-importance-Development Process, Importance of new product for growth of enterprise, Definition of product and new product, Responsibility for new product development, Demands on product development team, Classification of products from new product development point of view- Need based/Market pull products, Tech. push, Platform based, Process based and customized products, New product development process and organization, Generic product development process for Market Pull Products, Modification of this process for other types of products. **II** **Need Analysis:** Problem Formulation Establishing economic existence of need, Need Identification and Analysis, Engineering Statement of Problem, Establishing Target Specification.	**BTME802.A: Finite Elements Methods** **Unit-I** **Introduction:** Objective, scope and outcome of the course. Introduction to FEM, Application of FEM, Advantages of FEM, FEA Software. **Steps of FEM:** Discretization, Local stiffness matrix, coordinate transformation, Assembly, Global stiffness matrix, imposition of Boundary conditions, Properties of stiffness matrix, Banded symmetric matrix and bandwidth. **Unit-II** **One-dimensional Finite Element Analysis:** Basics of structural mechanics, stress and strain tensor, constitutive relation, Principle of minimum Potential, Finite element model concept, Derivation of finite elements equations using potential energy approach for linear and quadratic 1-D bar element. Shape functions and their properties, Assembly, Boundary conditions, Computation of stress and strain, Problems on 1-D structural analysis.	Code Change

		III **Generation of Alternatives and Concept Selection:** Concept generation- a creative process, Creativity, Road Elects to creative thinking-Fear of criticism and Psychological set, Tools of creativity like brain storming, Analogy, Inversion etc., Creative thinking Process, Concept feasibility and Concept Selection, Establishing Engineering Specification of Products. **IV** **Preliminary and Detailed Design:** Design Review Preliminary design- Identification of subsystems, Subsystem specifications, Compatibility, Detailed design of subsystems, component design, Preparation of assembly drawings, Review of product design from pointof view of Manufacturing, Ergonomics and aesthetics. **V** **Management of New Product:** Development and Launch New Product Management's Challenges, Maintaining focus, Promotion of Right Culture, Management of Creativity, Top Management attention, Design Team Staffing and Organization, Setting key mile stone, Identification of Risk Areas, Project Execution and Evaluation Product Launch Strategies,	**Unit-III** **Two Dimensional Finite Element Analysis:** Finite element formulation using three nodded triangular (CST) element , Plane stress and Plane strain problems, Shape functions, node numbering and connectivity, Assembly, Boundary conditions, Problems on 2-D structural analysis. **Unit-IV** Finite Element Formulation from Governing Differential Equation: Galerkin FEM method. Application to one dimensional structural problems, one-dimensional heat transfer problems, etc., Introduction to variational formulation (Ritz Method.) **Unit-V** **Higher Order Elements:** Lagrange's interpolation formula for shape functions, Convergence of solution, static condensation, p and h methods of mesh refinement, Aspect ratio.	
86	**BTME805**	**BTME804.B: COMPUTATIONAL FLUID DYNAMICS** **I** **Introduction to Computational Fluid Dynamics and Principles of Conservation**: Conservation of mass, linear momentum: Navier-Stokes equation, Conservation of Energy, General scalar transport equation, Reynolds transport theorem, **Classification of Partial Differential Equations and Physical Behaviour:** Elliptic, parabolic and hyperbolic partial differential equations **Approximate Solutions of Differential Equations:** Error Minimization Principles, Approximate solutions of differential equations, variational approach, Weighted residual approach: trial function and weighting function, Essential and natural boundary conditions, Least square method, Galerkin's method, Rayleigh-Ritz method **II**	**BTME802.B: Energy Management** **Unit-I** Introduction: Objective, scope and outcome of the course.(This compulsory for all course) **Unit-II** Energy Basics; Energy Demand Management, Conservation & Resource Development, Energy for Sustainable Development. **Unit-III** Need for Energy Management by Sector-Industry, Buildings & Houses, Transport, Electric Power. **Unit-IV** Need for Energy Management by Sector-Agriculture, Domestic; Energy forecasting techniques; Energy Integration, Energy Matrix.	New Course

		Fundamentals of Discretization: Pre-processing, Solution, Postprocessing, Finite Element Method, Finite difference method, Well posed boundary value problem, Conservativeness, Boundedness, Transportiveness, Finite volume method (FVM), 1-D steady state heat conduction without and with constant source term **Finite Volume Method:** FV Discretization of a 1-D steady state diffusion type problem, Composite material with position dependent thermal conductivity, Source term linearization, Implementation of boundary conditions, 1-D unsteady state diffusion problems: implicit, fully explicit and Crank-Nicholson scheme **III** **Solution of Systems of Linear Algebraic Equations:** Solution techniques for systems of linear algebraic equations: Elimination, Iteration and Gradient Search method, L-U decomposition technique, Tridiagonal matrix algorithm (TDMA): Thomas algorithm **Iteration methods:** Generalized analysis of the iterative methods, Sufficient condition for convergence, Scarborough criteria of for convergence Relaxation methods, Preferential characteristics of iterative methods, Multigrid method, Line by line TDMA, Alternating direction implicit method, Gradient search methods: Steepest descent method, Conjugate gradient method **IV** **Discretization of Convection-Diffusion Equations: A Finite Volume Approach:** Central difference scheme, Upwind scheme, Exponential scheme and Hybrid scheme, Power law scheme, Generalized convection-diffusion formulation, The concept of false diffusion, QUICK scheme. **Discretization of Navier Stokes Equations:** Discretization of the Momentum Equation: Stream Function-Vorticity approach and Primitive variable approach, Staggered grid and Collocated grid, SIMPLE Algorithm, SIMPLER Algorithm **V** **Introduction to Turbulence Modeling:** Vorticity transport equation, Homogeneous turbulence and isotropic turbulence, Reynolds average Navier stokes (RANS) equation, Necessity of	**Unit-V** Energy Auditing; Energy management for cleaner production, application of renewable energy, appropriate technologies.	

		turbulence modeling, Turbulence model: Eddy viscosity, Mixing length, The S-T model, RNG S-T model, S-U model, Reynolds stress model (RSM),Large eddy Simulation (LES),Direct numerical simulation (DNS) The basic structure of a CFD code: Pre-processor, Solver and Postprocessor, User-defined-subroutines, Solution to some basic problems in heat transfer and fluid flow		
87	**BTME806**	**BTME804.C: TOTAL QUALITY MANAGEMENT** **I** Introduction to TQM: Definition, Basic approach, Guru's of TQM, TQM framework, benefits. Leadership: Characteristics of Quality Leadership, Leadership Concepts, The 7 Habits of Highly Effective People, The Deming Philosophy, The Role of TQM Leaders, Quality Council, Core Values, Concepts, and Framework, Quality Statements, Strategic Planning Communications, Decision Making. Customer Satisfaction: Introduction, Customer Perception of Quality, Feedback, Using Customer Complaints, Service Quality, Translating Needs into Requirements, Customer Retention. **II** Continuous Process Improvement: Introduction, Process, The Juran Trilogy, Improvement Strategies, Types of Problems PDSA Cycle, Problem-Solving Method, DMAIC, Kaizen, Reengineering. Supplier Partnership: Principles of Customer/Supplier Relationship Partnering, Sourcing Supplier, Selection ,Supplier Certification Supplier Rating, Relationship Development. Performance Measures: Basic Concepts, Strategy, performance measure presentation, Cost of Quality, Malcolm Baldrige and Rajiv Gandhi National Quality Award, Balanced Score Card **III** Lean Enterprise: Historical Review, Lean Fundamentals, Value Stream Map, Implementing Lean, Benefits. Six Sigma: Statistical Aspects, Improvement Methodology, Organizational Structure Benefits. Benchmarking: Benchmarking Defined, Reasons to Benchmark, Process, deciding what to benchmark, Pitfalls and	**BTME802.C: Waste and By-product Utilization** **Unit-I** Introduction: Objective, scope and outcome of the course. (This compulsory for all course) **Unit-II** Types and formation of byproducts and waste; magnitude of waste generation in different agro- processing industries; concept scope and maintenance of waste management and effluent treatment, basics pf Waste Recycling & Resources Recovery System (WRRRS), Temperature, pH, Oxygen demands (BOD, COD), fat, oil and grease content, metal content, forms of phosphorous and sulphur in waste waters, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues. **Unit-III** Waste utilization in various industries, furnaces and boilers run on agricultural wastes and byproducts, briquetting of biomass as fuel, production of charcoal briquette, generation of electricity using surplus biomass, producer gas generation and utilization. **Unit-IV** Waste treatment and disposal, design, construction, operation and management of institutional community and family size biogas plants, concept of vermi-composting, Pre-treatment of waste: sedimentation, coagulation, flocculation and floatation, Secondary treatments: Biological and chemical oxygen demand for different food plant waste– trickling filters, oxidation ditches, activated sludge process, rotating biological contractors, lagoons. **Unit-V**	New Course

		Criticisms. **IV** Quality Management Systems: Benefits of ISO Registration, ISO Series of Standards, Sector-specific Standards, ISO 9001 Requirements, Implementation, Documentation, Writing the Documents, Internal Audits, Registration. Environmental Management Systems: ISO 14000 Series Standards, Concepts of ISO 14001, ISO 14001, Requirements, Benefits, Integrating QMS and EMS. Other EMS Systems, Relationship to Health and Safety Quality Function Deployment: The QFD Team, Benefits, the voice of the Customer, Organization of Information, House of Quality, Building a House of Quality, QFD Process. Total Productive Maintenance: The Plan, Learning the New Philosophy,Promoting the Philosophy, Training, Improvement Needs, Goal, Developing Plans, Autonomous Work Groups **V** Management Tools: Forced Field Analysis, Nominal Group Technique, Affinity Diagram, Interrelationship Digraph, Tree Diagram, Matrix Diagram, Prioritization Matrices, Process Decision Program Chart, Activity Network Diagram Experimental Design: Introduction, Basic Statistics, Hypothesis, t Test F Test. One Factor at a Time Orthogonal Design, Point and Interval Estimate, Two Factors Full Factorials. Taguchi's Quality Engineering: Introduction, Loss Function, Orthogonal Arrays, Signal-to-Noise Ratio, Parameter Design, ToleranceDesign, Case study	*Tertiary treatments:* Advanced waste water treatment process-sand, coal and activated carbon filters, phosphorous, sulphur, nitrogen and heavy metals removal, Assessment, treatment and disposal of solid waste.	
88	**BTME 807**	**BTME805: CAM LAB.** **1** To prepare part programming for plain turning operation. **2** To prepare part programming for turning operation in absolute mode. **3** To prepare part program in inch mode for plain turning operation. **4** To prepare part program for taper turning operation. **5** To prepare part program for turning operations using turning cycle. **6** To prepare part program for threading operation. **7** To prepare part program for slot milling operation. **8** To prepare part program for gear cutting operation.	**BTME803: Industrial Engineering Lab** 1. Determination of time standard for a given job using stopwatch time-study. 2. Preparation of flow process chart, operation process chart and man-machine charts for an existing setup and development of an improved process. 3. Study of existing layout of a workstation with respect to controls and displays and suggesting improved design from ergonomic	Course Code Change

		9 To prepare part program for gear cutting using mill cycle. **10** To prepare part program for drilling operation. **11** To prepare part program for multiple drilling operation in Z-axis. **12** To prepare part program for multiple drilling in X-axis. **13** To prepare part program for multiple drilling in X and Z axis usingdrilling cycle	viewpoint. 4. To perform ABC analysis for the given set of inventory data. 5. To develop Bill of Materials/Product structure tree and calculate planned order release (POR) using MRP format 6. To solve the operations research problems on Linear programming/Transportation/Assignment etc. using OR software's like TORA/LINGO/LINDO/SAS/EXCEL SOLVER etc. 7. Simulation of inventory system/Queuing system/production system using Monte-Carlo method. 8. To perform case study on sales forecasting. 9. To perform case study on project management using PERT/CPM. 10. To perform a case study on plant location and layout planning. 11. To perform a case study on capacity planning.	
89	**BTME808**	**BTME806: CAD LAB.** **1** Introduction and different features of the CAD Software. **2** 2-D Drafting. **3** 3-D Modeling. **4** 3-D Advanced Modeling. **5** Assembly modeling. **6** Feature Modification and Manipulation **7** Detailing. **8** Sheet Metal Operations. **9** Surface Modeling **10** One Dimensional problems of Finite Element Method	**BTME804: Metrology Lab** 1. Study of various measuring tools like dial gauge, micrometer, vernier caliper and telescopic gauges. 2. Measurement of angle and width of a V-groove by using bevel protector.. 3. To measure a gap by using slip gauges 4. Measurement of angle by using sine bar. 5. Study and use of surface roughness instrument (Taylor Hobson make) Inspection of various elements of screw thread by Tool makers microscope and optical projector. 6. Measurement of gear tooth	Code Change

			thickness by using gear tooth vernier caliper. 7. To check accuracy of gear profile with the help of profile projector. 8. To determine the effective diameter of external thread by using three-wire method. 9. To measure flatness and surface defects in the given test piece with the help of monochromatic check light and optical flat. 10. To plot the composite errors of a given set of gears using composite gear tester. 11. Measurement of coating thickness on electroplated part and paint coating on steel and non-ferrous material using coating thickness gauge. 12. Study and use of hardness tester for rubber and plastics. 13. To check the accuracy of a ground, machined and lapped surface - (a) Flat surface (b) Cylindrical surface. 14. To compare & access the method of small-bore measurement with the aid of spheres.	
90	**BTME809**	**BTME807: INDUSTRIAL ENGINEERING LAB-II** **1** Determination of time standard for a given job using stopwatch timestudy. **2** Preparation of flow process chart, operation process chart and manmachine charts for an existing setup and development of an improved process. **3** Study of existing layout of a workstation with respect to controls and displays and suggesting improved design from ergonomic viewpoint. **4** To carry out a work sampling study. **5** To conduct process capability study for a machine in the workshop. **6** To design a sampling scheme based on OC curve. **7** To conduct Shewart's experiments on	-	-

		known population **8** Generation of random numbers for system simulation such as facility planning, job shop		