Effective from the session 2019-2020

Induction Program

Induction program (mandatory)	**3 weeks duration**
Induction program for students to be offered right at the start of the first year.	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

Effective from the session 2019-20

BAC-C102
ENGINEERING CHEMISTRY

MM: 100 **Sessional: 30**
Time: 3 hrs **ESE: 70**
L T P **Credits 4**
3 1 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT –I

Periodic properties (8 hours)

Effective nuclear charge, Penetration of orbitals, Variations of s, p, d and f orbital energies of atoms in the periodic table, Atomic and Ionic sizes, Ionization energies, Electron affinity and Electronegativity, Polarizability, Oxidation states, Coordination numbers and Geometries, Hydrogen bonding, Concept of hybridization.

UNIT -II

Chemical kinetics & Use of free energy in chemical equilibria (8 hours)

Introduction, Rate of reaction, Factors influencing rate of reaction, Order and Molecularity of reaction, Arrhenius equation, Concept of activation energy and its determination, Collision theory of reaction rates.

Thermodynamic functions: Energy, Entropy and Free energy, Estimations of entropy and Free energies, Free energy and emf. Cell potentials, the Nernst equation and applications (without derivation) Acid-base equilibria.

UNIT -III

Polymers (8 hours)

Polymers, Nomenclature of polymers, Types of polymerization, Classification of polymerization, Industrial application of polymers, Conducting polymers.

(i) Plastics: Structure, Properties and uses of thermoplastic (Polyvinyl chloride, Teflon, Nylons and Polymethyl methacrylate) & Thermosetting (Bakelite) materials, Uses of plastics.

(ii) Rubber: Natural rubber & Synthetic rubber, Vulcanization of rubber, Advantages of vulcanization of rubber.

UNIT -IV

Nano chemistry (8 hours)

Introduction, Nanotechnology applications, Role of bottom-up & Top-down approaches in Nanotechnology, Material self-assembly, Self-assembling materials, Nanomaterials, Nanocrystals/Nanoparticles, Properties and applications of Nanoparticles, Carbon Nano tube (Basic concept Only).

UNIT -V

Organic reactions and synthesis of a drug molecule (8 hours)

Introduction to reactions involving Substitution, Addition, Elimination, Oxidation, Reduction, Basic concept of stereoisomerism (Geometrical & Optical isomerism).

Synthesis of a commonly used drug molecule (Definitions of different classes of drugs, Synthesis of Aspirin, Phenacetin & Paracetamol Only, Excluding mechanism).

Suggested Text Books

- **(i)** University chemistry, by B. H. Mahan
- **(ii)** Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
- **(iii)** Fundamentals of Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
- **(iv)** Physical Chemistry, by P. W. Atkins
- **(v)** Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp
- **(vi)** Principles of Physical Chemistry, by B.R. Puri, L.R. Sharma, M. Pathania
- **(vii)** A text book of Organic Chemistry, by S. K. Jain
- **(viii)** A text book of Engineering Chemistry, by S. S. Dara
- **(ix)** A text book of Engineering Chemistry, by Jain & Jain

Course Outcomes

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications.

The course will enable the student to:

- Rationalize periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
- Rationalize bulk properties and processes using thermodynamic considerations and learn about chemical kinetics.
- Know about the polymers, polymerization, synthesis and uses of different polymers, plastics and rubbers.
- Know about the Nano chemistry, nanoparticles, Nano materials, and their properties and applications.
- List major chemical reactions that are used in the synthesis of molecules.

Effective from the session 2019-20

BEM-C102
ENGINEERING MATHEMATICS -I

MM: 100 **Sessional: 30**
Time: 3 hrs **ESE: 70**
L T P **Credits 4**
3 1 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

Differential Calculus I: Successive differentiation, Leibnitz theorem, Taylor's & Maclaurin's Expansion, Indeterminate forms, Radius of curvature, Asymptotes, Double points and their classification, Tracing of curves.

UNIT II

Differential Calculus II: Partial Differentiation of functions, Normal to surfaces and tangent plane, Change of variables, Jacobian, Taylor's series of two variables, Truncation errors, Extrema of function of two and more variables, Method of Lagrange's multipliers.

UNIT III

Multiple Integrals: Fundamental Theorem of integral calculus, Differentiation under the integral sign, Double and triple integrals, change of order of integration, change of variables. Application to arc length, area, volume, centroid and moment of inertia. Gamma and Beta functions, Dirichlet's integral.

UNIT IV

Vector Calculus: Differentiation of a vector, Scalar and vector fields, Gradient, Divergence, Curl and their physical meanings, Differential operator and identities, Line, Surface and Volume integrals, green's theorem in plane. Gauss and Stoke's theorems (without proof). Simple applications.

UNIT V

Matrices: Elementary row/ column operations, Rank of a matrix and its applications, Eigen-values and Eign vectors, Cayley-Hamilton theorem, Diagonalization of Matrices, Linear dependence and independence, Normal matrices, Complex matrices and unitary matrices.

Text Books / References

1. Prasad C., A first course in mathematics for Engineers, Prasad Mudranalaya
2. Kreyszig E., Advanced Engineering Mathematics, John Wiley, New York, 1999
3. Grewal B.S., Higher Engineering Mathematics, Khanna, New Delhi, 2000
4. Srivastava R.S.L., Engineering Mathematics Vol. I

Effective from the session 2019-20

BCE-C102
PROGRAMMING FOR PROBLEM SOLVING

MM: 100 **Sessional: 30**
Time: 3 hrs **ESE: 70**
L T P **Credits 4**
3 1 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

Introduction to Computers: Block diagram of computers, functions of its important components, Memory and I/O devices. Concept of assembler, interpreter, compiler & generation of languages. **Number System:** Decimal, Binary, Octal, and Hexadecimal numbers and their arithmetic (addition, subtraction, multiplication, and division): 1's and 2's complements

UNIT II

Programming in C: History, Introduction to C Programming Languages, Structure of C Programs, Compilation and Execution of C Programs, debugging techniques, Data Type and sizes, Declarations of variables, Modifiers, Identifiers and keywords, Symbolic Constants, Storage classes (automatic, external, register and static), Enumerations, command line parameters, Macros, The C Preprocessor.
Operators: Unary operators, Arithmetic & Logical operators, Bit wise operators, Assignment operators and expressions, Conditional expressions, Precedence and order of evaluation.
Control Statements: If-else, switch, break, continue, the coma operator, go to statement.
Loops: while, do-while, for loop.

UNIT III

Arrays: One-dimensional arrays: declaration, initialization and application. Two-dimensional array: declaration, initialization and application, Multidimensional arrays.
Handling of Character Strings: Declaring and initializing string variables, reading strings, Writing strings, Arithmetic operation on strings, comparison of two strings and string handling functions.
Pointers: Accessing the address of the variable, Declaring and initializing pointers, accessing a variable through its pointer expression, pointer increment and scale factor, pointers and array, pointers and character strings.

UNIT IV

Functions: Need for user defined function, return value and its type, function calls, no argument and No return values function, Argument and No return values functions, argument and return value functions. Handling of non-integer function, Scope and life time of variable in functions.
Recursion: Recursive Definition and processes, recursion in C, example of recursion, Tower oh Hanoi Problem, simulating recursion, Backtracking, recursive algorithms, principles of recursion, tail recursion, removal of recursion.

UNIT V

Structures: Structures definition, giving value to members, structure initialization, array of structures, array within structures, structures within structures, structures and functions, Structure Pointers.
File Handling: Creating and Deleting a File, Updating File, Copying File, Searching & Sorting in a File.

Text Books / References

1. Rajaraman V.(3/e), Fundamental of Computers, PHI, New Delhi, 1999
2. Sanders,D.H., Computers Today, Mcgraw Hill, 1998
3. Kris Jamsa, DOS the complete reference, Tata McGraw Hill
4. J.Peek Tim O'reilly & M.Locekides, UNIX POWER TOOLS, BPB Publication
5. Yashwant Kanetkar, Let Us C, BPB
6. Yashwant Kanetkar, C In Depth, BPB

Effective from the session 2019-20

BME-C103
BASIC MECHANICAL ENGINEERING

MM: 100 **Sessional: 30**
Time: 3 hrs **ESE: 70**
L T P **Credits 3**
3 1 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

Thermodynamics I: Introduction to SI units, Definition of thermodynamic system, Surrounding and Universe, Quasi static process, Energy interaction Zeroth law, Concept of temperature First law of thermodynamics, Application to closed and open system, Concept of Enthalpy, steady flow energy equation, Throttling process.

UNIT II

Thermodynamics II: Second law, reversible and irreversible process, Thermal reservoir, heat engines and thermal efficiency, COP of heat pump and refrigerator, Carnot cycle, Claudius inequality, Concept of entropy, Entropy change for ideal gases**.**

UNIT III

Thermodynamics III: Generation of steam at constant pressure, Properties of steam, Use of property diagram, Process of vapor in closed and open system, Rankine cycle. Stroke clearance ratio, Compression ratio, Definition and calculation of mean effective pressure (no proof) for air standard cycles (Otto and diesel cycles

UNIT IV

Mechanics: Trusses: Plane structure, (Method of Joints and Sections only) Beams: Bending moment and shear force diagram for statically determinate beams.

UNIT V

Strength of Materials: Simple stresses and strain, strain energy, stress- strain diagram, elastic constants. Compound stress and strain: state of stress at a point, Simple tension, pure shear, general two-dimensional stress system, principal planes, principal stresses and strains, Mohr's stress circle, Poisson's ratio, maximum shear stress

Text Books / References

1 D S Kumar (2/e), Thermal Science and Engineering, S. K. Kataria, New Delhi,2001
2 P. K. Nag (2/e), Engineering Thermodynamics, TMH, New Delhi,2001
3 R. Yadav (7/e), Thermal Engineering, Central Publishing House, Allahabad, 2000
4 Shames Irving H.(4/e), Engineering Mechanics, PHI, New Delhi, 1994
5 Hibler (1/e), Statics and Dynamics, Pearson Education, Singapore, 2000

Effective from the session 2019-20

BEN-A103

ENVIRONMENTAL STUDIES

MM: 100 **Sessional: 30**
Time: 3 hrs **ESE: 70**
L T P **Credits 0**
2 0 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

The Multidisciplinary Nature of Environmental Studies & Ecosystems: (a) Definition, scope and importance of ecology and environment (b) The ecological components: (i) Abiotic components: soil, water, light, humidity and temperature (ii) Biotic components & their relationships- symbiosis, commensalisms, parasitism, predation and antibiosis (c) Concept of an ecosystem (d) Structure and function of an ecosystem (e) Producers, consumers and decomposers (f) Energy flow in the ecosystem (g) Ecological succession (h) Food chains, food webs and ecological pyramids (i) Introduction, types, characteristic features, structure and function of the following ecosystems: (i) Forest ecosystem (ii) Grassland ecosystem (iii) Desert ecosystem (iv) Aquatic ecosystems (pond, river, ocean estuaries, streams, lakes) (j) Need for public awareness

UNIT II

Natural Resources: (a) Renewable and Non-Renewable resources (b) Natural resources and associated problems: (i) Forest resources: use and over-exploitation, deforestation case, timber extraction, mining, dams and their effects on forest and tribal people (ii) Water resources: use and over-utilization of surface and ground floods, drought, conflicts over water, dams benefits and problem (iii) Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, case studies (iv) Food resources : world food problems, changes caused by agriculture overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies (v) Energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies (vi) Land resources: land as a resource, land degradation, man induced landslides, soil erosion and desertification (vii) Biodiversity & its conservation: definition- genetic, species and ecosystem diversity, values of biodiversity- consumptive use, productive use, social, ethical, aesthetic and option values (viii) Biodiversity at global, national and local levels, India as a mega-diversity nation, hot-spots of biodiversity, threats to biodiversity- habitat loss, poaching of wildlife, man-wildlife conflicts; endangered and endemic species of India, conservation of biodiversity: *in-situ* & *ex-situ* conservation of biodiversity (ix) Bio-geographical classification of India (x) Role of an individual in conservation of natural resources (xi) Equitable use of resources for sustainable lifestyles.

UNIT III

Environmental Pollution: (a) Definition, causes, effects and control measures of: air pollution, water pollution, soil pollution, noise pollution, thermal pollution and nuclear hazards (b) Solid waste management- causes, effects and control measures of urban and industrial wastes (c) Role of an individual in prevention of pollution (d) Pollution case studies (e) Disaster management: floods, earthquake, cyclone & landslides

UNIT IV

Social Issues and the Environment: (a) From unsustainable to sustainable development (b) Urban problems related to energy (c) Water conservation, rain water conservation, rain water harvesting,

management (d) Resettlement & rehabilitation of people- its problems and concerns, case studies (e) Environmental ethics- issues and possible solutions (f) Wasteland reclamation (g) Consumerism and waste products (h) Population growth, variation among nations, family welfare program (i) Environment and human health, human rights, value education (j) HIV/AIDS (k) Role of information technology (IT) in environment and human health (l) Case studies.

UNIT V

Environmental policies and laws: Salient features of following acts (a) Environment Protection Act 1986 (b) Air (Prevention and Control of Pollution) Act 1981 (c) Water (Prevention and Control of Pollution) Act 1974 (d) Wildlife Protection Act 1972 (e) Forest Conservation Act 1980 (f) Issues involved in enforcement of environmental legislation (g) Public awareness

Suggested Books

1. Asthana, D. K. (2006). Text Book of Environmental Studies. S. Chand Publishing.
2. Basu, M., Xavier, S. (2016). Fundamentals of Environmental Studies, Cambridge University Press, India
3. Basu, R. N., (Ed.) (2000). Environment. University of Calcutta, Kolkata
4. Bharucha, E. (2013). Textbook of Environmental Studies for Undergraduate Courses. Universities Press.
5. De, A.K., (2006). Environmental Chemistry, 6th Edition, New Age International, New Delhi.

Effective from the session 2019-20

BAC-C151
ENGINEERING CHEMISTRY LAB

MM: 50 **Sessional: 15**
Time: 2 hrs **ESE: 35**
L T P **Credits 1**
0 0 2

LIST OF EXPERIMENTS

Choice of 10-12 experiments from the following:

1. Chemical analysis of a salt (mixture of one acidic radical and one basic radical).
2. Determination of relative surface tension of given liquid by Satalagmometer.
3. Determination of relative viscosity of given liquid by Ostwald's viscometer.
4. Separation of given binary mixture by thin layer chromatography.
5. Separation of given binary mixture by ascending paper chromatography.
6. Titration of a strong acid with a strong base.
7. Titration between potassium permanganate and ferrous ammonium sulphate solution.
8. Titration between potassium permanganate and oxalic acid solution.
9. Determination of turbidity of unknown sample by using turbiditimeter.
10. Determination of cell constant and conductance of solutions.
11. Determination of the pH of unknown solutions by pH meter.
12. Determination of redox potentials and emfs.
13. Determination of refractive index of unknown sample by using Abbe's refractometer.
14. Determination of chloride content in a water sample by Mohr's method.
15. Determination of molar mass of an unknown solid using the colligative property of freezing point depression.
16. Determination of the partition coefficient of a substance between two immiscible liquids.
17. Determination of moisture content present in hydrated copper sulphate.
18. Determination of saponification value of an oil.
19. Determination of acid value of an oil.

Laboratory Outcomes

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:
Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, pH, turbidity, refractive index, chloride content of water, etc.
Estimate concentration of an unknown sample via acid-base and oxidation – reduction titrations. Synthesize a small drug molecule and analyze a salt sample.
Identify the acid base radicals.
Separate the components present in a mixture by TLC and ascending paper chromatography.

Suggested Books

(i) Advanced practical physical chemistry, by J. B. Yadav
(ii) Analytical chemistry Vol. I, II, III, by Subhash, Satish
(iii) Applied chemistry, by Virmani and Narula

NOTE

1. In practical examination, the student shall be required to perform one experiment which carries 40 marks and 30 marks shall be reserved for practical record and viva-voce examination.
2. The number of students in a batch allotted to an examiner for practical examination shall not exceed 30 students.

Effective from the session 2019-20

BCE-C151

PROGRAMMING FOR PROBLEM SOLVING LAB

MM: 50 **Sessional: 15**
Time: 2 hrs **ESE: 35**
L T P **Credits 1**
0 0 2

LIST OF EXPERIMENTS

1. Conversion from one number system to another
2. Perform different arithmetic operations.
3. Greater of two numbers using logical operators
4. Check whether no. Is odd or even using arithmetic operators
5. Check whether no. Is prime or not.
6. Print Fibonacci series.
7. Print factorial of a no. Using recursion
8. Add two matrices.
9. Search a no. In array.
10. Reverse an array.
11. Find a leap year.
12. Multiply two matrices. 13. Pass by reference in functions
14. Find factorial of a number.
15. Create a menu function for all arithmetic operations using one program
16. Addition subtraction using call by functions.

NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D.

Effective from the session 2019-20

BME-C153
ENGINEERING GRAPHICS AND DESIGN LAB

MM: 100 **Sessional: 30**
Time: 3 hrs **ESE: 70**
L T P **Credits 2**
1 0 2

Unit 1: Introduction to Engineering Drawing
Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering and dimensioning, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, and Hypocycloid Scales – Plain, Diagonal and Vernier Scales;

Unit 2: Orthographic Projections and Projections of Regular solids
Principles of Orthographic Projections-Conventions – Principal planes, Auxiliary Planes, Introduction to first angle and third angle projection, Projections of Points, projection of lines- parallel to both the planes, parallel to one and inclined to other, inclined to both the planes, true length and traces of a line, and lines inclined to both planes, Projections of planes, traces of planes, angles of inclinations of planes, parallel planes.

Unit 3: Sections and Sectional Views of Right Angular Solids and Isometric Projections
Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)
Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Unit 4: Overview of Computer Graphics Customization and CAD Drawing
Computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software (AUTOCAD) [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in AUTOCAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids.

Unit 5: AUTOCAD as a tool for design and drawing objects

Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); orthographic projection techniques; Drawing sectional views of composite right regular geometric solids CAD software (AUTOCAD) modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, Multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling. Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Appling Color coding according to building drawing practices; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

Text Books / References

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson

Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & Pannaiah (2008), Text book on Engineering Drawing, Scitech Publishers

NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

Effective from the session 2019-20

BEG-A151
TECHNICAL COMMUNICATION

MM: 100 **Sessional: 30**
Time: 3 hrs **ESE: 70**
L T P **Credits 1**
0 0 2

Objective:

1. To expose the learners to English sound system and acquire phonetics skill and speech rhythm
2. To help the learners use grammar correctly
3. To train the learners to speak English, clearly, intelligently and effectively
4. To equip the learners to compete for a career, and enable them to function effectively in careers which demand good communicative skills
5. To impart moral values

Contents:

1. Nonverbal communication
   - Use of hands
   - Posture of shoulders
   - Eye contact
   - Weight of the body
   - Movement of the body

2. Applied phonetics
   - Sound of English – consonants and vowels
   - Phonemic transcription
   - Stress, Rhythm and intonation

3. Remedial grammar
   - Some useful expression (introduction, greetings etc.) that are used frequently
   - Common mistakes in the use of nouns, pronouns, adjectives, adverbs, prepositions, conjunctions
   - Use of the who and whom, much and many, still and yet, so as and so that, make and do
   - Tense and their use
   - Confusion of participles
   - Tag questions

4. Reading and speaking skills, listening and speaking skills
   - Presentation and addresses
   - Group discussions
   - Interviews
   - Role playing

5. Reading and writing skill, listening and writing skills
   - Letter writing – formal and informal
   - Real life social situations
   - Curriculum vitae
   - Agenda, notice and minutes

6. Case studies
   - Study of renowned speeches of famous personalities ○ Swami Vivekananda ○ Mahatma Gandhi ○ Jawaharlal Nehru ○ Swami Shraddhanand ○ Steve Jobs

Text Books / References

1) Balasubramaniam, T. *Phonetics for Indian Students*. Macmillan India Ltd.
2) Daniel, Jones. English Pronouncing Dictionary. Cambridge University Press.
3) Oxford Advanced Learners' Dictionary.
4) Taylor, Grant "conversation practice", Tata Mc Graw Hills, new Delhi 5) F.T.A. Wood, "Remedial English Grammar", macmillan India Ltd.
6) Berry, Thomas Elliot, "The Most Common Errors in English Usage" Tata Mc Graw Hills, New Delhi
7) Krishnaswamy, N. "*Modern English*. Macmillan India Ltd.
8) Desmond, "people watching"

Effective from the session 2019-20

BAP-C202
ENGINEERING PHYSICS

MM: 100 **Sessional: 30**
Time: 3 hrs **ESE: 70**
L T P **Credits 4**
3 1 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT –I

Wave & Oscillations: Simple harmonic motion, damped and forced simple harmonic oscillator, Mechanical and electrical simple harmonic oscillators, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, electrical and mechanical impedance, steady state motion of forced damped harmonic oscillator, power absorbed by oscillator.

UNIT –II

Quantum Mechanics: Introduction to quantum physics, black body radiation, explanation using the photon concept, photoelectric effect, Compton effect, de Broglie hypothesis, wave-particle duality, Born's interpretation of the wave function, verification of matter waves, uncertainty principle, Schrodinger wave equation & its solution for particle in box

UNIT –III

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

UNIT –IV

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

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: Ruby laser, He-Ne and CO2 laser, properties and applications of lasers.

UNIT –V

Electronic materials: Free electron theory of metals, quantum theory of free electrons, Fermi level, Density of states, Energy bands in solids, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Density of states, Occupation probability, Fermi level, **Semiconductors**: Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrierconcentration and temperature (equilibrium carrier statistics), concentration of charge carriers, Carrier generation and recombination, Carrier transport: diffusion and drift in p-n junction.

Text Books / References

1.I.G. Main, Vibrations and Waves in Physics, Cambridge University Press (1993).

2. H. J. Pain, The Physics of Vibrations and waves, Wiley India Pvt., Ltd. 6th Edition (2010).
3. David Griffiths, Introduction to Electrodynamics, Pearson Education India Learning Private Ltd. 4th Edition (2015).
4. Halliday, Resnick, Walker, Fundamental of Physics, Wiley India Pvt. Ltd; 10th Edition (2015).
5. W. Saslow, Electricity, magnetism and light, Academic Press, 1th Edition (2002).
6. E. Hecht, Optics, Pearson Education, India, 4 th Edition (2008).
7. A. Ghatak, Optics, Tata McGraw-Hill Education India, 5 th Edition (2012).
8. O. Svelto, Principles of Lasers, Springer Science & Business Media (2010).
9. D.J. Griffiths, Quantum Mechanics, Pearson Education (2014).
10. R. Robinett, Quantum Mechanics, OUP Oxford (2006).
11. L.I. Schiff, Quantum Mechanics, Tata McGraw-Hill Education Pvt. Ltd, 4th Edition (2014)
12. D.A. Neamen, Semiconductor Physics and Devices, Times Mirror High Education Group, Chicago (1997).
13. E.S. Yang, Microelectronic Devices, McGraw Hill, Singapore (1998).
14. B. G. Streetman, Solid State Electronic Devices, Prentice Hall of India (1995).
15. K. Charles, Introduction to Solid State Physics, John Wiley, Singapore, 7th Edition (1996).

BEM-C202
ENGINEERING MATHEMATICS II

MM: 100 **Sessional: 30**
Time: 3 hrs **ESE: 70**
L T P **Credits 4**
3 1 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

Differential Equations: Ordinary differential equations of first order, orthogonal trajectories, linear differential equations with constant coefficients, Simple applications, Euler- Cauchy equations, Equations of the form $y'' = f(y)$. Solution of second order differential equations by change of dependent and independent variables, Method of variation of parameters for second order differential equations.

UNIT II

Partial Differential Equations: Introduction of partial differential equations, solution of Linear partial differential equations of second order with constant coefficients and their classification, Method of separation of variables.

UNIT III

Solution in Series: Solution in series of second order linear differential equations, Bessel's and Legendre's equations and their solutions, Properties of Bessel function and Legendre's polynomials, Rodrigue's formula, Recurrence relations, Generating functions, Jacobi series, Integral representation of Bessel's functions.

UNIT IV

Fourier Series: Fourier series, Dirichlet's condition and convergence, Change of interval, Half range series, Harmonic analysis.

UNIT V

Statistics: Random variables, Probability mass function, Probability density function, Moments, Moment generating functions. Binomial, Poisson and Normal distributions. Correlation and Regression. Method of least squares and curve fitting - straight line and parabola.

Text Books / References

1. Kreyszig E., Advanced Engineering Mathematics, John Wiley, New York, 1999
2. Simmons, G.F., Differential Equations with Applications and Historical Notes, McGraw-Hill, 1991.
3. Grewal B.S., Higher Engineering Mathematics, Khanna, New Delhi, 2000 4. Jain R. K., Iyenger S.R.K., Advanced Engineering Mathematics, Narosa , 2002.
5. Miller and Freunds, Probability and Statistics for Engineers, PHI, 2011.
6. Kapur J. N. & Saxena H.C., Mathematical Statistics, S Chand, 2010.

BEE-C202
BASIC ELECTRICAL ENGINEERING

MM: 100 **Sessional: 30**
Time: 3 hrs **ESE: 70**
L T P **Credits 4**
3 1 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

D.C. Network Theory: Concept of elements**,** Circuit theory concepts- Mesh and node analysis, StarDelta transformation. Network Theorems- Super-position theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, DC Transients- RL, RC circuits.

UNIT II

Steady State Analysis of A.C. Circuits: Sinusoidal and Phasor representation of voltage and current, average and rms value, form and peak factor of sinusoidal and different waveforms, single -phase A.C. circuit- behavior of resistance, inductance and capacitance and their combination in series & parallel and power factor, series parallel resonance-band width and quality factor.
Three Phase A.C. Circuits: Star-Delta connections, line and phase voltage/current relations, three phase power and its measurement.

UNIT III

Magnetic Circuits: Ampere turns, magnetomotive force, permeability, reluctance, composite magnetic circuits, comparison between magnetic and electric circuits.
Transformer: Principle of operation, types of construction, phasor diagram, equivalent circuit, efficiency and voltage regulation of single-phase transformer, O.C. and S.C. tests.

UNIT IV

D. C. Machines: Principle of electromechanical energy conversion, types of D.C. machines, E.M.F. equation, Magnetization and load characteristics, losses and efficiency, speed control of D.C. motors and applications.
Measuring Instruments: Principle of working and constructional features of Permanent Magnet Moving Coil and Moving Iron ammeters and voltmeters, Electrodynamic Wattmeter, Induction type single-phase Energy meter.

UNIT V

Three-phase Induction Motor: Principle of operation, types and methods of starting, slip-torque characteristics and applications.
Single-phase Induction Motor: Principle of operation, methods of starting.
Three-phase Synchronous Machines: Principle of operation and application of synchronous motor.

Text Books

1. V. Del Toro, Principles of Electrical Engineering, Prentice Hall International.
2. H. Cotton, Advanced Electrical Technology, Wheeler Publishing.
3. E. Huges, Electrical Technology.

References

1. B. L., Theraja, Electrical Technology, Vol-1, S. Chand Publisher, New Delhi.
2. W.H. Hayt & J.E. Kennedy, Engineering circuit Analysis, Mc Graw Hill.
3. I.J. Nagrath, Basic Electrical Engineering, Tata Mc Graw Hill.
4. A.E. Fitgerald, D.E., Higginbotham and A Grabel, Basic Electrical Engineering, Mc Graw Hill.
5. Ashfaq Hussain, Fundamentals of Electrical Engineering, Dhanpat Rai Publish.

Effective from the session 2019-20

BET-C202
ELECTRONIC DEVICES

MM: 100 **Sessional: 30**
Time: 3 hrs **ESE: 70**
L T P **Credits 4**
3 1 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

Semiconductors, energy band description of semiconductors, effect of temperature on semiconductors, intrinsic and extrinsic semiconductors, donor and acceptor impurities, electron and hole concentration, conductivity of a semiconductor, mobility and resistivity, Generation and Recombination, Hall effect, Fermi level, mass action law, charge densities in a semiconductor, diffusion and Poisson and continuity equation.

UNIT II

P-N junction and its properties, V-I characteristics of P-N junction, semiconductor-diode, depletion layer, equivalent circuits of junction diode, diode equation, diode resistance and capacitance, application of junction diode as clippers, clampers and rectifiers (Half-wave, Full-wave and bridge), efficiency of rectifiers, ripple factor, filter circuits, Zener and avalanche breakdown mechanism, Zener diode and its characteristics, equivalent circuit of Zener diode, Zener diode as a voltage regulator, LED, photo diode and solar cell.

UNIT III

Bipolar junction transistor (BJT) and its action, Transistor configurations (CB, CE and CC) and their characteristics, cut-off, active and saturation regions. Transistor as a switch, operating point, dc load line, Transistor biasing and its necessity, thermal runaway, types of biasing and their analysis, stability factors, Transistor as a regulator. Concept of Transistor amplifier, graphical analysis of CE amplifier, dc and ac equivalent circuits, Emitter follower and its ac model.

UNIT IV

Ebers-Moll model of BJT, T model of BJT, Hybrid model of BJT at low frequency, computation of voltage gain, current gain and power gain, Zi and Zo and approximate formulas, high frequency transistor hybrid π model.

UNIT V

Field Effect Transistor: JFET and its characteristics, biasing of JFET, small signal low frequency and high frequency model of JFET amplifier, configurations of JFET, MOSFET, MESFET (Enhancement & depletion types) their construction and characteristics, configuration of MOSFET, MOS capacitor.

Text Book

1. Integrated Electronics: Jacob Millman & C.C. Halkias

References

1. Malvino and leach “Digital principle and applications.
2. Streetman Ben.G, “Solid state electronic devices” (3/e), PHI
3. Millman and grabel, “Microelectronics” PHI
4. Robert Bolyestad “Electronic devices and circuit”, PHI

Effective from the session 2019-20

BHU-S202
VEDIC SCIENCE & ENGINEERING

MM: 100 **Sessional: 30**
Time: 3 hrs **ESE: 70**
L T P **Credits 0**
2 0 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

Science in Vedic literature and Indian Philosophy-I: Kanad's atomic theory, concept of parmanu, Formation of molecules, Parimandal, Comparison with Dalton's atomic theory and models of Thompson, Rutherford and Bhor. Concept of SAMATA and VISHAMTA vs Maxwell-Boltzmann's distribution of velocities and energies.

UNIT II

Science in Vedic literature and Indian Philosophy-II: First and Second Law of thermodynamics in daily life. Law of helplessness of mankind in thermodynamics and Indian philosophy. Entopy in life and concept of pralaya. Dhananjay Vs concept of Radioactivity-life after death. Atomic spectrum Vs concept of Kundalini.

UNIT III

Vedic Mathematics: Measurements in Vedic Times, ancient scale of length, mass, time and temperature, Number system, Geometry according to sulba Sutra. Overview of Vedic Mathematical Rules (ekadhiken pooren, Nikhil navtascharaman dashatah, oordhavatriyagyabhyam)

UNIT IV

Electrical, Electronics & Aeronautical Engineering in Vedas: Concept of electrical Engineering, type of electricity – Tadit, Saudamini, Vidyut, Shatakoti, Haradini, Ashani. Electronics Engineering in Vedic literature. Aeronautical Engineering in Vedic literature, Types of Vimanas and their construction and working, Shakun viman, Rukma viman, Tripura viman, concept of calculator and ancient ways of computation.

UNIT V

Mechanical, Chemical, Civil & Architectural engineering in Vedic Literature: Mechanical & Chemical Engineering in ancient India, Art of Alchemy, Types of Iron and steel. Civil and Architectural engineering in Vedic literature. Concept of cryptography & Art of secret writing.

Text Books / References

1. Science in Vedas by Acharya Vaidyanath Sashtri.
2. Science in the Vedas by Hansraj, Shakti Publications, Ludhiana.
3. Vedic Mathematics by Swamisri Bharati Krishana Teerathaji, Motilal Banarasi Das, Delhi.
4. Brahad Viman shastra by Maharishi Bhardwaj.
5. Vymanika shastra, English translation by G. R. Josyer.
6. Alchemy and Metallic Medicines in Ayurveda by : Vaidya Bhagwan Das. 7. History of Hindu Chemistry by : P. C. Raya
8. Indian Alchemy by : Dr. S. Mahdihassan.
9. Ancient Scientist of Indian by Satya Prakash.
10. Vaishaishik Darshan by Maharishi Kanad.
11. Vedas : The sources of ultimate science by S. R. Verma, Nag Publisher, New Delhi.

Effective from the session 2019-20

BAP-C251
ENGINEERING PHYSICS LAB

MM: 50 **Sessional: 15**
Time: 2 hrs **ESE: 35**
L T P **Credits 1**
0 0 2

LIST OF EXPERIMENTS

1. To verify the inverse square law of radiation using Photoelectric effect.
2. To determine the value of Planck's constant and photoelectric work function of the material of the cathode using Photoelectric cell.
3. To determine the frequency of an unknown signal by the drawing the Lissajous patterns for various frequency ratios and evaluate the phase difference between two sinusoidal signals applied to X and Y inputs of cathode ray oscilloscope.
4. To determine the value of e/m of an electron by helical method / Thomson method.
5. To verify the existence of Bohr's energy level with Frank-Hertz apparatus.
6. To determine the resistivity and energy band gap by Four Probe method.
7. To determine the Curie temperature of the given Ferrite material.
8. To investigate resonance in forced Oscillations and to find the Spring Constant.
9. To find the refractive index of the material of given Prism using Spectrometer.
10. To determine the wavelength of He-Ne laser by Diffraction Method.
11. To determine the specific rotation of sugar solution using Laurent's half-shade Polarimeter.

NOTE

1. Additional experiments may be added based on contents of syllabus.
2. In practical examination the student shall be required to perform one experiment.
3. A teacher shall be assigned 20 students for daily practical work in laboratory.
4. No batch for practical class shall consist of more than 20 students.
5. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
6. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

Effective from the session 2019-20

BEE-C251
BASIC ELECTRICAL ENGINEERING LAB

MM: 50 **Sessional: 15**
Time: 2 hrs **ESE: 35**
L T P **Credits 1**
0 0 2

LIST OF EXPERIMENTS

1. Verification of Kirchhoff's laws.
2. Verification of The venin's theorems.
3. Verification of Norton's theorem
4. Verification of Superposition theorem.
5. Verification of maximum power transfer theorem.
6. Measurement of power in three-phase circuit by two wattmeter method.
7. Determination of efficiency of a single-phase transformer by load test.
8. To perform open circuit test on single-phase transformer & find equivalent circuit parameters.
9. To perform short circuit test on single-phase transformer & find equivalent circuit parameters.
10. D.C. generator characteristics
    (a) Shunt generator
    (b) Series generator
    (c) Compound generator
11. Speed control of D.C. shunt generator.
12. To study running and reversing of a three-phase Induction Motor.
13. To study & calibration of a single-phase Energy Meter.
14. Calibration of voltmeter and ammeter.
15. To study of resonance in RLC circuit.

NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

Effective from the session 2019-20

BET-C251
ELECTRONICS DEVICES LAB

MM: 50 **Sessional: 15**
Time: 2 hrs **ESE: 35**
L T P **Credits 1**
0 0 2

LIST OF EXPERIMENTS

1. To draw the V-I characteristics of PN junction diode.
2. To draw the V-I characteristics of Zener diode and study it as voltage regulator.
3. To study junction diode as half wave and full wave rectifier.
4. To study junction diode as clipper and clamper.
5. To draw the input and output characteristics of a transistor in CE and CB configuration.
6. To find the small signal h-parameters of a transistor.
7. To draw the input and output characteristics of FET and to measure the pinch off voltage.
8. To draw the drain and transfer characteristic curve of MOSFET.
9. To draw the frequency response of FET amplifier.
10. To draw the frequency response curve of Emitter Follower.

NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

Effective from the session 2019-20

BME-C252
WORKSHOP PRACTICE

MM: 50 **Sessional: 15**
Time: 2 hrs **ESE: 35**
L T P **Credits 1**
0 0 2

LIST OF EXPERIMENTS

Carpentry Shop

1. Study of Carpentry Tools, Equipment and different joints.
2. To prepare a half T joint of given dimensions. **Molding Shop**
3. Introduction to Patterns, pattern allowances, Gate, Riser, and Runner.
4. To prepare a mould of half bearing.

Metal Joining.

5. To prepare a butt joint of MS strips using Arc welding.
6. To prepare a T joint of MS strips using Oxy Acetylene gas welding.

Fitting Shop

7. To prepare a rectangular piece with slant edge of given size from M.S. flat. **Machine Shop**
8. To prepare a job on Lathe machine of given shape and size.
9. To prepare a job on Shaper machine of given shape and size.
10. To prepare a job on Milling machine of given shape and size.
11. To prepare a job on CNC train master of given shape and size.
12. To prepare a job on drilling machine of given shape and size.

NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

Effective from the session 2019-20

BSP-S251
PHYSICAL TRAINING & YOGA

MM: 50 **Sessional: 50**
Time: 2 hrs
L T P **Credits 0**
0 0 2

UNIT-1

1. Warming Up (Meaning, Types and methods)
2. Components of physical fitness (strength, endurance, speed, flexibility and agility and coordinative ability)
3. Methods of Improving Strength
4. Methods of Improving Endurance
5. Methods of Improving Speed
6. Methods of Improving Flexibility
7. Limbering down

UNIT-2

1.Yama
2. Niyama
3. Asana
4. Shatkarma
5. Dharna and dhyana
6. Meditation and Samadhi

Effective from the session 2019-20

BEM-C302
ENGINEERING MATHEMATICS – III

MM: 100 **Sessional: 30**
Time: 3 hrs **ESE: 70**
L T P **Credits 4**
3 1 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

Laplace Transform: Laplace transform of elementary functions, shifting theorems, transform of derivatives, Differentiation and Integration of transforms, Heaviside unit step and Dirac Delta functions, Convolution theorem, Solution of ordinary linear differential equations used in Mechanics, Electric circuits and bending of beams.

UNIT II

Fourier Transform: Definition of Fourier transform, Fourier sine and cosine transforms. Fourier integral formula, Parseval's identity, Applications of Fourier transform in solving heat equations.

UNIT III

Z transform: Definition, Linearity property, Z transform of elementary functions, Shifting theorems, Initial and final value theorem, Convolution theorem, Inversion of Z transforms, Solution of difference equations by Z transforms.

UNIT IV

Functions of Complex Variable: Limit and Continuity of functions of Complex Variables: Analytic Functions, Harmonic Conjugate, Cauchy-Riemann Equations (without proof), Line Integral, Cauchy Goursat theorem (without proof), Cauchy Integral formula (without proof), Singular Points, Poles & Residues, Residue Theorem, Application of Residues theorem for Evaluation of Real Integral (Unit Circle).

UNIT V

Errors and Roots of Equations: Absolute, relative, round-off and truncation errors. Significant digits. Algebraic and Transcendental Equations, Numerical solution, Method of bisection, Newton-Raphson method, Direct iterative method, convergence.

Text Books / References

1. Kreyszig E., Advanced Engineering Mathematics, John Wiley, New York, 1999
2. Gerald, C.F., Wheatley P.O., Applied Numerical Analysis, Pearson, 2007.
3. Grewal B.S., Higher Engineering Mathematics, Khanna, New Delhi, 2000.
4. Jain R. K., Iyenger S.R.K., Advanced Engineering Mathematics, Narosa , 2002.
5. Jain R. K., Iyenger S.R.K., Jain M.K., Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, 2012.

Effective from the session 2020-2021

BME-C306
MATERIAL ENGINEERING

MM: 100 **Sessional: 30**
Time: 3 Hr. **ESE: 70**
L T P **Credit : 3**
3 0 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I

Crystal Structure: Crystal structure determination technique, Miller Indices, Diffusion, Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems. **8**

UNIT-II

Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength. **8**

UNIT-III

Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Fick law, Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non-destructive testing (NDT). **8**

UNIT-IV

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid andmonotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron. **8**

UNIT-V

Heat treatment of Steel: Annealing, tempering, normalising and spheroid sing, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening. **8**

Suggested book:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Higdon, A., Ohlsen, E.H., Stiles, W.B., Weese, J.A., and Riley, W.F., "Mechanics of Materials", John Wiley & Sons, ISBN: 978-0-470-50873-2.	1989
2.	Timoshenko, S.P., and Gere, J.M., "Mechanics of Materials", 2nd Ed., CBS Publishers, ISBN: 9788123908946.	2002
3.	W. D. Callister, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India, **ISBN-10:** 0471736961	2006
4.	Hearn, E.J., "Mechanics of Materials", 3rd Ed., Pergamon, **SBN:** 9780750632669.	2003

Effective from the session 2020-2021

BME-C307
APPLIED THERMODYNAMICS

MM: 100 **Sessional: 30**
Time: 3 Hr. **ESE: 70**
L T P **Credit : 4**
3 1 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy. 8

UNIT II

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Super-critical and ultra-super-critical Rankine cycle- Gas power cycles. 4

Air standard Otto, Diesel and Dual Cycles-Air standard Brayton cycle, effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles. 4

UNIT III

Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, super saturation- compressible flow in diffusers, efficiency of nozzle and diffuser. 8

UNIT IV

Steam turbines, velocity and pressure compounding of steam turbines, Governing of turbines. Velocity diagram of simple & compound multistage impulse & reaction turbines & related calculations work done efficiencies of reaction, impulse Reaction Turbines, state point locus, Reheat factor. 8

UNIT V

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors. 8

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Moran, M.J., and Shapiro, H.M., "Fundamentals of Engineering Thermodynamics", 4th Ed., John Wiley & Sons, ISBN-10: 0470495901	2000
2.	Wark, K. Jr., and Donald, E.R., "Thermodynamics", 6th Ed., McGraw-Hill, ISBN 0-07-240296-2	1999
3.	Arora, C.P., "Refrigeration and Air Conditioning", 2nd Ed., TataMcGraw-Hill, ISBN-10: 9780070083905	2002

4.	Gordon, R., and Mayhew, Y., "Engineering Thermodynamics and Heat Transfer", 4th Ed., Addison-Wesley, SBN-10: 8131702065	2001
5.	Cengel, Y.A. and Boles, M.A., "Thermodynamics: An Engineering Approach", 3rd Ed., Tata McGraw-Hill, ISBN: 9780070262171.	2002

Effective from the session 2020-2021

BME-C308
ENGINEERING MECHANICS

MM: 100 **Sessional: 30**
Time: 3 Hr. **ESE: 70**
L T P **Credit : 3**
3 0 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I

Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in pace – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy. 8

UNIT-II

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack. 6

UNIT-III

Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines. 8

UNIT-IV

Centroid of simple figures from first principle. centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.9

UNIT-V

Introduction to Kinetics of Rigid Bodies, Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation;

9

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Irving H. Shames, Engineering Mechanics, 4th Edition, Prentice Hall, ISBN: 0133569241	2006
2.	P. Beer and E. R. Johnston, Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill, ISBN: 9781260085006	2011

3.	Bansal R.K., A Text Book of Engineering Mechanics, Laxmi Publications, ISBN-10: 8131804097.	2010
4.	Khurmi R.S., Engineering Mechanics, S. Chand & Co., ISBN-10: 8121931002.	2010
5.	Tayal A.K., Engineering Mechanics, Umesh Publications,5SBN 9789380117386.	2010

Effective from the session 2020-2021

BEE-C306
ELECTRICAL MACHINES

MM: 100 **Sessional: 30**
Time: 3 Hr. **ESE: 70**
L T P **Credit : 4**
3 1 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

Transformer: Construction, types and principle of operation, polarity test, Sumpner's test, all day efficiency.

Autotransformer: Volt- amp relation, efficiency, advantages & disadvantages and applications; Three- phase transformers: Connections, three- phase bank of single phase transformers, Scott connections; Instrument Transformers. 8

UNIT II

D.C. Machines: Construction, emf and torque equations. Armature reaction, commutation, performance characteristics of motors and generators, starting of motors, speed control losses and efficiency. 8

UNIT III

Three-Phase Induction Motor: Construction, rotating magnetic field and principle of operation,of equivalent circuit, torque production, Torque- slip characteristics, speed control, starting of squirrel cage and slip ring induction motors. 7

UNIT IV

Three-phase Synchronous Machines:

Alternator: Construction, emf equation & effects of pitch and distribution factors phasor diagram, armature reaction, Voltage regulation and its determination by synchronous impedance method, methods of synchronization.

SynchronousMotor: Principle of operation and starting torque and mechanical power developed, effect of excitation on line current, v-curves. 9

UNIT V

Fractional H.P. Motors: Single phase induction motor: Construction, revolving field theory and principle of operation, equivalent circuit and starting methods, no load and blocked rotor test. Universal motor, repulsion motor, stepper motor, and their applications.

Industrial Applications: Concept of braking in dc and ac motors, two quadrants and four quadrant operation of dc and three phase induction motors, industrial applications of dc and ac motors. 8

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Electric Machines by I J Nagrath& D P Kothari, Tata McGraw Hill,ISBN-9780074517895.	1997
2.	electric Machines by Ashfaq Husain, Dhanpat Rai & Com., ISBN-10: 8177001663.	2005

3.	Generalised Theory of Electrical Machines by Dr. P S Bimbhra , ISBN: 978-81-7409-225-0.	1996
4.	Irvin L.Kosow, Electric Machinery and Transformers Prentice Hall of India, ISBN-0132487330.	1990

Effective from the session 2020-2021

BME-C356
MATERIALS ENGINEERING LAB

MM: 50 **Sessional: 15**
Time: 2 Hr. **ESE: 35**
L T P **Credit: 1**
0 0 2

LIST OF EXPERIMENTS

1. Specimen preparation for micro structural examination-cutting, grinding, polishing, etching.
2. Grain Size determination of a given specimen.
3. Comparative study of microstructures of different given specimens (mild steel, gray C.I., brass, cooper etc.)
4. Heat treatment experiments such as annealing, normalizing, quenching, case hardening andcomparison of hardness before and after.
5. Material identification of say 50 common items kept in a box.
6. Faradays law of electrolysis experiment.
7. Study of corrosion and its effects.
8. Study of microstructure of welded component and HAZ. Macro & Micro examination.
9. Other tests such as shear, bend tests on UTM.
10. Hardness testing of given specimen using Rockwell and Vickers/Brinell testing machines.
11. Spring index testing on spring testing machine.
12. Fatigue testing on fatigue testing machine.
13. Torsion testing of a rod on torsion testing machine.
14. Study of non-destructive testing methods like magnetic flaw detector, ultrasonic flaw detector,eddy current testing machine, dye penetrant tests.
15. To conduct the Impact test (Izod / charpy) on the Impact testing machine and to find the impact strength.

NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

Effective from the session 2020-2021

BME-C357
APPLIED THERMODYNAMICS LAB

MM: 50 **Sessional: 15**
Time: 2 Hr. **ESE: 35**
L T P **Credit: 1**
0 0 2

LIST OF EXPERIMENTS

Minimum 10 experiments out of following:

1. Study of Fire Tube boiler model.
2. Study of Water Tube boiler model.
3. Study and working of Two stroke petrol Engine
4. Study and working of Four stroke petrol Engine
5. Study and working of Two stroke Diesel Engine
6. Study and working of Four stroke Diesel Engine.
7. Study of Impulse & Reaction turbine
8. Study of Steam Engine model.
9. Study of Gas Turbine model.
10. Study of Refrigeration model.
11. To conduct the tensile test on a UTM and determine ultimate tensile strength, percentage elongation for a steel specimen.
12. To conduct the compression test and determine the ultimate compressive strength for a specimen.
13. To determine the hardness of the given specimen using Brinell / Rockwell / Vicker testing machine.

NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

Effective from the session 2020-2021

BME-C358
ENGINEERING MECHANICS LAB

MM: 50 **Sessional:15**

Time: 2 Hr. **ESE: 35**
L T P **Credit: 1**
0 0 2

LIST OF EXPERIMENTS

1. To determine the efficiency of a machines
2. To determine the mechanical advantage and efficiency of screw jack
3. To measure coefficient of friction of different surfaces
4. To study the forces acting on trusses
5. To study the moment of inertia of a flywheel
6. To study Lami's theorem using universal force table apparatus
7. To study the equilibrium of parallel forces – simply supported beam reactions
8. To determine the velocity ratio, mechanical advantage and efficiency of worm and worm wheel.
9. To verify the parallelogram law of forces.
10. To verify the moment area theorem for slope anddeflection of beam.
11. To study and verify the behavior of strutswith various end conditions.
12. To study the performance of differential axle and wheel and find itsvelocity ratio, efficiency and law of machine.
13. To study of forces in the members of jib crane.

Note:

1. Each student shall be required to perform one experiment in the practical examination.
2. A Teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Every student shall have to perform minimum eight experiments during the semester.
6. Any Experiment based on syllabus may be added by permission of Head / Dean.

Effective from the session 2020-2021

BEE-C356
ELECTRICAL MACHINES LAB

MM: 50 **Sessional: 15**
Time: 2 Hr. **ESE: 35**
L T P **Credit: 1**
0 0 2

LIST OF EXPERIMENTS

1. To perform polarity test on single-phase transformer.
2. To perform open circuit test on single phase transformer & find its equivalent circuit parameters.
3. To perform short circuit test on single phase transformer & find its equivalent circuit.
4. To study Scott connection on single phase transformer.
5. To obtain magnetization characteristics of DC shunt generator.
6. To obtain load characteristics of DC shunt motor.
7. Speed control of DC shunt motor by armature control and field control.
8. To perform No load and block rotor lest on three phase induction motor & determine equivalent circuit
9. To study speed control of three phase induction motor by varying supply voltage.
10. To determine V-curve and inverted V-curve of three phase synchronous machine.
11. To perform No load and block rotor test on single phase induction motor.

NOTE
1. Each student shall be required to perform one experiment in the practical examination.
2. A Teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Every student shall have to perform minimum ten experiments during the semester.
6. Any Experiment based on syllabus may be added by permission of Head / Dean

Effective from the session 2020-2021

BME-C406
FLUID MECHANICS AND FLUID MACHINES

MM: 100
Time: 3 Hr.
L T P
3 1 0

Sessional: 30
ESE: 70
Credit : 4

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

Definition of fluid, Newton's law of viscosity, Units and Dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension,Measurement of pressure by manometers and mechanical gauges, Buoyancy; Stability of immersed and floating bodies ,Need for dimensional analysis – methods of dimension analysis – Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model analysis. 8

UNIT II

Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications, Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli.

Concept of boundary Layer-Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sublayer, separation and its control. 8

UNIT III

Fluid Kinematics, Description of Fluid flow: Lagrangian and Eulerian approach; Types of fluid Flows, Steady and unsteady, Uniform and non-uniform, Laminar and turbulent flows, Acceleration of a fluid particle along a straight and curved path,Stream function and Velocity potential.

Major and Minor energy losses, Hydraulic gradient and total energy lines; Flow in sudden expansion, contraction, bends. 9

UNIT IV

Classification of Fluid Mechanics, Application of momentum and momentum equation to flow through hydraulic machinery, Euler s fundamental equation. Various efficiencies – velocity components at entry and exit of the rotor, velocity triangles.

Impact of Jet on vanes in stationary and moving vanes, Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles. 8

UNIT V

Centrifugal Pumps, reciprocating pump, working principleClassifications of pumps, vector diagram efficiencies of centrifugal and reciprocating pumps, specific speed, model testing, cavitation and separation, performance characteristics, Draft tube- Specific speed, unit quantities.

7

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Munson, B.R., Young, D.F., and Okiishi, T.H., "Fundamentals of Fluid Mechanics", 5th Ed., John Wiley & Sons, ISBN: ES8-1-118-11613-5.	2005
2.	Yuan, S.W., "Foundation of Fluid Mechanics", 2nd Ed., Prentice-Hall, ISBN- 0133298477.	1988
3.	White, F.M., "Fluid Mechanics", 5th Ed., McGraw-Hill, ISBN 0073398276.	2002
4.	Govind Rao, N.S., "Fluid Flow Machines", Tata McGraw-Hill, **ISBN**, 0074518542.	1998
5.	Dixon, S.L., "Fluid Mechanics and Thermodynamics of Turbomachinery", 5th Ed., Butterworth-Heinemann,**ISBN-**9780080470627.	2005

Effective from the session 2020-2021

BME C407
MANUFACTURING SCIENCE AND PROCESS

MM: 100 **Sessional: 30**
Time: 3 Hr. **ESE: 70**
L T P **Credit: 3**
3 0 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

Introduction: Importance of manufacturing. Economic & technological considerations in manufacturing. Survey of manufacturing processes. Materials & manufacturing processes for common items. 4

Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses. 4

UNIT II

Metal Forming Processes I: Elastic & plastic deformation, yield criteria. Hot working vs cold working. Load required to accomplish metal forming operation. Analysis (equilibrium equation method) of forging process with sliding friction sticking friction and mixed condition for slab and disc. Work required for forging, Hand, Power, Drop Forging. 4

Metal Forming Processes II: Analysis of Wire/strip drawing and max. reduction, Tube drawing, Extrusion and its application. Condition for Rolling force and power in rolling. Rolling mills. Design, lubrication and defects in metal forming. 4

UNIT III

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, cutting tool materials, cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC Machining 8

UNIT IV

Powder Metallurgy: Powder metallurgy manufacturing process. The process, advantage and applications. 4

Jigs & Fixtures: Locating & clamping devices/principle. Jigs and Fixtures and its applications. 4

Manufacturing of Plastic Components: Review of plastics, and its past, present & future uses. Injection moulding. Extrusion of plastic section. Welding of plastics. Future of plastic & its applications. Resins & Adhesives. 4

UNIT V

Introduction to non-conventional Machining: Benefits, application and working principle of EDM, ECM, LBM, EBM, USM. AJM, WJM. **4**

Unconventional Metal forming processes: Unconventional metal forming processes such as explosive forming, electro- magnetic, electro-hydraulic forming. **4**

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	DeGarmo, E. P., Black, J.T., and Kohser, R.A., "Materials and Processes in Manufacturing", Prentice-Hall of India,ISBN-10: 0470924675.	1997
2.	Kalpakjian, S., and Schmid, S.R., "Manufacturing Engineering and Technology", Pearson Education,ISBN-10: 0133128741.	2000
3.	Groover, M.P., "Fundamentals of Modern Manufacturing", John Wiley & Sons, ISBN-10: 0470467002.	2002
4.	Lindberg, R.A., "Processes and Materials of Manufacture", PrenticeHall of India, ISBN-10: 9788120306639.	1990
5.	Rao,P.N., "Manufacturing Technology", (Vol. 2), Tata McGraw-Hill, ISBN-10: 9383286628.	1998

Effective from the session 2020-2021

BME-C408
KINEMATICS & DYNAMICS OF MACHINES

MM: 100 **Sessional: 30**
Time: 3 Hr. **ESE: 70**
L T P **Credit: 4**
310

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

Introduction: Links-types, Kinematics pairs-classification, Constraints-types, Degree of Freedom- Grashof's law, Grubler's equation, linkage mechanisms, inversions of four bar linkage, slider crank chain and double slider crank chain, Mechanical advantage, Transmission angle, Quick return mechanism, Rocker mechanisms

Velocity in Mechanisms: Displacement and Velocity analysis of simple mechanism, slider crank mechanism using relative velocity method and instantaneous centers in mechanism, Kennedy's theorem, instantaneous center method. **8**

UNIT II

Acceleration in Mechanisms: Acceleration diagram, Acceleration analysis of simple mechanism, slider crank mechanism using relative velocity method diagram, Coriolis component of acceleration, Analysis of Universal Hook's joint.

Kinematics Synthesis of Planar Linkages: Introduction to linkage synthesis, Three position synthesis of four bar and slider crank mechanisms for motion and path generation. **6**

UNIT III

Friction: Surface contacts- sliding and rolling friction, friction drives: Friction of pivot and collar Bearings and friction of Single plate, Multiplate and Cone clutches, Belts and pulleys, Flat and V-belts design and selection, friction in external and internal shoe brakes, Band and Block brakes. **8**

UNIT IV

Cams: Classification of cams and followers- Terminology and definitions- Cam profile synthesis for knife edge, roller and flat faced followers by graphical methods for Uniform velocity, Parabolic, and Simple harmonic motions, Cams with specified contour- Analytical cam design– tangent and circular cams. **9**

UNIT V

Gears: Classification & terminology, fundamental law of gearing and conjugate action, Involute and cycloidal gear profiles, interference, under cutting, minimum number of teeth on gear and pinion to avoid interference, simple, compound and planetary gear trains. **9**

Effective from the session 2020-2021

Suggested Books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Martin, G.H., "Kinematics and Dynamics of Machines", 2nd Ed., McGraw-Hill,ISBN-13: 978-1577662501.	1982
2.	Vinogradov, O., "Fundamentals of Kinematics and Dynamics of Machines and Mechanisms", CRC Press, ISBN 9780849302572.	2000
3.	Massie, H.H., and Reinholtz, C.F., "Mechanisms and Dynamics of Machinery, 4th Ed., John Wiley & Sons, ISBN: 978-0-471-80237-2.	1987
4.	Vicker, J.J., Shigley, J.E., and Pennock, G.R., "Theory of Machines and Mechanisms", 3rd Ed., Oxford University Press,ISBN-13: 978-0195371239.	2003
5.	Hannah, J., and Stephens, R.C., "Mechanics of Machines : Elementary Theory and Examples", 4th Ed., Viva Books, ISBN-10: 0713132329.	2004

Effective from the session 2020-2021

BME-C409
STRENGTH OF MATERIALS

MM: 100 **Sessional: 30**
Time: 3 Hr. **ESE: 70**
L T P **Credit : 4**
3 1 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses, elastic constants and their relations, volumetric, linear and shear strains, principal stresses and principal planes, Mohr's circle. **8**

UNIT II

Beams and types of beams, transverse loading on beams, shear force and bending moment diagrams, Types of beam supports, simply supported and over-hanging beams, cantilevers.
Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads. **10**

UNIT III

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.**8**

UNIT IV

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.**8**

UNIT V

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure. **6**

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Bedi, D.S., Strength of Materials, Khanna Publishing, Delhi, ISBN-10: 9382609113.	2013
2.	Rajput, R.K., Strength of Materials, Laxmi Publications, ISBN-10: 9788131808146.	2018
3.	Sadhu Singh, Strength of Materials, Khanna Publication, ISBN-978-81-7409-048-5.	1978
4.	Subramanian R.,Strength of Materials, , Oxford Publications, ISBN-10: 0198061102.	2010
5.	Crandall, S.H., Dahl, N.C., and Lardner, T.J., "An Introduction to the Mechanics of Solids", 2nd Ed., McGraw-Hill, ISBN-10: 0070134413.	1978

Effective from the session 2020-2021

BME-C410
PRINCIPLES AND PRACTICES OF MANAGEMENT

MM: 100 **Sessional: 30**
Time: 3 Hr **ESE:70**
L T P **Credit : 3**
3 0 0

2.

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT I

Introduction, Relation of Management with other disciplines, Management and Manager, evolution of Management with special emphasis on Scientific management, Introduction of managerial environment and levels of management, Management skills. **8**

UNIT II

Functions of Management**:** Planning, Decision making, Organization designs, leading and controlling, control systems. **7**

UNIT III

Introduction of Marketing, Marketing Environment, Target marketing, Marketing Mix, P's of Marketing, Product life cycle. **8**

UNIT IV

Introduction to Operations Management: Operations Planning and Control, Management of Supply Chain, Introduction to Material Management, Systems and procedures for inventory management. **9**

UNIT V

Human Behavior: Factors of individual behavior, Perception, Learning and personality development, Interpersonal relationship and Group Dynamics, Training and development. **8**

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Ardalan, A., "Economic and Financial Analysis for Engineering and Project Management", CRC Press	1999
2.	Mondal, S.,"Management: Principles and Practice"Jaico Publishing House; 1 edition , ASIN: B009WPQNXM.	2013
3.	Tripathi, P.C. "Principles of Management" ISBN-10: 9789352605354.	2017
4.	Mahajan,P., "Principles and Practice of Management" ISBN-10: 9352590449.	2017

BKT-A403

BHARTIYA GYAN PARAMPARA
(INDIAN KNOWLEDGE TRADITION)

MM: 100 **Sessional: 30**
Time: 3 Hr. **ESE: 70**
L T P **Credit : 0**
2 0 0

इकाई प्रथम

1- वैदिक एवं लौकिक साहित्य का परिचय एवं उसका उद्देश्य। (वैदिक साहित्य, आर्ष साहित्य एवं स्मृति साहित्य)
2- वैदिक प्रार्थनाएं- गायत्री, भद्रप्राप्ति, शांति, संगठन, सौमनस्य एवं पंच महायज्ञ का सामान्य परिचय।
3- ब्रह्मचर्य महिमा, वैदिक राष्ट्रभक्ति एवं शिव संकल्प। (ब्रह्मचर्य सूक्त- अथर्ववेद 11.5 , पृथ्वी सूक्त- अथर्ववेद 12.1 , शिवसंकल्प सूक्त – यजुर्वेद 34.1-6 में वर्णित विषय वस्तु के आधार पर)

इकाई द्वितीय

1- वैदिक कालीन सामाजिक एवं शिक्षा व्यवस्था।
2- संस्कारों की जीवन में उपयोगिता।
3- पुरुषार्थ चतुष्टय – धर्म, अर्थ, काम, मोक्ष।

इकाई तृतीय

1- त्रैतवाद- ईश्वर, जीव और प्रकृति का स्वरूप।

2- कर्म एवं पुनर्जन्म सिद्धांत। (कर्म, निष्काम कर्म-योग एवं कर्मफल सिद्धांत)

इकाई चतुर्थ

1- मानव जीवन के विकास में योग की महत्ता।
2- अष्टांग योग – यम, नियम, आसन, प्राणायाम, प्रत्याहार, धारणा, ध्यान, समाधि।

इकाई पंचम

1- भारतीय संस्कृति एवं सभ्यता - एक परिचय।
2- ऋषि दयानंद एवं स्वामी श्रद्धानंद का व्यक्तित्व एवं कृतित्व।
3- आर्य समाज की स्थापना, उद्देश्य एवं कार्य। (सामाजिक जनजागरण, अछूत्तोद्धार, महिला शिक्षा, शुद्धि आंदोलन, सामाजिक कुरीतियों का उन्मूलन, स्वतंत्रता संग्राम में योगदान)

सहायक पुस्तकें–

1. वैदिक साहित्य एवं सस्कृति, डॉ0 कपिल देव द्विवेदी।
2. उपनिषद् दीपिका, डॉ0 रामनाथ वेदालंकार।
3. वैदिकदर्शन, डॉ0 कपिल देव द्विवेदी, विश्वविद्यालय प्रकाशन वाराणसी
4. प्राचीन भारत तथा सामाजिक एवं आर्थिक इतिहास, डॉ0 देवेन्द्र गुप्ता, भारतीय बुक कौपोरेशन नई दिल्ली।
5. योगदर्शन, स्वामी रामदेव, पतंजलि योगपीठ हरिद्वार।
6. सत्यार्थ प्रकाश, स्वामी दयानन्द।
7. आर्यसमाज का इतिहास, डॉ0 सत्यकेतु विद्यालंकार।
8. भारतीय नवजागरण के पुरोधा, डॉ0 भवानी लाल भारतीय
9. संस्कृत साहित्य का इतिहास, डॉ0 कपिल देव द्विवेदी, विश्वविद्यालय प्रकाशन वाराणसी।

Effective from the session 2020-2021

BME-C456
FLUID MACHANICS AND FLUID MACHINES LAB

MM: 50 **Sessional: 15**
Time: 2 Hr. **ESE: 35**
L T P **Credit: 1**
0 0 2

LIST OF EXPERIMENTS:

1. To measure the surface tension of a liquid.
2. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
3. To determine the coefficients of velocity, contraction and discharge of an orifice (or a mouthpiece) of a given shape. To plot the flow net for a given model using the concept of electrical analogy.
4. To find the velocity distribution in a pipe and hence to compute the discharge by integrating the velocity profile obtained.
5. To verify the Bernoulli's theorem.
6. To calibrate an orifice meter and venturimeter and to study the variation of the coefficient of discharge with the Reynolds number.
7. To calibrate and to determine the coefficient of discharge for rectangular and triangular notches.
8. To verify Darcy's law and to find out the coefficient of permeability of the given medium.
9. To verify the momentum equation.
10. Turbine experiment on Pelton wheel.
11. Turbine experiment on Francis turbine.
12. Turbine experiment on Kaplan turbine.
13. Experiment on Reciprocating pump.
14. Experiment on Centrifugal pump.
15. Experiment on Hydraulic Ram
16. Study through first visit of any pumping station/plant
17. Study through second visit of any pumping station/plant.

NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean

Effective from the session 2020-2021

BME-C457
MANUFACTURING SCIENCE AND PROCESS LAB

MM: 50 **Sessional: 15**
Time: 2 Hr **ESE: 30**
L T P **Credit: 1**
0 0 2

LIST OF EXPERIMENTS:

1. Design of pattern for a desired casting (containing hole)
2. Pattern making
3. Making a mould (with core) and casting.
4. Sand testing (at least one such as grain fineness number determination)
5. Injection moulding with plastics

a. Forging hand forging processes

6. Forging - power hammer study & operation
7. Tube bending with the use of sand and on tube bending m/c.
8. Press work experiment such as blanking/piecing, washer, making etc.
9. Wire drawing/extrusion on soft material.
10. Rolling-experiment.
11. Bending & spring back.
12. Powder metallurgy experiment.
13. Jigs and Fixture experiment.

NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

Effective from the session 2020-2021

BME-C458
THEORY OF MACHINES LAB

MM: 100 **Sessional: 15**
Time: 2 Hr. **ESE: 35**
L T P **Credit: 1**
002

LIST OF EXPERIMENTS:

1. Study of simple links/models/mechanisms.
2. Study of various commonly used mechanisms and its inversions in machines
3. Study of various types of models of cam and follower arrangements.
4. Study of various models of gear trains arrangements.
5. Experiment on cam and follower apparatus
6. Experiment on Journal bearing apparatus
7. Experiment on critical speed of shaft (whirling of shaft) apparatus
8. Experiment on static Balancing Dynamic Balancing apparatus
9. Experiment on Engine Brakes
10. Experiment on Engine Clutch
11. Experiment on Gyroscope apparatus
12. Experiment on Governor apparatus

NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean

Effective from the session 2020-2021

BME-C459
MACHINE DRAWING LAB

MM: 50 **Sessional: 15**
Time: 2 Hr. **ESE: 35**
L T P **Credit: 1**
0 0 2

1. Introduction(2 drawing sheets)
Introduction, classification of machine drawings, principles of drawing, conventional representation of machine components and materials, lines, types of lines, dimensioning types, lines and rules of dimensioning. Orthographic Projections (3 drawing sheets) Introduction to orthographic projection, concept of first angle and third angle projection, drawing of simple machine elements in first angle projection, missing line problems, principle of visualization of objects, sectional views, full and half sectional views, auxiliary views.

2. Fasteners (2 drawing sheets)
Temporary and permanent fasteners, 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.

3. Riveted joints(3 drawing sheet)
Introduction, rivets and riveting, types of rivets, types of riveted joints, drawing of boiler joints etc. Free hand sketching (1 drawing sheet) Introduction, Need for free hand sketching, Free hand sketching of foundation bolts, studs, pulleys, couplings etc.

4. Assembly drawing(3 drawing sheets)
Introduction to assembly drawing, drawing assembly drawing of simple machine elements like rigid or flexible coupling, muff coupling, Plummer block, footstep bearing, bracket etc.

5. Computer aided drafting(2 drawing sheets) Introduction to computer aided drafting; advantages and applications of CAD, concepts of computer aided 2D drafting using any drafting software like AutoCAD, Solid Edge, Solid Works etc., basic draw and modify commands, making 2D drawings of simple machine parts.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	French, T.E., Vierck, C.J., and Foster, R.J., "Engineering Drawing and Graphic Technology", 14th Ed., McGraw-Hill, ISBN-10: 0070223475.	1993
2.	Giesecke, F.E., Mitchel, A., Spencer, H.C., Hill, I.L., Dygdon, J.T., Novak, J.E., and Lockhart, S.D., "Technical Drawing", 13th Ed., Prentice-Hall, ISBN:0135135273.	2008
3.	Lakshminarayanan, V., and Mathur, M.L., "Text Book of Machine Drawing (with Computer Graphics)", 12th Ed., Jain Brothers,ISBN: 8186321330.	2007
4.	Sidheswar, N., "Machine Drawing", McGraw-Hill, ISBN-10: 9780074603376.	2004

NOTE
1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H

Effective from 2021-22

Course Code: BME-C511
Course Name: Heat Transfer

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	Fundamental knowledge of Thermodynamics
Objectives:	1. Basic Concepts of Heat Transfer 2. Design and Rating of Heat exchangers with and Without Phase Change. 3. Design and Rating of Compact Heat Exchangers
Course Coordinator	Mr. Mayank Pokhriyal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction to Heat Transfer:** Concepts of the mechanisms of heat flows: conduction, convection and radiation; effect of temperature on thermal conductivity of materials; introduction to combined heat transfer mechanism.	**03**
	Module-2	**Conduction:** One-dimensional general differential heat conduction equation in the rectangular, Cylindrical and spherical coordinate systems; initial and boundary conditions.	**03**
	Module-3	**Steady State one-dimensional Heat conduction:** Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation; thermal resistance concept; Analogy between heat and electricity flow; thermal contact resistance; critical thickness of insulation.	**03**
UNIT-2	*Module-4*	Fins of uniform cross-sectional area; errors of measurement of temperature in thermometer wells.	**02**
	Module-5	**Transient Conduction:** Transient heat conduction Lumped capacitance method, Time constant Unsteady state heat conduction in one dimension only, Heisler charts**.**	**04**
UNIT-3	*Module-6*	**Forced Convection:** Basic concepts; hydrodynamic boundary layer; thermal boundary layer, flow over a flat plate; flow across a single cylinder and a sphere; flow inside ducts; empirical heat transfer relations; relation between fluid friction and heat transfer; liquid metal heat transfer.	**05**
	Module-7	**Natural Convection:** Physical mechanism of natural convection; buoyant force; empirical heat	**05**

		Transfer relations for natural convection over vertical planes and cylinders, horizontal plates and Cylinders, and sphere	
UNIT-4	*Module-8*	**Thermal Radiation:** Basic radiation concepts; radiation properties of surfaces; black body radiation laws; shape factor; black-body radiation exchange; Radiation exchange between diffuse non-black bodies in an enclosure; radiation shields; solar radiation	**06**
UNIT-5	*Module-9*	**Heat Exchanger:** Types of heat exchangers; fouling factors; overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; effectiveness-NTU method; compact heat exchangers.	**05**
	Module-10	**Condensation and Boiling:** Introduction to condensation phenomena; heat transfer relations for Laminar film condensation on vertical surfaces and on a horizontal tube; boiling modes pool boiling, curve, forced convective boiling.	**04**
Total No. of Hours			**40**

Learning Outcomes:	At the end of the course students are able to: 1. To be able to understand various modes of heat transfer in solid liquid and gas. 2. To be able to understand and apply general heat conduction equation in Cartesian, cylindrical and spherical co-ordinates system and their composite structure also. 3. To be able to understand the heat flow in unsteady state condition. 4. To understand and learn various concepts of forced convection, momentum equation and its solution for hydrodynamic boundary layer over a flat plate. 5. To be able to understand the heat exchanger, types of heat exchanger and thermal radiation in black, grey and real surfaces. Planks distribution law, vein's law, Stephen', Boltzmann law, Kirchhoff's law, radiations shield and shape factor. 6. Design double pipe heat exchanger, Shell and tube heat exchanger, finned tube and other compact heat exchangers.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Elements of Heat transfer by Bayazitouglu & Ozisik, McGraw-Hill Book Company. ISBN-0071001328	1998
2.	Heat Transfer By J.P. Holman, McGraw-Hill International edition. ISBN 0070586748	2004
3.	Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill International edition ISBN-9780071764292	2011
4.	Principles of Heat Transfer by Frank Kreith, McGraw-Hill Bo ok co. ISBN- 1305387104	2017

Effective from 2021-22

Course Code: BME-C512
Course Name: Measurement & Metrology

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Basic Knowledge of Metric and SI unit of physical quantities, Statistics.
Objectives:	1. This course provides standard methodology for inspection and also discusses the equipment required for the inspection process so as to see that the designer's specifications are met. 2. To understand the statistical concepts in quality control and quality assurance and to appreciate the concepts of on-line and off-line quality control in today's Manufacturing, subsequently applying these concepts to various situations through problem solving.
Course Coordinator	Mr. Mayank Pokhriyal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction:** Introduction to Metrology and its relevance, importance of dimensional measurement, line and end standards. Need of inspection, sources of errors, basic types of errors precision and accuracy. Method of estimating accuracy and precision, standard and their evolutions. Simple measurement tools: Rules, calipers, height gauges, micrometers, depth gauge dial indicator, slip gauges, sine bar.	**08**
UNIT-2	*Module-2*	**Limits, fits and tolerances-** interchangeability, selective assembly, limits of size, types of fits, Indian standard specifications for the design fits. Limit gauging- Taylor's principles of limit gauging, design of gauges, classification of gauges. Interferometers: Types of light sources and interferometers, Types of scale and grading, optical flats.	**08**
UNIT-3	*Module-3*	**Metrology of Screw Thread Gear Metrology**: Gear error, Gear measurement, Gear Tooth Vernier; Profile Projector, Tool markers microscope. Advancements in Metrology: Co-ordinate Measuring Machine, Universal Measuring Machine, Laser in Metrology.	**08**
UNIT-4	*Module-6*	**Metrology and Inspection:** Standards of linear measurement, line and end standards.	**04**
	Module-7	Linear and angular measurements devices and systems Comparators: Sigma, Johansson's	**04**

		Microkrator. Limit gauges classification, Taylor's Principle of Gauge Design.	
UNIT-5	*Module-8*	**Measurement of Geometric Forms:** Straightness, flatness,roundness.Tool makers microscope,profile project autocollimator. Interferometry: principle and use of interferometry, optical flat. Measurement of screw threads and gears, Surface texture: quantitative evaluation of surface roughness and its measurement.	**08**
Total No. of Hours			**40**

Learning Outcomes:	At the end of the course students are able to: 1. Identify techniques to minimize the errors in measurement 2. Identify methods and devices for measurement of length, angle, and gear and thread parameters, surface roughness and geometric features of parts. 3. Choose limits for plug and ring gauges. 4. Explain methods of measurement in modern machineries 5. Select quality control techniques and its applications 6. Plot quality control charts and suggest measures to improve the quality of product and reduce cost using Statistical tools.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	R. K. Jain, Engineering Metrology**,** Khanna Publications, 17th edition. ISBN-9788174091536	1975
2.	V. A. Kulkarni, A. K. Bewoor, Metrology & Measurements, Tata McGraw Hill Co. Ltd., 1st edition. ISBN-9788126519071	2009
3.	Gupta. I.C., "Engineering Metrology", Dhanpat Rai Publications. ISBN-8189928457	2005

Effective from 2021-22

Course Code: BME-C513
Course Name: Solid Mechanics

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	Basics of Mechanical Engineering & Strength of Materials.
Objectives:	1. The objective is to present the mathematical and physical principles in understanding the linear continuum behavior of solids.
Course Coordinator	Dr. Jasbir Singh

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction to Cartesian tensors, Strains** Concept of strain, derivation of small strain tensor and compatibility, Stress Derivation of Cauchy relations and equilibrium and symmetry equations, principal stresses and directions.	**08**
UNIT-2	*Module-2*	**Constitutive equations:** Generalized Hooke's law, Linear elasticity, Material symmetry; Boundary Value Problems: concepts of uniqueness and superposition.	**04**
	Module-3	**Deflection of beam:** Relation between slope deflection and radius of curvature, solution of beam deflection, problem by Macaulay's method, Direct integration method, Method of super position, Moment Area Method.	**04**
UNIT-3	*Module-4*	**Columns & Struts:** Column under axial load, concept of instability and buckling, slenderness ratio, derivation of Eulers formulae for the elastic buckling load, Eulers, Rankine, Gordom's formulae Johnson's empirical formula for axial loading columns and their applications.	**08**
UNIT-4	*Module-5*	Plane stress and plane strain problems, introduction to governing equations in cylindrical and spherical coordinates, axisymmetric problems, application to thick cylinders, rotating discs.	**05**
	Module-6	Deformation in circular shaft due to torsion, Basic assumption, Torsion equation, Torsion of non-circular cross-sections.	**03**

UNIT-5	*Module-7*	**Springs:** Stresses in open coiled helical spring subjected to axial loads and twisting couples, leaf springs, flat spiral springs, concentric springs.	**08**
Total No. of Hours			**40**

Learning Outcomes:	Upon completion of this course, students will be able to: 1. Understand the deformation behavior of solids under different types of loading and obtain mathematical solutions for simple geometries.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press.	2004
2.	Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International.	1965
3.	Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall international.	1969
4.	Bedi, D. S., Strength of Materials, Khanna Publishing, Delhi	2002

Effective from 2021-22

Course Code: BME-M001
Course Name: Universal Human Values

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 0**
Prerequisites:	Moral Education
Objectives:	The objective of the course is four fold: 1 .Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence. 2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence. 3. Strengthening of self-reflection. 4. Development of commitment and courage to act.
Course Coordinator	Mr. Rishi Kumar Prajapati

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education.** Purpose and motivation for the course, recapitulation from Universal Human Values-I Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration Continuous Happiness and Prosperity- A look at basic Human Aspirations Priority Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.	**5**
	Module-2	**Include practice sessions** to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking disliking.	**3**
UNIT-2	*Module-3*	**Understanding Harmony in the Human Being - Harmony in Myself!**	**8**

		Understanding human being as a co-existence of the sentient 'I'& the Material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) Understanding the characteristics and activities of 'I' and harmony in 'I' Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail Programs to ensure Sanyam and Health.Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.	
UNIT-3	*Module-4*	**Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship** Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention & competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.	**5**
	Module-5	Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.	**3**

UNIT-4	*Module-6*	Understanding Harmony in the Nature and Existence - Whole existence as Coexistence. Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-	**5**

		pervasive space. Holistic perception of harmony at all levels of existence	
	Module-7	Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.	**3**
UNIT-5	***Module-8***	Implications of the above Holistic Understanding of Harmony on Professional Ethics.Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order: At the level of individual: as socially and ecologically responsible engineers, technologists and managers. At the level of society: as mutually enriching institutions and organizations. Sum up Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc	**8**
Total No. of Hours			**40**

Learning Outcomes:	1. By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature). 2. They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). 3. It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction. 4. This is only an introductory foundational input. It would be desirable to follow it up by faculty-student or mentor-mentee programs throughout their time with the institution. 5. Higher level courses on human values in every aspect of living. E.g. as a professional.

S. No.	Name of Authors /Books /Publisher	Year of Publication
1	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books,New Delhi,	2010
2	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak,	1999
3	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi,	2004

Effective from 2021-22

Course Code: BME-C561
Course Name: Heat Transfer Lab

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 30** **Credit : 1**

Prerequisites:	Fundamental knowledge of Thermodynamics.
Objectives:	1. To impart practical knowledge on heat transfer, mass transfer in engineering systems. 2. To do the experiments related to their subjects like thermodynamics, thermal engineering, heat and mass transfer concepts.
Course Coordinator	Mr. Mayank Pokhriyal

Module	Course Content	No. of Hours
Module-1	Conduction - Composite wall experiment	**02**
Module-2	Conduction - Composite cylinder experiment	**02**
Module-3	Convection - Pool boiling experiment	**02**
Module-4	Convection - Experiment on heat transfer from tube-natural convection.	**02**
Module-5	Convection - Heat Pipe experiment.	**02**
Module-6	Convection - Heat transfer through fin-natural convection.	**02**
Module-7	Convection - Heat transfer through tube/fin-forced convection.	**02**
Module-8	Any experiment - Such as on Stefen's Law, on radiation determination of emissivity, etc.	**02**
Module-9	Any experiment - Such as on solar collector, etc. on radiation	**02**
Module-10	Heat Exchanger - Parallel flow experiment	**02**
Module-11	Heat Exchanger - Counter flow experiment	**02**
Module-12	Any other suitable experiment such as on critical insulation thickness.	**02**
Module-13	Conduction - Determination of thermal conductivity of fluids.	**02**
Module-14	Conduction - Thermal Contact Resistance Effect.	**02**
Total		**28**

Learning Outcomes:	At the end of the course students are able to: 1. At the end of course students will learn to the calculation of heat transfer coefficient of heat flow through conduction and convection mode. 2. To be able to understand comparison of lagged cylinder and vertical pipe cylinder heat transfer in free convection. 3. To be able to understand heat exchanger as parallel flow and counter flow and find temperature distribution in heat exchanges, oversell heat transfer coefficient and efficiencies. 4. To learn and understand the superconductivity characteristics of heat pipe and plot graph

	5. To be able to understand the emissivity of test plate with respect to black plate.

NOTE:	1. Apart from the above practical listed any eight practical can be conducted by each student. 2. Each student shall be required to perform one experiment in the practical examination. 3. A Teacher shall be assigned 20 students for daily practical work in laboratory. 4. No batch for practical class shall consist of more than 20 students. 5. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students. 6. Every student shall have to perform minimum eight experiments during the semester. 7. Any Experiment based on syllabus may be added by permission of Head / Dean.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Fundamentals of Momentum, Heat and Mass Transfer by James R.Welty; John Wiley & Sons(Pvt).Ltd. ISBN: 978-1-119-49541-3	2019
2.	Heat Transfer, by Vijay Gupta, New Age International (P) Ltd. Publishers ISBN10 8122408001	2016
3.	Heat Transfer, by Y.V.C. Rao, University Press., ISBN-8173713847	2001

Effective from 2021-22

Course Code: BME-C562
Course Name: Measurement & Metrology Lab

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 30** **Credit : 1**

Prerequisites:	Study of Measurement by different tools.
Objectives:	1 Measurement of linear and angular dimensions 2. To perform various alignment tests on machine tools 3. Estimation of surface roughness 4. Measurement of pressure, flow, speed, displacement and temperature.
Course Coordinator	Mr. Mayank Pokhriyal

Module	Course Content	No. of Hours
1.	Study & working of simple measuring instruments. Like Vernier calipers, micrometer, tachometer etc.	**02**
2.	Measurement of effective diameter of a screw thread using 3-wire method.	**02**
3.	Measurement of angle using sine bar & slip gauges.	**02**
4.	Study of angular measurement using level protector	**02**
5.	Pressure measuring experiment	**02**
6.	Temperature measurement experiment	**02**
7.	Measurement of the surface roughness.	**02**
8.	Force measuring experiment.	**02**
Total No. of Hours		**24**

Learning Outcomes:	At the end of the course students are able to: 1 .Demonstrate the use of instruments for measuring linear (internal and external), angular dimensions and surface roughness. 2. Perform alignment tests on various machine tools. 3. Demonstrate the use of instruments for measuring pressure, flow, speed, displacement and temperature.

NOTE:	1. Each student shall be required to perform one experiment in the practical examination. 2. A Teacher shall be assigned 20 students for daily practical work in laboratory. 3. No batch for practical class shall consist of more than 20 students. 4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students. 5. Every student shall have to perform minimum eight experiments during the semester.	

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications.	2005
2.	Jain R.K. "Engineering Metrology", Khanna Publishers.	2009
3.	Doeblein E.O., "Measurement Systems, Application Design", McGraw Hill.	1990
4.	Kumar D.S., "Mechanical Measurements and Control", Metropolitan, N. Delhi.	2005

Course Code: BME-C570
Course Name: Project (Summer Training)

MM: 50 **Time: 2Hr.** **L T P** **0 0 2**	**Sessional:15** **ESE: 35** **Credit : 1**

Prerequisites:	Fundamental Knowledge of Different Machines.
Objectives:	1. The objective of the summer training and internship program on recent/ latest technologies is to make students acquire knowledge of latest technologies and also to work under the guidance of industry professionals. 2. Students will develop presentation, listening and communication skills 3. Students will develop Argumentative Skills and Critical Thinking. Course Outcomes: 4. Students will gain knowledge of the current and upcoming technologies. 5. Students will be able to look into the working environment in the industry.
Course Coordinator	Mr. Sunil Kumar

Students will develop better communication skills and critical thinking. The presentation will be held for the Summer Training and Internship program done in summer break on recent/ latest technologies after IV semester examination, a certificate of completion to be submitted along with the presentation in the department. In case, any student is unable to do an internship in some company, he is allowed to do any one extra online skill enhancement course, for which the course completion certificate along with the presentation has to be submitted in the department.

Learning Outcomes:	1. Students will gain knowledge of the current and upcoming technologies. 2. Students will be able to look into the working environment in the industry 3. Students will develop better communication skills and critical thinking.

Effective from 2021-22

Program Elective -I (Fifth semester)

Course Code: BME-P521

Course Name: Manufacturing System Design

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	
Objectives:	The objective is to introduce students to the basics of manufacturing system modelling and design.
Course Coordinator	Mr. Praveen Kumar Pandey

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	Introduction to the course and overview of manufacturing systems	**04**
	Module-2	Manufacturing strategy, Manufacturing flexibility, Manufacturing complexity	**04**
UNIT-2	*Module-3*	Basic decision making models, Investment decisions under uncertainty using lifecycle costing models	**04**
UNIT-3	*Module-4*	System reliability and maintenance models, Economic design of quality control plans.	**08**
UNIT-4	*Module-5*	Single and mixed model assembly lines, Shop floor scheduling algorithms, Economic lot sizing, Inventory control models	**10**
UNIT-5	*Module-6*	Performance modelling of production lines, Production control mechanisms like Kanban, CONWIP and PLOCA, Futuristic approaches for manufacturing system control	**10**
Total No. of Hours			**40**

Learning Outcomes:	On completing the course, students should be able to understand the dynamics of manufacturing systems and use quantitative approaches to develop simple models for evaluating the performance of various elements of a manufacturing system

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Miltenburg J., "***Manufacturing Strategy: How to formulate and Implement a winning plan",*** 2nd Ed, Taylor & Francis, ISBN 9781138084001	2005
2.	James L. Riggs J. L., Bedworth D. D., Randhawa S. U., "***Engineering Economics",*** 4th Ed, Tata McGraw Hill, ISBN-0079122485	2004

3.	Ebileng C. E., "***An Introduction to Reliability and Maintainability Engineering",*** McGraw Hill India, ISBN-9780070421387	2000
4.	Askin R. G., Goldberg J.B., "***Design and Analysis of Lean Production Systems",*** John Wiley & Sons(Asia), ISBN- 978-0-471-11593-9	2003

Effective from 2021-22

Course Code: BME-P522
Course Name: Soft Computing Techniques

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Programming Skills in C , C + , Matlab and mathematics
Objectives:	1. Understand Soft Computing concepts, technologies, and applications 2. Understand the underlying principle of soft computing with its usage in various application. . 3. Understand different soft computing tools to solve real life problems.
Course Coordinator	Dr. Jasbir Singh, Mr. Mayank Pokhriyal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction:** Introduction to soft computing, Introduction to biological and artificial neural networks, Introduction to fuzzy sets and fuzzy logic systems	**05**
UNIT-2	*Module-2*	**Artificial neural networks and applications:** Different artificial neural network models, learning in artificial neural networks, neural network applications in control systems	**08**
UNIT-3	*Module-3*	**Fuzzy systems and applications:** Fuzzy sets, fuzzy reasoning, fuzzy interference systems, fuzzy control, fuzzy clustering, application of fuzzy systems.	**10**
UNIT-4	*Module-4*	**Neuro-fuzzy systems:** Neuro-fuzzy modelling, Neuro-fuzzy control	**04**
	Module-5	**Genetic Algorithms:** Simple GA, Crossover and mutation, genetic algorithms, in search and optimization.	**05**
UNIT-5	*Module-6*	**Applications:** Pattern Recognitions, Image processing, Biological sequence alignment and drug design, Robotics and sensors, Information retrieval systems, Share market analysis, Natural language processing	**08**
Total No. of Hours			**40**

Learning Outcomes:	Upon successful completion of this course students should be able to: 1. Develop application on different soft computing techniques like Fuzzy, GA and Neural network 2. Implement Neuro-Fuzzy and Neuro-Fuzz-GA expert system.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication

1.	Konar, "***A computational intelligence [i.e. intelligence]: principles, techniques and applications", I st*** Ed, Springer, ISBN- 3-540-20898-4	2005
2.	Friedman M. & Kandel A., "***Introduction to pattern recognition: statistical, structural, neural and fuzzy logic approaches",*** 2 nd vol., World Scientific, ISBN-978-981-02-3312-9	1999
3.	Jang J. S. R., Sun C. T. & Mizutani E., "***Neuro-fuzzy and soft computing: a computational approach to learning and machine intelligence",*** Prantice Hall, ISBN-0-13-261066-3	1997
4.	Mitchell M., "***An introduction to genetic algorithm", 2 nd*** Ed, MIT Press, ISBN-9780262631853	1998
5.	Ross T. J., "***Fuzzy logic with engineering applications", 2 nd*** Ed, John Wiley & Sons, ISBN- 0-470-86075-8	2004

Effective from 2021-22

Course Code: BME-P523
Course Name: Advanced Engineering Thermodynamics

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Fundamental Knowledge of Basic Thermodynamics Engineering.
Objectives:	This course deals with the advance level of Thermodynamics. In this student will learn about entropy generation. Reactive system and its application in Thermodynamics.
Course Coordinator	Dr. Shobhit Srivastava

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Review of laws of thermodynamics:** Energy concepts for closed and open systems.	**06**
UNIT-2	*Module-2*	**Entropy considerations:** Minimization of entropy generation principle and thermodynamic optimization.	**08**
UNIT-3	*Module-3*	**Energy:** Energy analysis of thermal systems and plants, Thermo-economic applications.	**08**
UNIT-4	*Module-4*	**Phase transition:** Equations of state, Multi-component and multi-phase system, Reactive systems.	**08**
UNIT-5	*Module-5*	Kinetic theory of gases, Distribution of molecular velocities and energy, transport properties of gases	**06**
	Module-6	Principles of irreversible thermodynamics and applications.	**04**
Total No. of Hours			**40**

Learning Outcomes:	After the completion of this course, student will have a good understanding of entropy, entropy generation systems, reactive system, kinetic theory of gases and applications.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Bejan A., "***Advanced engineering thermodynamics", 3rd*** Ed, John Wiley & Sons, ISBN-978-0-471-67763-5	2006
2.	Bejan A., "***Entropy generation minimization: the method of thermodynamic optimization of finite-size systems and finite time processes",*** 1st Ed, CRC Press, ISBN-9781498782920	1995
3.	Annamalai K. & Puri I.K., "***Advanced thermodynamics engineering",*** 2nd Ed, CRC Press, ISBN- 9781498768412	2011
4.	Wark K., "***Advanced thermodynamics for engineers",*** 1st Ed, Mc-Graw Hill, ISBN-9780070682924	1994
5.	Winterbone D. E., "***Advanced thermodynamics for engineers",2nd*** Ed, Arnold, ISBN- 9780080999838	2015

Effective from 2021-22

Course Code: BME-P524
Course Name: Machine Tool Design

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Fundamental Knowledge of Manufacturing Science.
Objectives:	1. To gain the knowledge of different drives and mechanisms used in machine tools . 2. To gain the knowledge of design of gear boxes & feed boxes used in machine tools. 3. To gain the knowledge of design of structures, guide ways, spindles of machine tools. **4.** To gain the knowledge of various control systems used in machine tools.
Course Coordinator	Mr. Sanjeev Lambha

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction:** Developments is machine tools, types of machine tools surface, profits and paths Produced by machine tools. Features of construction and operations of basic machine tools e.g. lathe, drill, milling shapes and planers, grinding machine etc.	**05**
	Module-2	General requirement of machine tool design. Machine tool design process. Tool wear, force Analysis.	**05**
UNIT-2	*Module-3*	**Machine Tools Drives:** Classification of machine tool drives, group Vs individual drives, Selection of electric motor, A brief review of the elements of mechanical transmission e.g. gear, belt and chain drives, slider-crank mechanism, cam mechanism, nut & Screw transmission, Devices for intermittent motion, reversing & differential mechanisms	**03**
	Module-4	Couplings and clutches Elements of hydraulic transmission system. e.g. pumps, cylinder, directional control valves, pressure valves etc. Fundamentals of Kinematics structure of machine tools.	**06**
UNIT-3	*Module-5*	**Regulation of Speed and Feed Rates:** Laws of stepped regulation, selection of range ratio, standard progression ratio, selection of best possible structural diagram, speed chart, Design of feed box.	**03**
	Module-6	Developing gearing diagrams. Stepless regulation of speed and feed in machine tool, speed and feed	**04**

		control	
UNIT-4	*Module-7*	**Design of Machine Tool Structure:** Requirements and design criteria for machine tool structures, selection of material Basic design procedure for machine tool structures, design of bed, column and housing, Model technique in design. Design of guideways and power screws.	**03**
	Module-8	Basic guideway profiles, Designing guideway for stiffness a wear resistance, hydrostatic and antifriction grandways. Design of sliding friction power Screws. Design of spindlier & spindle supports. Layout of bearings, selection of bearings for machine tools	**06**
UNIT-5	*Module-9*	**Dynamics of Machine Tools:** General procedure for assessing the dynamic stability of cutting process, closed loop system, chatter in machine tools. Control Sy stems : Functions, requirements &types of machine tool controls, controls for speed & feed change. Automatic and manual Controls. Basics of numerical controls. Machine tool testing.	**05**
Total No. of Hours			**40**

Learning Outcomes:	1. Ability enhancement for the design of various components of structures, guideways, spindles of machine tools **2.** Ability enhancement to adopt & implement the recent trends required as per the applications.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	N.K. Mehta, Machine Tools Design & Numerical Controls, T.M.H. New Delhi. ISBN-10-9781259004575	2012
2.	S.K. Basu, Design of Machine Tools ,Allied Publishers. ISBN-10-8120417771	2014
3.	Bhattacharya A and Sen.G.C, Principles of Machine Tools, New Central Book Agency. ISBN-10-8173811555	2009

Effective from 2021-22

Course Code: BME-P525
Course Name: Applied Elasticity & Plasticity

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Strength of Materials
Objectives:	By the end of this section, you will be able to: 1. Explain the limit where a deformation of material is elastic 2. Describe the range where materials show plastic behavior 3. Analyze elasticity and plasticity on a stress-strain diagram
Course Coordinator	Mr. Sanjeev Kumar Lambha, Mr. Yogesh Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Theory of Elasticity:** Analysis of stress and strain, equilibrium, Compatibility and constitutive equations, General equation in Polar coordinates, Rotating discs and stresses in circular discs, Stress function in terms of harmonic and complex functions, Equation of equilibrium of a deformed body in curvilinear coordinates, Principle of superposition and principle of virtual work, Torsion of thin tubes.	**10**
UNIT-2	*Module-3*	**Theory of Elasticity:** Bending of cantilevers, Uniformly and continuous loaded beams, Bending of circular, elliptical and rectangular cross-section bars, Axis-symmetric formulation and deformation of solids of revolution.	**05**
UNIT-3	*Module-3*	**Theory of Plasticity:** Theory of Plasticity-Nature of engineering plasticity, Differential equations of equilibrium, 3D stress analysis, infinitesimal deformation, finite deformation, Von Mises', Tresca's and anisotropic yield criteria, Halgh-Westergard stress space representation of yield criteria, experimental verification of yield criteria, Subsequent yield surfaces.	**08**
UNIT-4	*Module-4*	**Theory of Plasticity:** Elastic and plastic stress-strain relations and stress strain rate equations, Prandtle-Reuaa equations, Generalized plastic stress strain relations, Anisotropy and instability. Plane plastic flow.	**05**

UNIT-5	*Module-5*	**Theory of Plasticity:** Slip-line field theory, Application of slip line field theory to plane strain metal forming processes Plane plastic stress and pseudo plane stress analysis and its applications, Extremum principle for rigid perfectly plastic material, surfaces of stress and velocity discontinuity. Upper bound and lower bound theorems and applications.	**12**
Total No. of Hours			**40**

Learning Outcomes:	1. Can explain the stress, strain, torsion and bending properties. 2. Apply the concepts of stress, strain, torsion and bending and deflection of bar and beam in engineering field. 3. Calculate and determine the stress, strain and deflection of solid body that subjected to external and internal load. 4. Enable to design the optimum dimension of the body in a variety of situations where specific properties are required. 5. Relates the basic theory of elasticity and plasticity with application of solid mechanics. 6. It provides an understanding how the stress-strain characteristics affect ultimate failure of materials. 7. Able to relate theory of plasticity to design tooling in manufacturing instead of using 'thumb rule'.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	A. I. Lurie, "***Theory of Elasticity (foundations of engineering mechanics)",*** springer, ISBN- 3540245561	2005
2.	Gladwell G. M. Kluwer, "***Contact problems in the classical theory of elasticity",*** Springer Netherland Aca, ISBN 978-90-286-0760-6	1998
3.	Chakrabarty K., "***Applied Plasticity",*** Springer-Verlag New York 2000, Springer-Verlag, ISBN- 978-1-4757-3268-9	2000
4.	Hill R., "***The mathematical theory of plasticity",*** OUP UK, Oxford University, ISBN-0198503679	1998

Effective from 2021-22

Open Elective -I (Fifth semester)

Course Code: BME-O531

Course Name: Engineering Economy

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Analysis of Market demand and Survey.
Objectives:	1.Emphasizes the systematic evaluation of the costs and benefits associated with proposed technical projects. 2. The student will be exposed to the concepts of the "time value of money" and the methods of discounted cash flow. **3.** Students are prepared to make decisions regarding money as capital within a technological or engineering environment
Course Coordinator	Mr. Rishi Kumar Prajapati

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	Nature and Purpose of Engineering Economics, Economic Decisions, Role of engineers in Business, Large Scale Engineering Projects, Types of Strategic Engineering. Understanding financial statements: The balance sheet, the income statement, the cash flow statement, The fund flow statement using ratios to make business decisions.	**08**
UNIT-2	*Module-2*	**Demand Analysis:** Meaning of Demand, Types of demand, and Determinants of demand.	**04**
	Module-3	Elasticity of Demand, Demand Forecasting.	**04**
UNIT-3	*Module-4*	**Production Function:** Input output relationship, Production Function, Least cost combination of Inputs, Returns to scale, Managerial uses of production functions, Economies of scale.	**08**
UNIT-4	*Module-5*	**Cost Analysis and Market Structure:** General cost terms, Classification of costs, Cost concepts Relevant to decision making, Break Even analysis, Cost Volume Profit Analysis.	**05**
	Module-6	Introduction of different market structures- Perfect competition, Monopoly, Monotheistic competition, Price discrimination, Oligopoly.	**03**

UNIT-5	*Module-7*	**Depreciation:** Introduction, Straight line method of depreciation, declining balance method of depreciation-sum of the years digits method of depreciation, sinking fund method of depreciation/Annuity method of depreciation, service output method of depreciation-Evaluation ofpublic alternatives - introduction, Examples, Inflation adjusted decisions -procedure to adjust inflation,Examples on comparison of alternatives and determination of economic life of asset.	**08**
Total No. of Hours			**40**

Learning Outcomes:	1. Describe the role of economics in the decision making process and perform calculations in regard to interest formulas 2. Estimate the Present, annual and future worth comparisons for cash flows **3.** Calculate the rate of return, depreciation charges and income taxes 4. Enumerate different cost entities in estimation and costing 5. Explain the importance of finance functions, financial ratios and solve related problems **6.** Explain the elements of budgeting and bench marking •

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Chan S. Park, Contemporary Engineering Economics, Prentice Hall (3/e) 2002. ISBN 978-0-13-277542-7	2002
2.	Mote VL and Paul Samuel, Managerial Economics Concepts and Cases. ISBN-10-0070965188	2017
3.	K.K. Dewett, "Modern Economics Theory, 1997, S. Chand & Co., New Delhi. ISBN-10-8121924634	1997

Effective from 2021-22

Course Code: BME-O532
Course Name: Cloud Computing

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	
Objectives:	The course has following objectives: 1 To understand the concepts of Cloud Computing. 2 To learn Taxonomy of Virtualization Techniques. 3 To learn Cloud Computing Architecture. 4 To acquire knowledge on Aneka Cloud Application Platform. 5 To learn Industry Cloud Platforms.
Course Coordinator	Dr. Mayank Agarwal, Dr. Nishant Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Overview of cloud computing:** What is a cloud, Definition of cloud, Characteristics of cloud, why use clouds, how clouds are changing, driving factors towards cloud, Comparing grid with cloud, Public clouds (commercial)	**7**
UNIT-2	*Module-2*	**Cloud computing concepts:** Concepts of cloud computing, Cloud computing leverages the Internet, Positioning cloud to a grid infrastructure, Elasticity and scalability, Virtualization, Characteristics of virtualization, Benefits of virtualization, Virtualization in cloud computing, Hypervisors, Multitenancy, Types of tenancy, Application programming interfaces (API), Billing and metering of services, Management, tooling, and automation in cloud computing.	**7**
UNIT-3	*Module-3*	**Cloud service delivery:**Cloud service, Cloud service model architectures, Infrastructure as a service (IaaS) architecture, Infrastructure as a service (IaaS) details, Platform as a service (PaaS) architecture, Platform as a service (PaaS) details, Platform as a service (PaaS), Examples of PaaS software, Software as a service (SaaS) architecture, Software as a service (SaaS) details, Examples of SaaS applications, Trade-off in cost to install versus, Common cloud management platform reference architecture: Architecture overview diagram, Common cloud management platform,	**7**

		Database as a Service - Monitoring as a Service – Communication as services.	
UNIT-4	*Module-4*	**Cloud deployment scenarios:** Cloud deployment models, Public clouds, Hybrid clouds, Community, Virtual private clouds, Vertical and special purpose, Migration paths for cloud, Selection criteria for cloud deployment, Case study example: AWS Platform. Virtualization for Cloud Need for Virtualization – Pros and cons of Virtualization – Types of Virtualization –System Vm, Process VM, Virtual Machine monitor – Virtual machine properties - Interpretation and binary translation, HLL VM - Hypervisors – Xen, KVM, VMWare, Virtual Box, Hyper-V	**6**
UNIT-5	*Module-5*	**Security in cloud computing:** Cloud security reference model, how security gets integrated, Cloud security, understanding security risks, Principal security dangers to cloud computing, Data corruption or loss, User account and service hijacking, Steps to reduce cloud security breaches.	**6**
	Module-6	**Classification of Cloud Implementations**: Amazon Web Services, The Elastic Compute Cloud (EC2). The Simple Storage Service (S3), The Simple Queuing Services (SQS), Google AppEngine - PaaS, Windows Azure; Aneka, Hadoop, A Comparison of Cloud Computing Platforms	**7**
Total No. of Hours			**40**

Learning Outcomes:	At the end of this course student will be able to: 1 Understand the concept of virtualization and how this has enabled the development of 2 Cloud Computing 3 Know the fundamentals of cloud, cloud Architectures and types of services in cloud 4 Understand scaling, cloud security and disaster management 5 Design different Applications in cloud 6 Ability to use AWS/IBM Cloud/Google cloud

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Buyya Rajkumar, "***Practices and paradigms in cloud computing",*** **1st** Ed, Wiley, ISBN- 978-8126541256	2013
2.	Miller Michael, "***Cloud Computing",*** 1st Ed, Que Publishing, ISBN-978-0789738035	2008
3.	Jasm Kris, "***Cloud computing",*** **1st** Ed, Jones and Barret India, ISBN-978-1449647391	2012
4.	Velte Anthony, Velte Toby and Elsenpeter Robert, "***Cloud Computing: A practical approach",*** 1st Ed, Tata McGraw Hill, ISBN-978-0070683518	2009
5.	Hurwitz Judith, Bllor Robin, Kaufman Marcia and Halper F, "***Cloud computing for dummies",*** 1st Ed, Wiley, ISBN-978-8126524877	2009

Effective from 2021-22

Course Code: BME-O533
Course Name: Automatic Control System

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	
Objectives:	The course has following objectives: 1. To introduce the fundamentals of modeling, analysis and response of control systems in continuous and discrete data systems. 2. To familiarize students with classical and modern control systems including non-linear systems.
Course Coordinator	Mr. Gajendra Singh Rawat

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Control System:** Open loop & closed control; servomechanism, Physical examples. Transfer Functions, Block diagram algebra, Signal flow graph, Mason's gain formula Reduction of parameter variation and effects of disturbance by using negative feedback.	**7**
UNIT-2	*Module-2*	**Time Response Analysis:** Standard test signals, time response of first and second order systems, time response specifications, steady state errors and error constants Design specifications of second order systems: Derivative error, derivative output, integral error and PID compensations, design considerations for higher order systems, performance indices	**7**
UNIT-3	*Module-3*	**Control System Components:** Constructional and working concept of ac servomotor, synchros and stepper motor. **Stability and Algebraic Criteria:** Concept of stability and necessary conditions, Routh- Hurwitz criteria and limitations. **Root Locus Technique:** The root locus concepts, construction of root loci.	**7**
UNIT-4	*Module-4*	**Frequency Response Analysis:** Frequency response, correlation between time and frequency responses, polar and inverse polar plots, Bode plots. **Stability in Frequency Domain:** Nyquist stability criterion, assessment of relative stability: gain	**6**

		margin and phase margin, constant M&N circles.	
UNIT-5	*Module-5*	**Introduction to Design:** The design problem and preliminary considerations lead, lag and lead-lag networks, design of closed loop systems using compensation techniques in time domain and frequency domain	**6**
	Module-6	**Review of State Variable Technique:** Review of state variable technique, conversion of state-variable model to transfer function model and vice-versa, diagonalization, Controllability and observability and their testing	**7**
Total No. of Hours			**40**

Learning Outcomes:	At the end of this course student will be able to: Understand the general concept of a system and classify systems into different types and represent a system using different techniques like block diagram, signal flow graph. 2. Develop transfer function model of mechanical, electrical, thermal, fluid system and different control system components like servomotors, synchronous, potentiometer, Tacho-generators etc. 3. Analyze system response and evaluate error dynamics in time domain. 4. Determine system stability using Routh-Hurtwitz (RH) criteria, root locus techniques in time domain and Bode plot and Nyquist technique in frequency domain. 5. Design different control law or algorithms like proportional control, proportional plus derivative(PD) control, proportional plus integration(PI) control, and proportional plus integration plus derivative (PID) control and different compensators like lag, lead, lag-lead.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Nagrath & Gopal, Control System Engineering, 4th Edition, New age International ISBN-10-9789386070111	2008
2.	K. Ogata, Modern Control Engineering, Prentice Hall of India, ISBN-10-0136156738	2009
3.	Norman S. Mise, Control System Engineering 4th edition, Wiley Publishing Co	2006
4.	M.Gopal, Control System; Principle and design, Tata McGraw Hill ISBN-9780070482890	2002
5.	D.Roy Choudhary, Modern Control Engineering, Prentice Hall of India. ISBN: 9788120321960,	2005

Effective from 2021-22

Course Code: BME-O534
Course Name: Composite Materials

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Strength of material, Material Science.
Objectives:	1. To understand the mechanical behaviour of composite materials 2. To get an overview of the methods of manufacturing composite materials
Course Coordinator	Mr. Mayank Pokhriyal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	Definition and applications of composite materials, Fibers-glass, carbon, ceramic and aramid fibers; Matrices-polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. .	**03**
	Module-2	Lamina-assumptions, macroscopic viewpoint, generalized Hooke's law, reduction of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, and transformed stiffness.	**04**
UNIT-2	*Module-3*	Manufacturing of composite materials, hand layup processes – spray up process	**03**
		compression moulding – reinforced reaction injection moulding – resin transfer moulding – Pultrusion – Filament winding – Injection moulding	**05**
UNIT-3	*Module-4*	Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties	**03**
	Module-5	Determination of lamina stresses, maximum stress and strain criteria, von Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, Tsai-Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates.	**06**

UNIT-4	*Module-6*	Characteristics of MMC, various types of metal matrix composites, alloy vs. MMC, advantages of MMC, limitations of MMC, Reinforcements – particles – fibres. Effect of reinforcement – volume fraction – rule of mixtures.	**03**
	Module-7	Processing of MMC – powder metallurgy process – diffusion bonding – stir casting – squeeze casting, a spray process, Liquid infiltration In-situ reactions-Interface-measurement of interface properties- applications of MMC in aerospace, automotive industries	**05**
UNIT-5	*Module-8*	Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies. Testing of composites:	**04**
	Module-9	Physical, Mechanical, Wear, machinability and Other Properties. Effect of size, shape and distribution of particulate on properties	**04**
Total No. of Hours			**40**

Learning Outcomes:	At the end of the course students are able to: 1. Upon completion of this course, the students will have an overview of the 2. Mechanical behaviour and application of composite materials 3. Use of different techniques to process different types of composites and know the limitations of each process. 4. Explain the need of the research in the composite materials to fulfill the demand of the hi-tech applications.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill	1994
2.	Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill.	1998
3.	Mathews F. L. and Rawlings R. D., "Composite Materials: Engineering and Science", 1st Edition, Chapman and Hall, London, England.	1994
4.	Chawla K. K., "Composite materials", Second Edition, Springer – Verlag.	1998

Effective from 2021-22

Course Code: BME-O535
Course Name: Machine Learning

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Understanding of Basic Programming Concept and Mathematics (probability and statistics).
Objectives:	The course has following objectives To learn the fundamentals of Machine Learning. To understand basic component of an intelligence system. To explore applications of machine learning. To understand different types of machine learning algorithms and tools. To learn how to use machine learning model to solve real world problem.
Course Coordinator	Mr. Deepak Painuli

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	Introduction to Machine Learning, Difference between Artificial Intelligence (AI), Machine Learning (ML) and Deep Learning (DL), Applications of Machine Learning, Limitations or need for applying ML algorithms, Types of Machine Learning and their use cases, Types of problem – Regression and Classification, Types of data – Structured Data and Unstructured Data. Batch and online learning.	**03**
UNIT-2	*Module-2*	Tools required for machine learning- Python Libraries (Numpy, Pandas, Matplotlib etc), Framework for machine learning algorithm (Scikit-learn, TensorFlow, Keras, Anaconda, Google Colab etc), Popular ML Datasets (MNIST Dataset, IRIS Dataset, Wine quality dataset, ImageNet, IMDB reviews, Recommender Systems Dataset etc), Data repositories sources for machine learning practices (UCI Machine learning repository, Kaggle, Wikipedia, CMU, Google Dataset Search, The Big Bad NLP Database etc).	**12**
UNIT-3	*Module-3*	Basic concept of Probability theory and Linear Algebra, Bias, Variance, Bias-Variance tradeoff, overfitting and underfitting. Pre-processing of data - Data cleaning, wrangling and filtering, Handling missing and categorical data, Data scaling, Feature extraction and selection, covariance matrix, Dimensionality Reduction, Train-Test splitting	**05**

		strategy, Training Set, Validation Set, Test Set, Importance of cross validation – Holdout Method and K-fold cross validation..	
UNIT-4	*Module-4*	Introduction to performance metrics for Machine Learning Algorithm – Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Confusion Matrix, Classification Accuracy, Classification Report (Precision, Recall/Sensitivity, Specificity, F1-Score, Area Under ROC curve). Fine tuning of model – Grid Search, Randomized Search, Ensemble Method. Concept of Bagging.	**15**
UNIT-5	*Module-5*	Introduction to regression problems, Types of regression – Linear Regression, Logistic Regression, Polynomial Regression. Introduction to classification problems and Types of classification - Binary Classification, Multi-Class Classification, Multi-Label Classification, Imbalanced Classification. Introduction to reinforcement learning and types - Model-Free and Model-Based RL..	**05**
Total No. of Hours			**40**

Learning Outcomes:	understand a wide variety of **learning** algorithms. Understand how to evaluate models generated from data. Apply the algorithms to a real problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Introduction to Machine Learning, Alpaydin, E., MIT Press, 2004	2004
2.	Introduction to Machine Learning with Python: A Guide for Data Scientists, Andreas C. Müller and Sarah Guido, O'Reilly, 2016	2016

Effective from 2021-22

Course Code: BME-C611
Course Name: Design of Machine Elements

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	Basics of Mechanical Engineering & Strength of Materials.
Objectives:	This course seeks to provide an introduction to the design of machine elements commonly encountered in mechanical engineering practice, through 1. A strong background in mechanics of materials based failure criteria underpinning the safety-critical design of machine components 2. An understanding of the origins, nature and applicability of empirical design principles, based on safety considerations 3. An overview of codes, standards and design guidelines for different elements 4. An appreciation of parameter optimization and design iteration 5. An appreciation of the relationships between component level design and overall machine system design and performance
Course Coordinator	Dr. Jasbir Singh

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction:** Definition, Methods, standards in design & selection of preferred size. Selection of materials for static & fatigue loads, Materials for components subjected to creep, BIS system of designation of steels, limits, fits and tolerance.	**08**
UNIT-2	*Module-2*	**Design against static load**: Factor of safety, principal stresses, theories of failure.	**04**
	Module-3	**Design against fluctuating load:** stress concentration, stress concentration factors, Fluctuating/alternating stresses, fatigue failure, endurance limit, design for finite & infinite life, Soderberg & Goodman criteria, Design of shafts under static and fatigue loadings.	**05**
UNIT-3	*Module-4*	**Mechanical springs:** Design of Helical and leaf springs, against static & fatigue loading.	**03**
	Module-5	**Design analysis of Power Screws:** Form of threads, square threads, trapezoidal threads, stresses in screw, design of screw jack.	**04**
UNIT-4	*Module-6*	**Design of sliding and rolling contact bearings:** Types of ball bearings, roller bearing, needle roller	**03**

		bearing, life of bearing, reliability considerations, Selection of ball, roller, tapered roller and thrust bearings	
	Module-7	**Hydrodynamic theory of lubrication:** types of bearings, design of bearings using design charts, boundary lubrication, hydrostatic bearings, hydrodynamic thrust bearing.	**05**
UNIT-5	*Module-8*	**Design of transmission elements**: Spur Gears: Conjugate action, involute gears, gear cutting methods, tooth loads, strength of spear gears in bending and in wear. Dynamic loading, Gear materials, design of gears.	**03**
	Module-9	**Helical Gears:** Tooth relationship, tooth proportions. Design of helical gears, **Worm and Bevel Gears:** Analysis of loads and stresses, power rating, efficiency.	**05**
Total No. of Hours			**40**

Learning Outcomes:	Upon completion of this course 1 Students will get an overview of the design methodologies employed for the design of various machine components.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Shigley, J.E. and Mischke, C.R., **Mechanical Engineering Design**, Fifth Edition, McGraw-Hill International.	1989
2.	Deutschman, D., Michels, W.J. and Wilson, C.E., **Machine Design Theory and Practice**, Macmillan.	1992
3.	Juvinal, R.C., **Fundamentals of Machine Component Design**, John Wiley.	1994
4.	Spottes, M.F., **Design of Machine elements**, Prentice-Hall India,	1994
5.	R. L. Norton, **Mechanical Design – An Integrated Approach**, Prentice Hall.	1998

Effective from 2021-22

Course Code: BME-C 612
Course Name: Internal Combustion Engines

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	Thermodynamics I and II, Fluid Mechanics, Heat Transfer.
Objectives:	1 This course presents the concepts and theories of operation of internal combustion engines based upon the fundamental engineering sciences of thermodynamics, gas dynamics, heat transfer and mechanics. 2 Discusses the design and operating characteristics of conventional spark-ignition (gasoline), compression-ignition (diesel), Wankel (rotary) and stratified charged spark-ignition engines. 3 Thermodynamic ideal cycles are analyzed and compared to actual cycles. Fuel and air induction and exhaust processes as well as engine fuel metering and manifold phenomena are examined. 4 Pollutant formation and control are discussed and engine operating characteristics are assessed. Engine/transmission/road-load characteristics of vehicles are calculated. 5 Mixture Characteristics, combustion, the actual cycle, knock, power calculations and the gas exchange, Engine cooling and lubricating systems
Course Coordinator	Mr. Kapil Dev Sharma
NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction to I.C. Engines:** Engine classification, Air standard cycles, Otto, Diesel, Stirling, cycle, Actual cycle analysis, Two and four stroke engines, SI and CI engines, Valve timing diagram, Rotary engines.	**05**
	Module-2	**Fuels:** Alternative Fuels for SI and CI engine Gaseous fuels, LPG, CNG, Biogas, Producer gas, important qualities of SI and CI engine fuels, Rating of SI and CI engine fuels, Dopes, Additives.	**03**
UNIT-2	*Module-3*	**SI Engines:** Carburetion, Rich and Lean mixture, Carburetor types Theory of carburetor, MPFI. Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and it's control, Combustion chamber design for SI engines. Ignition system requirements, Magneto, Battery and Electronic ignition systems, ignition timing and spark plug ignition	**08**
UNIT-3	*Module-4*	**CI Engine:** Fuel injection in CI engines, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings. Combustion in CI engines, Ignition delay, Knock and its control, Combustion	**08**

		chamber design of CI engines. Scavenging methods in 2 Stroke engines, Engine emissions and control.	
UNIT-4	*Module-5*	**Engine Cooling:** Different cooling systems, Radiators and cooling fans.	**02**
	Module-6	**Lubrication:** Lubrication principal, Type of lubrication system, Supercharging: Effect of altitude on power output, Types of supercharging and Turbocharging. Testing and Performance: Performance parameters, Basic measurements, Testing of SI and CI engines.	**06**
UNIT-5	*Module-7*	**Compressors:** Classification, Reciprocating compressors, Single and multi-stage, Intercooling, volumetric efficiency. Rotary compressors, Classification, Centrifugal compressor, Elementary theory, Vector diagram efficiencies, Elementary analysis of axial compressors, Surging and stalling, Root's blower, Waned compressor, Performance analysis.	**08**
Total No. of Hours			**40**

Learning Outcomes:	At the end of the course students are able to: 1 Students shall gain the ability to understand Otto and Diesel Engine Technology courses using basic engineering knowledge. 2 Student shall gain information about the fundamentals of thermodynamics in Internal combustion engines. 3 Student shall gain an ability and information to follow recent developments about the internal combustion engine technology. 4 Students can able to understand the operation of internal combustion engines and theoretical calculations to obtain thermodynamic efficiencies and then assess operating losses. 5 To assess the relation between engine power output to the required power for vehicle propulsion. 6 Differentiate among different internal combustion engine designs

Suggested books:

S.No.	Name of Authors /Books /Publisher	Year of Publication
1.	Gill and Smith Ziu ***"Fundamentals of Internal Combustion Engine***" by Oxford & IBH Publishing. ISBN- 09-9788120417106	2007
2.	Mathur and Sharma ***"A Course in International Combustion Engines"*** by Dhanpat Rai & Sons publication. **ISBN**-13: 978-9383182428	2001
3.	E.F. Obvert ***"I.C Engine Analysis & Practice"*** by E.F Obvert., ASIN: B00005XIWN	1991
4.	V. Ganeshan ***"I.C Engines"*** by Tata Mc Graw Hill Publishers. **ISBN**-13:978-0070648173	2012
5.	R. Yadav ***"I.C Engines"*** Central Publishing House, Allahabad. **ISBN**: 9788185444468	2018

Effective from 2021-22

Course Code: BME-C661
Course Name: Mechanical Engineering Design Lab

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit : 1**

Prerequisites:	Fundamental Knowledge of Machine Elements.
Objectives:	1. To learn the principles of material testing for various engineering applications. 2. To learn the metallurgical characterization of different metallic samples. 3. To learn about the different types of gear trains and cam & follower**.**
Course Coordinator	Dr. Jasbir Singh

Module	Course Content	No. of Hours
Module-1	Uniaxial tension test on mild steel rod.	**02**
Module-2	Torsion test on mild steel rod	**02**
Module-3	Impact test on a metallic specimen	**02**
Module-4	Brinnell and Rockwell hardness tests on metallic specimen	**02**
Module-5	Bending deflection test on beams	**02**
Module-6	Strain measurement using Rosette strain gauge	**02**
Module-7	Microscopic examination of heat-treated and untreated metallic samples	**02**
Module-8	Velocity ratios of simple, compound, epicyclic and differential gear	**02**
Module-9	Kinematics of four bar, slider crank, crank rocker, double crank, double rocker and oscillating cylinder mechanisms	**02**
Module-10	Cam & follower and motion studies	**02**
Module-11	Single degree of freedom Spring-mass-damper system, determination of natural frequency and damping coefficient	**02**
Module-12	Determination of torsional natural frequency of single and double rotor systems undamped and damped natural frequencies	**02**
Total No. of Hours		**24**

Learning Outcomes:	At the end of this course students will be able to: 1. Prepare the specimens for metallographic examination with best practice, can operate the optical microscope and understand, interpret, analyze the microstructure of materials. 2. Classify the different mechanical testing methods with their inherent merits and limitations. 3. Apply various test methods for characterizing physical properties of materials. 4. Student will able to determine the velocity ratio of gear trains.

NOTE:	1. Apart from the above practical listed any eight practical can be conducted by each student. 2. Each student shall be required to perform one experiment in the practical examination. 3. A Teacher shall be assigned 20 students for daily practical work in laboratory. 4. No batch for practical class shall consist of more than 20 students. 5. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students. 6. Every student shall have to perform minimum eight experiments during the semester. 7. Any Experiment based on syllabus may be added by permission of Head / Dean.	

Effective from 2021-22

Course Code: BME-C662
Course Name: Internal Combustion Engines Lab

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit : 1**

Prerequisites:	Fundamental Knowledge of engines
Objectives:	1. To impart the knowledge on the practical aspects of Internal Combustion Engine Systems. 2. To impart the knowledge on the advanced engine technologies. 3. To understand the combustion, performance and emission behaviour of SI and CI engine system at different load and speed conditions. 4. To understand the behaviour of engine system at different operating conditions. 5. To understand the arrangement of multicylinders and effect on Turing moment diagram. 6. To know the importance and working of spark plug timing in multi cylinder engine
Course Coordinator	Mr. Kapil Dev Sharma

Module	Course Content	No. of Hours
Module-1	Study the working of Two stroke petrol and diesel engines	**02**
Module-2	Study the working of Four stroke petrol and diesel engines	**02**
Module-3	Study & experiment on four stroke engine valve mechanism	**02**
Module-4	Study & experiment on Ignition system of I.C. Engine	**02**
Module-5	Study & experiment on Fuel Supply System of S.I. Engines-Carburetor, Fuel Injection Pump and MPFI.	**02**
Module-6	Study & experiment on Fuel Supply System of C.I. Engines-Injector & Fuel Pump.	**02**
Module-7	Performance Analysis of Four stroke S.I. Engine-Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance	**02**
Module-8	Performance Analysis of Four stroke C.I. Engine-Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance	**02**
Module-9	Experiment on Exhaust Gas Analysis of an I.C. Engine.	**02**
Module-10	Determination of Indicated H.P. of I.C. Engine by Morse Test	**02**
Module-11	Comparative study of technical specifications of common small cars (such as Maruti Swift, Hyundai i20, Cheverlet Aveo, Tata Indica, Ford Fusion etc	**02**
Module-12	Comparative study & technical features of common scooters & motorcycles available in India	**02**
Module-13	Experiment on Engine Tuning.	**02**
Total No. of Hours		**26**

Learning Outcomes:	At the end of this course students will be able to: 1. Understand the various components of engine, its function, assembling of engine parts and working of advanced engine technologies. 2. Understand the procedures of conducting performance, combustion and emission test on engines and its significance.

	3. Understand the method of calculating the volumetric efficiency and fuel-air ratio of an engine. 4. Understand the effect of various operating parameters of the engine on combustion, performance and emissions. 5. Understand the methods of calculating flash point, fire point and viscosity of the various oil samples. 6. Understand the role of after treatment systems on reducing engine out emissions	
NOTE:	1. Apart from the above practical listed any eight practical can be conducted by each student. 2. Each student shall be required to perform one experiment in the practical examination. 3. A Teacher shall be assigned 20 students for daily practical work in laboratory. 4. No batch for practical class shall consist of more than 20 students. 5. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students. 6. Every student shall have to perform minimum eight experiments during the semester. 7. Any Experiment based on syllabus may be added by permission of Head / Dean.	1

Course Code: BME-C670
Course Name: Project-II

MM: 50 **Time: 2Hr.** **L T P** **0 0 2**	**Sessional:15** **ESE: 35** **Credit : 1**

Prerequisites:	Fundamental Knowledge of Different Machines.
Objectives:	1. To increase the communication ability on students and to prepare then for presenting seminar on advanced topics of their branch. 2. The students will be required to deliver a seminar on a topic of general interest in or any advanced technical topics related to the theory papers studied. The topic will be decided by mutual consent of the Faculty- in-charge and students.
Course Coordinator	Mr. Sunil Kumar

* Total 50 marks include 25 marks for report and 25 marks for presentation.

Learning Outcomes:	1. Students will get equipped with knowledge of latest/upcoming problems and solutions. 2. Students will also be able to improve skills for project planning, implementation and communication.

Effective from 2021-22

Program Elective -II & III (Sixth semester)

Course Code: BME-P621
Course Name: Smart materials and structures

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Materials Engineering
Objectives:	Structures in the traditional context once simply meant a selection of the dimensions of the load bearing components of a structure. Essentially conventional design and materials science were integrated to obtain a structural design.
Course Coordinator	Mr. Sunil Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	Introduction to smart structure, historical development, characteristics, examples; active vibration damping system, active noise reduction system in automobile, aircraft, other vehicles etc.	**04**
UNIT-2	*Module-2*	Smart materials, their characteristics and applications; electroresponsive materials, thermoresponsive materials, optoresponsive materials, magnetoresponsive materials.	**08**
UNIT-3	*Module-3*	Optical fiber sensor technology; Interferrometers, Structural Health Monitoring using optical fiber sensors.	**06**
UNIT-4	*Module-4*	Smart structures using piezoelectric materials; vibration damping, energy harvesting, structural health monitoring.	**06**
	Module-5	Smart structures using SMA materials; vibration damping, flapping mechanism, biomedical applications.	**06**
UNIT-5	*Module-6*	Smart structures using ER/MR fluids; vibration damping, smart bearing	**05**
	Module-7	Nanomaterials, characteristics and their applications as smart systems	**05**
Total No. of Hours			**40**

Learning Outcomes:	At the end of this course students are able to: Know about smart materials, their characterization and applications in developing/designing smart structures.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Srinivasan A. V., McFarland D. M., "*Smart Structures Analysis and Design",* Cambridge University Press, ISBN- 0521659779	2000
2.	Soh C. K., Yang Y., Bhalla S. "*Smart Structures Analysis and Design, Control and Bio-Mechanics",* springer, ISBN- 3642244629	2012
3.	Reece P. L., "*Smart Materials and Structures",* IOP Publishing (United Kingdom), Publisher, ISBN- 0964-1726	2018
4.	M.V. Gandhi, B.D. Thompson., "Smart Materials and Structures" Springer; 1992nd edition.	1992

Effective from 2021-22

Course Code: BME-P622
Course Name: Vibrations and Noise Control

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Strength of Materials and Mathematics.
Objectives:	The students learn the fundamental vibration analysis methods for single degree of freedom systems, two degree of freedom systems and multi degree of freedom systems, Acoustics and Noise control. They can classify various machine vibrations which are important in engineering and sensitivity. They can have the mastery of applying the fundamental concepts of vibration to practical engineering problems. They will be able to solve unknown vibration problems.
Course Coordinator	Mr. Sanjeev Kumar Lambha

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction:** Importance and scope of vibrations, terminology and classification, concept of degrees of freedom, harmonic motion, vectorial representation, complex number representation, addition of harmonic motions, beats phenomenon.	**03**
	Module-2	**Vibration of Single degree of freedom system:** Modelling of stiffness and damping (both viscous and coulomb). Estimation of damping by decay plots and half power method. Impulse, transient and forced vibration response of single degree of freedom system. Theory of practice of vibration isolation. Vibration measuring instruments.	**05**
UNIT-2	*Module-3*	**Two Degree of freedom system:** Principle mode of vibration, Mode shapes, Undamped forced vibrations of two degree of freedom systems with harmonic excitation, Vibration absorber, Undamped dynamic vibration absorber and centrifugal pendulum absorber. Application to undamped and damped absorbers.	**06**
UNIT-3	*Module-4*	**Critical Speed of Shafts:** Critical speed of a light shaft without damping, critical speed of shafts having multiple discs, secondary critical speed.	**03**
	Module-5	**Multi-Degree of Freedom system (Exact Analysis):** Equation of motion, The matrix method, Eigen values and Eigen vectors, Methods of influence coefficients and Maxwell's reciprocal	**06**

		theorem. Torsional vibration of multi rotor systems, vibration of geared systems.	
UNIT-4	*Module-6*	**Multi-Degree of Freedom system (Approximate methods):** Multi-degree freedom systems. Modal analysis. Rayleigh's and Dunkerley's method. Holzer's and Myklestad-Prohl transfer matrix methods.	**05**
	Module-7	**Continuous Systems:** Governing wave equation and Euler Bernoulli equation. Free and forced vibrations including modal analysis.	**04**
UNIT-5	*Module-8*	**Acoustics and Noise Control:** Acoustic wave equation, Acoustic energy and sound intensity. Propagation of sound, Concept of Acoustic impedance. Sound power transmission, Transmission loss. Human Response and ratings, Various Measures of sound. Weighting filters, loudness, Indices of loudness. Acoustic radiation from spherical source and piston source. Acoustic sensors. Measuring Techniques and Instruments. types of measurement environment and uses. Industrial noise control, Noise in machinery.	**08**
Total No. of Hours			**40**

Learning Outcomes:	At the end of the course students are able to: 1. Understand the concept of degree of freedom, natural frequency of single degree of freedom system, frequency response, decay in response curve, transmissibility (vibration isolation) and solve actual vibration problems. 2. Understand coupled natural frequencies and natural modes of two degrees of freedom systems, and explain the concept of modal analysis. 3. Understand the concept of acoustics, sound propagation, Noise in industries, Noise in machineries etc. and are able to apply these concepts onto the practical applications.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Meirovitch Leonard, "***Elements of Vibration Analysis***", .McGraw Hill, ISBN: 0-07-118174-1.	2001
2.	Dukipatti R. V. and Srinivas J., "***Textbook of Mechanical Vibrations***", 2nd Ed., PHI Learning Pvt. Ltd., ISBN-978-81-203-4524-9.	2012
3.	Thomson W.T. , "***Theory of Vibration with Applications***", 5th Ed., Pearson, ISBN-978-0136510680.	1997
4.	Ambekar A. G. "***Mechanical Vibrations and Noise Engineering***", PHI, *ISBN-81-203-2900-7*.	2006

Course Code: BME-P623
Course Name: Mechatronics

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	
Objectives:	The objective of the course is to impart knowledge to the learners on mechanical systems, electrical systems, electronics systems, computer technologies, testing techniques and fault disgnosis techniques which are essential components of a mechatronic systems
Course Coordinator	Mr. Anuj Sharma, Mr. Yogesh Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction:** Introduction to mechatronics, components, multidisciplinary nature, examples: camera, engine fuel control system	**03**
	Module-2	**Essential electronics and Boolean algebra**: Digital representation: Binary, Decimal, Hexadecimal, Conversion from Binary to Decimal and vice-versa. Binary arithmetic: Addition, Subtraction: 2‟s complement, Multiplication and Division, Boolean algebra: AND, OR, NOT, NAND, NOR, XOR logic, Truth table, Realization of logic in physical systems: switches-LEDs, cylinders. Fundamental identities, De Morgan‟s theorems and relationship with sets, Simplification, Electronics fundamentals: Review of some semiconductor devices, Concepts of Digital and Analog systems, Digital output (DO) and input (DI), Using switches, transistors, pneumatic devices, etc. to realize DI & DO Operational Amplifier: Principles, Configurations: Inverting; Summing; Integrating and Differentiating configurations, Digital to Analog conversion (DAC), The R-2R and summing Op-Amp circuit, Analog to Digital conversion (ADC), Successive approximation method, Flash method, etc. Programs for DI, DO, DA and AD for PC based plug in cards.	**09**
UNIT-2	*Module-2*	**Microprocessor, Computers and Embedded systems**: Introduction to the 8085 (8-bit microprocessor) and microcontroller: Architecture,	**08**

		programming, I/O, Computer interfacing, Programmable logic controller basics.	
UNIT-3	*Module-3*	**Sensors and actuators:** Strain gauge, resistive potentiometers, Tactile and force sensors, tachometers, LVDT, Piezoelectric accelerometer, Hall effect sensor, Optical Encoder, Resolver, Inductosyn, Pneumatic and Hydraulic actuators, stepper motor, DC motor, AC motor.	**08**
UNIT-4	*Module-4*	**Control Systems:** Mathematical modeling of Physical systems, System equations, Controllability and Observability, Pole placement, PID controller, Control of Hydraulic, Pneumatic, Mechanical and Electrical Systems.	**06**
UNIT-5	*Module-5*	**Integration and case studies**: Integration of Mechatronics component subsystems into a complete Mechatronics system, Applications to CNC machines and Robotics.	**06**
Total No. of Hours			**40**

Learning Outcomes:	Students will be able to design any systems with mechatronics perspective. They will be able to design the circuit for the system also they will be able to program it to run the system. Also they will be able to apply artificial intelligence algorithms to control the system.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	David G. Alciatore, and Michael B. Histand, *"**Introduction to Mechatronics and Measurement Systems**"*, Tata McGraw Hill, New Delhi, ISBN-978-0-07-064814-2	2007
2.	W. Bolton, *"**Mechatronics**",* Pearson Education Asia, New Delhi, ISBN- 1292250976	2018
3.	Dan Necsulescu, *"**Mechatronics**",* Pearson Education Asia, New DelhiISBN-9788178086767	2002
4.	N. P. Mahalik, *"**Mechatronics**",* Tata McGraw Hill, New Delhi. ISBN-0-07-048374-4	2003
5.	Wolfram Stadler, *"**Analytical Robotics and Mechatronics**",* McGraw-Hill Book Co., ISBN -0071137920	2005
6.	Eronini Umez-Eronini, *"System Dynamics & Control",* Thomson Asia, ISBN- 978-0534944513	1998
7.	Shetty Devdas and Richard A Kolk, *"Mechatronics System Design",* Thomson Learning, Vikas Publishing House, New Delhi, ISBN- 143906198X	2010

Course Code: BME-P624
Course Name: Control Theory and Applications

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Mathematics
Objectives:	The objective of the course is to introduce methods of feedback control of dynamic systems primarily using classical control approaches.
Course Coordinator	Dr. Lokesh Joshi, Mr. Mayank Pokhriyal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	Introduction, Fourier and Laplace transforms description of systems.	**02**
	Module-2	Mathematical Modelling of flow, heat transfer, electrical, pneumatic and vibration systems; Linearization; Linear system; Transfer function models; Block diagram representation; Signal flow graph.	**06**
UNIT-2	*Module-3*	Transient response analysis using Laplace transform; First and second order systems and their characteristics; Higher order systems; Steady state error and error constants; Design/performance specifications in time domain.	**04**
	Module-4	**Characteristics of feedback control systems**: Disturbance rejection, sensitivity; Standard feedback controllers: on/off; Proportional, integral, derivative, PD and PID.	**04**
UNIT-3	*Module-5*	**Sensors and actuators for control systems:** Sensors for temperature, pressure, flow and motion control, accelerometers, gyros, encoders, solenoids, potentiometers, tachogenerator, hydraulic amplifier, DC motor, stepper motors etc.	**04**
	Module-6	Realization of standard controllers using hydraulic, pneumatic, electronic, electro-hydraulicand electro-pneumatic systems.	**03**
	Module-7	Stability of control systems; poles/ zeros, complex plane; Routh's criterion; Delay and its influence on control system performance.	**02**
UNIT-4	*Module-8*	Frequency response, Bode plots; Nyquist plot, Nyquist stability criterion	**03**

	Module-9	**Control system design Root Locus:** Root locus method of design; Lead and lag compensation.	**02**
	Module-10	**Control system design using Frequency response:** Frequency domain specifications: Gain margin, Phase margin; Correlation of Frequency and time domain specifications; Frequency domain design: Lead and lag compensator design using Bode Plots.	**04**
UNIT-5	*Module-11*	Introduction to Modern control: State space representation; Pole placement; state observer; Control with state feedback.	**04**
	Module-12	Review of applications of control in: Machine tools, Aerospace, Boiler, Engine Governing, Active vibration control.	**02**
Total No. of Hours			**40**

Learning Outcomes:	1. Understand the fundamental of feedback control system. 2. Understand time response specifications and determine the (absolute) stability of a closed-loop control system. 3. Design controller as per given specifications using different techniques 4. Determine the time and frequency-domain responses of first and second-order systems to step and other standard inputs.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Joao P. Hespanaha, ***Linear Systems Theory. Princeton University Press***, ISBN-978-0691140216	2009
2.	Nagrath & Gopal, ***Control System Engineering***, 6th Edition, New age International, ISBN-	2018
3.	K. Ogata, ***Modern Control Engineering***, 5th Edition, Prentice Hall of India, ISBN- 978-0136156734	2009
4.	Norman S. Mise, ***Control System Engineering*** , 4th edition, Wiley Publishing Co., ISBN-978-0471445777	2003
5.	M.Gopal, ***Control System; Principle and design***, 4th edition, Tata McGraw Hill, ISBN-9780070482890	2002

Course Code: BME- P625
Course Name: Product Design and Development

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Basic Knowledge of Marketing.
Objectives:	The goal of the course is to introduce multidisciplinary aspects of product development and innovation. Also Students will familiarize themselves with basic methodology and tools that can be used in product development projects. And practical problems will be considered in cooperation with companies in order to simulate real product development situations .
Course Coordinator	Mr. Yogesh Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	Product, Definition, Scope, Terminology etc.Design definitions, old and new design methods, Design by evolution, Examples such as evolution of sewing m/c, bicycle, safety razor etc..	**03**
	Module-2	Need based developments; Technology based developments. Physical reliability & Economic feasibility of design concepts.	**05**
UNIT-2	*Module-3*	Morphology of design, Divergent, transformation and convergent phases of product design,identification of need, Analysis of need. Design for what? Design criteria, functional, aesthetics, ergonomics, form, shape, size, colour.Mental blocks, Removal blocks, Ideation techniques, Creativity, Check list	**06**
UNIT-3	*Module-4*	Transformations, Brainstorming & Synetics, Morphological techniques. Utility concept, Utility value, Utility index	**03**
	Module-5	Decision making under Multiple criteria. Economic aspects, Fixed and variable costs, Break-even analysis	**06**
UNIT-4	*Module-6*	Reliability considerations, Bath tub curve, Reliability of systems in series and parallel, Failure rate, MTTF and MTBF, Optimum spares from Reliability considerations	**05**
	Module-7	Design of display and controls, Man-machine interface, Compatibility of displays and controls.	**04**

		Ergonomic aspects, Anthropometric data and its importance in design. Application of Computers in Product development & design.	
UNIT-5	*Module-8*	Existing techniques such as work-study, SQC etc. which could be used to improve method &quality of product. Innovation versus Invention. Technological Forecasting. Use of Standards for Design..	**08**
Total No. of Hours			**40**

Learning Outcomes:	At the end of the course students are able to: 1. Able to understand the technical and business aspects of the product development process 2. Skilled in implementation of gathering data from customers and establish technical specification. 3. Able to understand product functional decomposition. 4. Be able to participate in engineering problem solving. 5. Able to understand the principles behind product modularization, to be able to understand intellectual property issues in product development. 6. Be able to understand ethical issues in product development.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	A.K.Chitab &R.C.Gupta, Product Design & Manufacturing - PHI (EEE). ISBN-978-81-203-4282-8	2011
2.	R.P. Crewford ,The Technology of Creation Thinking-Prentice Hall	2008
3.	M.K. Starr, Product Design & Decision Theory - Prentice Hall	1963
4.	Mccormick EJ ,Human Factor Engg, Mc GrowHill, ISBN-10-007054901X	1992

Course Code: BME-P626
Course Name: Computational Fluid Dynamics

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Fluid Mechanics & Machines, Heat Transfer
Objectives:	To provide elementary knowledge about CFD (Computational Fluid Dynamics)
Course Coordinator	Dr. Shobhit Srivastava

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	Governing Differential Equations and Finite Difference Method- Classification of PDEs- Initial and Boundary conditions - Initial and Boundary value problems - Finite difference method- Central, Forward, Backward difference for a uniform grid – Central difference expressions for a non-uniform grid - Numerical error - Accuracy of solution – Grid independence test.	**08**
UNIT-2	*Module-2*	Conduction Heat Transfer- Applications of Heat conduction - Steady and Unsteady conductions - One dimensional steady state problems - Two dimensional steady state problems - Three dimensional steady state problems - Transient one dimensional problems.	**08**
UNIT-3	*Module-3*	Convection Heat Transfer- Introduction - Steady one dimensional Convection-Diffusion - Unsteady one. Dimensional Convection – Diffusion – Unsteady two dimensional Convection - Diffusion.	**08**
UNIT-4	*Module-4*	Incompressible Fluid Flow- Introduction - Governing equations - Difficulties in solving Navier- Stokes equation - Stream function - Vorticity method - In viscid flow (steady) - Determination of pressure for viscous flow.	**08**
UNIT-5	*Module-5*	Applications of Computational Fluid Dynamics- Computer graphics in CFD - Future of CFD - Enhancing the design process - understanding - Applications - Automobile, Engine, Industrial, Civil, Environmental.	**08**
Total No. of Hours			**40**

Learning Outcomes:	After the completion of course student will learn about the basic and governing of heat flow in conduction and convection mode. Student will also learn the application of CFD in

	different areas.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Muralidhar K., and Sundararajan T., "***Computational Fluid flow and Heat Transfer***", Narosa Publishing House, ISBN- 978-81-7319-522-8	2014
2.	Ghoshdasdidar P. S., "***Computer simulation of flow and heat transfer"***, Tata McGraw – Hill, New Delhi, ISBN-9780074631508	1998
3.	Anderson D. A., Tannehill J. L, and Pletcher R. H., "***Computational fluid mechanics and Heat Transfer"***, Hemisphere Publishing Corporation, ISBN-978-1591690375	2021
4.	John David Anderson, "***Computational Fluid Dynamics: The Basics with Applications***", McGraw Hill, New York, ISBN-9780071132107	2010

Effective from 2021-22

Course Code: BME-P627
Course Name: Environmental Pollution and Abatement

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	NIL
Objectives:	1. Impart knowledge on fundamental aspects of air pollution & control, noise pollution, and solid waste management. 2. Provide basic knowledge on sustainable development. 3. Introduces some basics of sanitation methods essential for protection of community health.
Course Coordinator	Mr. Rishi Kumar Prajapati

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	Historical perspectives, Effects of Pollutants on Human Health- Human respiratory system	**06**
UNIT-2	*Module-2*	Classification and sources of pollutants-CO, CO2, O2, N2 cycles – sources and sinks.	**05**
UNIT-3	*Module-3*	Reactions of pollutants in the Atmosphere-Smoke, smog, fog, acid rain and ozone layer. Global warming and its effects. Regulatory laws and standards. Atmospheric diffusion of pollutants, transport, transformation and deposition. Atmospheric lapse rate, inversions and heat balance.	**10**
UNIT-4	*Module-4*	Air sampling and pollutant measurement methods-Principles and instruments. Ambient air quality and emission standards.	**09**
UNIT-5	*Module-5*	Control principles- Removal of gaseous pollutants by absorption, adsorption, chemical reaction and other methods. Selective catalytic reduction of NOX. Particulate emission control; settling chambers, cyclone separation, wet collectors, fabric filters and electrostatic precipitators. Clean coal technology and shifted emphasis on non-carbon sources of energy.	**10**
Total No. of Hours			**40**

Learning Outcomes:	1. Quantify and analyze the pollution load. 2. Analyze/design of suitable treatment for wastewater 3. Model the atmospheric dispersion of air pollutants.

	4. Selection and design of air pollution control devices. 5. Analyze the characteristics of solid waste and its handling & management.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Schnelle K. B., & Brown C. A. "***Air pollution control technology handbook***", CRC Press, ISBN- 9780429122354	2001
2.	Peavy H. S., Rowe D. R. & Tchobanoglous G. "***Environmental engineering***", 4th Edition, McGraw-Hill, ISBN- **978-9351340263**	2017
3.	Vesilind P. A., Morgan S. M., & Heine L. G "***Introduction to Environmental Engineering***", 1st Edition, Cengage Learning, ISBN- 978-0495295853	2010
4.	Ruth F. Weiner and Robin Matthews, ***"Environmental Engineering",*** 4th Edition, Elsevier,ISBN- 9780750672948	2003
5.	J.G. Henry and G.W. Heinke , ***"Environmental Science and Engineering",*** Pearson Education.	1996

Effective from 2021-22

Course Code: BME-P628
Course Name: Integrated Design and Manufacturing

MM: 100 **Time: 3 Hr.** **L T P** **2 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Material Science, Manufacturing technology
Objectives:	Those who can work effectively in an integrated product design and manufacturing role, as well as, providing an opportunity to develop technical and managerial skills for a competitive global market can go for the course. Upgrade the skills and knowledge of students seeking career opportunities at a managerial level in a broad range of design, manufacturing, consulting and service industries also can go for it.
Course Coordinator	Mr. Sunil Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	Life cycle of Mechanical Equipment Design	**8**
UNIT-2	*Module-2*	Requirements of life cycle personnel like customer, management, marketing, manufacturing, transportation, etc.	**8**
UNIT-3	*Module-3*	Role of analysis, creativity/ innovation, decision making and information processing in engineering design and problem solving.	**8**
UNIT-4	*Module-4*	Practice in engineering problem solving and designing. DFMA to meet requirements of design and manufacturing.	**8**
UNIT-5	*Module-5*	Principles of Material selection. Case studies and practice on Material selection and Design for manufacture and assembly using first principles, programs/ packages.	**8**
Total No. of Hours			**40**

Learning Outcomes:	There are tremendous advantages of integrating your design and manufacturing processes and teams. In doing so, you're increasing quality output, saving time and money on data translation and personnel training, and you're allowing your teams to work concurrently.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Asimov M., "***Introduction to design",*** Prentice-Hall, ISBN- 978-0134806167	1962
2.	Pugh S., "***Total design: integrated methods for successful product engineering",*** Addison- Wesley Pub., ISBN- 978-0201416398	1991
3.		
4.	Bralla J. G., "***Design for manufacturability handbook***", McGraw-Hill, ISBN-0852969767	1998

5.	Fiksel J., & Fiksel J. R., "***Design for environment: a guide to sustainable product development***", McGraw-Hill, ISBN- 0071605568	2009
6.	Anderson D. M., "***Design for manufacturability & concurrent engineering: how to design for low cost, design in high quality, design for lean manufacture, and design quickly for fast production***", CIM Press, ISBN- 1482204924	2014
7.	Ashby M. F., "***Materials selection in mechanical design***" Elsevier Butterworth-Heinemann, ISBN- 9380931727	2010
8.	NPTEL courses: *http://nptel.iitm.ac.in/courses.php* - web and video resources on *Design for Manufacturing.*	

Effective from 2021-22

Course Code: BME-P629
Course Name: Production Planning & Control

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Machine Tool and Machining , Classification of Production
Objectives:	1. To understand the various aspects of production. 2. To get an overview of quantity production of various engineering objects. 3. To understand the group technology and process planning for feasible and economical production.
Course Coordinator	Mr. Praveen Kumar Pandey, Mr. Mayank Pokhriyal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction**: Engineering production; Aim and objectives, history of progress, definition and requirements. Levels of production; piece, batch, lot, mass and quantity production, Mechanization and automation; need, degree and types of automation, Role of automation on industrial production.	**06**
UNIT-2	*Module-2*	**Classifications and methods**: Broad classification of engineering production methods. Major sequential steps in industrial production; performing, semi finishing, treatments finishing and assembly and inspection at different levels. Quantity production methods of common engineering components; metallic rods, bars, plates, sheets, tubes and wire; shafts and spindles. Metallic discs, pulley, rims, clutches and cams; threaded objects; screws, bolt and nuts, and lead screws different types of bearings; xgears (teeth); comparison of the methods w.r.t. process, productivity, product- quality and economy automobile parts; engine block, piston, connecting rod and crank shaft. Methods of quantity production of cutting tools and tool inserts. Small size products in large volume; pins, clips, needles, metallic caps of bottles, washers, metallic utensils, chain links, paste tubes and coins; Quantity production by spinning, bulging, hydroforming, magneto forming and explosive forming.	**10**

UNIT-3	*Module-3*	**Applications of quantity production**: Process planning and scheduling for quantity production in; single spindle automatic lathe, transfer machines, CNC machine tools, Design and use of jigs and fixtures in machine shops.	**08**
UNIT-4	*Module-4*	**Mechanization of quantity production**: Group technology; principle and application in quantity production. Inspection and quality control in quantity production. Computerization and robotization in quantity production.	**08**
UNIT-5	*Module-5*	**Quantity methods for non-traditional processes**: Quantity production by non-traditional manufacturing processes. Methods and systems of quantity production of various ceramic and polymer products of common use.	**08**
Total No. of Hours			**40**

Learning Outcomes:	At the end of the course students are able to: 1. To have sufficient knowledge of process and operation on various machine. 2. To have knowledge of automation and computer based control on machine. 3. To have sufficient skills and hands on training so as get employment and industrial exposure.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Groover M. P., "***Fundamentals of Modern Manufacturing: Materials, Processes, and Systems***", John Wiley & Sons,7 th Ed., ISBN- 978-1-119-47521-7	2019
2.	Wakil S. D. E., "***Processes and design for manufacturing***", PWS Pub. Co, ISBN-1-57766-255-5	1998
3.	Kalpakjian S., "***Manufacturing engineering and technology***", Pearson, 8th Ed. ISBN 13: 978-0-13-522860-9	2020
4.	Lindberg R. A., "***Processes and materials of manufacture***", Allyn and Bacon, ISBN-0205118178	1990
5.	Ghosh A., & Mallik A. K., "***Manufacturing science***", Ellis Horwood, ISBN- 978-0135526057	1986
6.	Mishra P.K., *"**Nonconventional machining***", Narosa Publishing House, ISBN- 978-8173191381	1997
7.	Donaldson C., LeCain G. H., & Goold V. C., "***Tool design***", McGraw-Hill, ISBN- 978-0070153929	2012
8.	P. Palay, "***Material cutting Tool production****",* Manakin Press , ISBN- 978-9384370169	2016
9.	Parsons S. A. J., "***Metrology and gauging***", Macdonald & Evans, ISBN- 978-0712113434	1970

Effective from 2021-22

Open Elective -II (Sixth semester)

Course Code: BME-O631

Course Name: Numerical Analysis.

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Mathematics
Objectives:	Provide the numerical methods of solving the non-linear equations, interpolation, differentiation, and integration. To improve the student's skills in numerical methods by using the numerical analysis software and computer facilities.
Course Coordinator	Mr. Praveen Kumar Pandey

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Errors and Roots of Equations**: Absolute, relative, round-off and truncation errors. Significant digits.Algebraic and Transcendental Equations	**03**
	Module-2	Numerical solution, Method of bisection, Newton-Raphson method, Direct iterative method, convergence.	**05**
UNIT-2	*Module-3*	**Linear Simultaneous Algebric Equations :** Method of Gauss elemination, LU - decomposition Jacobi's and Gauss- Seidal methods, Largest eigen value and corresponding eigen vector (Powers method)..	**08**
UNIT-3	*Module-4*	**Interpolation:** Finite difference operators, Greogory- Newton, Stirling, Bessel and Lagrange's	**03**
	Module-5	Formula. Errors in interpolation. Divided differences.	**06**
UNIT-4	*Module-6*	**Numerical Differentiation and Integration**: Differentiation, Newton- Cotes formula of Inegration,Gaussian Quadrature formula.	**05**
	Module-7	Extension of Trapezodial and Simpson's rules to multiple integration.	**04**
UNIT-5	*Module-8*	**Ordinary Differential Equations**: Picard, Taylor, Eulers, Runge-Kutta, Adams-Bash forth and Milne's method. System of ordinary differential equations, Partial Differential Equations: Numerical solutions of Laplace and Poisson equations by finite difference method.	**06**
Total No. of Hours			**40**

Learning Outcomes:	Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations. Analyse and evaluate the accuracy of common numerical methods.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Grewal, B.S., Numerical Methods in Engineering & Sciences, Khanna, New Delhi, ISBN-10-817409248X	2013
2.	Sastry B., Introductory Method of Numerical Analysis, PHI, ISBN-10-9788120345928	2012
3.	Gerald C.F. (5/e), Applied Numerical Analysis, Addison Wesley, 1994. ISBN-10-8131717402	2007
4.	Jain M.K, Iyengar S.R.K., Jain R.K., Numerical Methods for scientific & Engineering Computation,Wiley, 1987. ISBN 0-85226-434-8	1987

Effective from 2021-22

Course Code: BME-O632
Course Name: Industrial Engineering

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Work and method Study of Industrial Engineering
Objectives:	1. Basic understanding of Industrial process like type of industry, optimization of production process, reduction of inventory, organization structure and modern manufacturing practices like JIT . 2. To apply knowledge of mathematics, science, and engineering for process mapping and productivity enhancement
Course Coordinator	Mr. Praveen Kumar Pandey

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Productivity**: Introduction, definition, measurement, productivity index, ways to improve productivity, Types of Production System.	**03**
	Module-2	**Work Study:** Meaning and benefits of work-study, time & motion study. Micro motion study P.M.T.S. man machine Diagram flow chart. Motion economy.	**05**
UNIT-2	*Module-3*	**Method Study:** Objectives and scope of method study, recording techniques, micro motion study and memo-motion study, fundamental motion and therbligs, principal of motion economy, critical examination. **Work Measurement**: Objectives of work measurement, work measurement techniques, procedure. Work sampling, determining the sample size, determining time standards by work sampling. Absolute error or desired absolute accuracy.	**08**
UNIT-3	*Module-4*	**Plant Layout and Materials Handling:** Plant location, type of layout, principles of facility layout principles of material handling, Material Handling equipment's	**03**
	Module-5	**Production Planning and Control:** Objectives, Forecasting, product design and development functions, steps in PPC. Planning rating, scheduling, Dispatching & follow-up, Effectiveness of PPC, Introduction of JIT. Elements involved in JIT, Advantages & Disadvantages of Just-In-Time Systems	**06**

UNIT-4	*Module-6*	**Inventory Control**: Inventory, Inventory control techniques; Inventory cost analysis and control; Economic order quantity and safety stock.	**05**
	Module-7	Introduction to MRP, supply chain Management .	**04**
UNIT-5	*Module-8*	**Industrial Ownership**: Proprietorship, partnership, Joint stock & co-operative stores. **Manpower Planning**: Resources, Human relationship. **Organization:** Principles of organization, Development of Organizational charts like line, staff, line and staff & Functional types. **Job Evaluation & Merit Rating:** Job analysis, Job description job simplification and job evaluation methods & description, merit rating, wage incentive plans..	**06**
Total No. of Hours			**40**

Learning Outcomes:	At the end of the course students are able to: 1. An ability to identify, formulate, and solve complex problems related to productivity.. 2. An ability to apply engineering design to produce solutions that meet specified needs 3. with consideration of public health, safety, and welfare, as well as global, cultural, social, 4. Environmental, and economic factors 5. An ability to function effectively on a team whose members together provide leadership for development of an organization. 6. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies..

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	H.Koontz & C.O. Donnel , Principles of management. An analysis of management functions-. Tata McGrow-Hall Co	2001
2.	J Moore ,Manufacturing Management, Prentice Hall Englewoon cliffs: New Jersey	2006
3.	Buffam E.S,Modern production operations Management, Wiley eastern.	2003
4.	O.P. Khanna.,Industrial Engg. & Management, ISBN-10-818992835X	2008

Effective from 2021-22

Course Code: BME-O633
Course Name: Operations Research

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Basic mathematics
Objectives:	1. Student can learn mathematical modelling to real word problem using LPP, Simplex method to find optimal solution. 2. Dual Simplex method, Integer programming problems and Dynamic programming problems and their solutions, Transportation, Assignment and Game theory. Queuing theory, their types and solutions.
Course Coordinator	Dr Rudraman

Note	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

Unit	**Course Content**	**No. of hours**
Unit-1	Linear Programming : introduction, Construction of LP Model, Graphical of Solution LP.Simplex Method, Introduction, Standard LP Form and its basic Solutions, Simplex Algorithm,. Artificial Starting Solution, Special cases in Simplex Method, Applications.	**9**
Unit-2	Duality: introduction, Definition of Dual Problems, Relationship between the Optimal Primal and Dual Solutions, Economic interpretation of Duality, Dual Simplex Method. Primal Dual Computation	**4**
Unit-3	Integer Programming : Methods of Integer Programming, Cutting-Plane Method : Fractional (Pure Integer) Method, Mixed-Cut method, Branch and Bound Technique Deterministic Dynamic Programming: introduction, Recursive Nature of Computing, forward and Backward Recursion , Applications of Dynamic Programming m Shortest Route Problem. Cargo Loading Problem, Work Force Size Model	**9**
Unit-4	Transportation and Assignment Model : Dcfinition of Transporation Model, Non Traditional Transportation Model, Transportation Algorithms, Assignments Model	**9**

	Game Theory :Minimax-Maximin criterion, Pure strategies,Mixed straicgies and Expected Payoff, Concept of Dominance, Graphical Solution of m x 2 and 2 x n Games Solution by Linear Programming method	
Unit-5	Queuing Theory: Definition of Queuing System, Characteristics of Queuing Models.. Notation, Transient and Steady State of Queuing System, Birth-Death process, Pure birth & Pure Death processes, (M/M/1):(FIFO), (M/M/s):(FIFO'), (M/M/1) (FIFO) Models, Their Characteristics, State Transition Diagrams	**9**
Total No. of Hours		**40**

Learning Outcomes	After completion of course student will be: 1. Analyse any real life system with limited constraints and depict it in a model form. 2. Convert the problem in to a mathematical model solve it manually as well as using software. 3. Develop a repost that describe the model analyse the results and propose recommendations in decision making process in real life problem. 4. Understand variety of problems such as assignment, transportation, travelling salesman etc. and their application in real life systems. 5. Understand different queuing situations in real life and find their optimal solution using different queuing models.

S. No.	Name of Authors/Books /Publisher	Year of publication
1.	Kanti Swarup,D.S.Hira,Prem Kumar Gupta	1992
2.	Frederick S. Hiller,Gerald J. Lieberman	1990
3.	S.D.Sharma	2002
4.	Hamdy A. Taha	1971

Effective from 2021-22

Course Code: BME-O634
Course Name: Concurrent Engineering

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Design of Product and Quality.
Objectives:	Concurrent Engineering aims to reduce the number of redesigns, especially those resulting from post-design input from support groups. Concurrent Engineering provides benefits such as reduced product development time, reduced design rework, reduced product development cost and improved communications.
Course Coordinator	Mr. Praveen Kumar Pandey

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction:** Background and challenges faced by modern production environment, sequential engineering process, Concurrent engineering definition and requirement, meaning of concurrent objectives of CE, benefits of CE, Life cycle design of products, life cycle costs.	**03**
	Module-2	Support for CE: Classes of support for CE activity, CE organizational, structure CE, team composition and duties, Computer based Support, CE Implementation Process.	**05**
UNIT-2	*Module-3*	**Design Product for Customer:** Industrial Design, Quality Function Deployment, house of quality, Translation process of quality function deployment (QFD).Modeling of Concurrent Engineering Design. Compatibility approach, Compatibility index, implementation of the Compatibility model integrating the compatibility Concerns	**08**
UNIT-3	*Module-4*	**Design for Manufacture (DFM):** Introduction, role of DFM is CE, DFM methods, e.g. value engineering, DFM guidelines, design for assembly, creative design methods, product family themes, design axioms,	**03**
	Module-5	Taguchi design methods, Computer based approach to DFM. Evaluation of manufacturability and assemblability.	**06**
UNIT-4	*Module-6*	**Quality by Design:** Quality engineering & methodology for robust product design, parameter.	**05**
	Module-7	Tolerance design, Quality loss function and signal to noise ratio for designing the quality, experimental approach.	**04**

UNIT-5	*Module-8*	**Design for X-ability:** Design for reliability, life cycle serviceability design, design for maintainability, design for economics, decomposition in concurrent design, concurrent design case studies.	**06**
Total No. of Hours			**40**

Learning Outcomes:	Concurrent Engineering is the practice of receiving product manufacturability input throughout the product development process. By considering manufacturability throughout the process, manufacturing issues can be identified and resolved as they surface, resulting in a better overall project outcome for the client.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of publication
1.	Concurrent Engineering Kusiak John Wiley. ISBN: 978-0-471-55492-9	1992
2.	Concurrent Engineering Menon Chapman & hall, ISBN- 978-0412581304	1994

Effective from 2021-22

Course Code: BME-O635
Course Name: Quality Management

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Industrial designing of product.
Objectives:	1. To Test kinematic and Geometric accuracy of Machine Tool Alignment, Location, Orientation errors between Spindle, Slides, Tool/ work Holders 2. Certification, Maintenance tasks, History.
Course Coordinator	Mr. Praveen Kumar Pandey

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	Principles of measurement, Concept of Tolerance & Fit, Standards of measurements; Concepts of interchangeability, Taylor's principles	**04**
	Module-2	Design of limit gauge; Selective assembly. Off-line & On-line Inspection,	**04**
UNIT-2	*Module-3*	Mechanical, pneumatic, electrical, electronic and optical measuring systems for in-process and post-process, product feature inspection; Measurement techniques of different machine elements e.g gears, threads, bearings, cutting tools etc., machine tool metrology; Principles of light wave interferometry and interferometers; Ultrasonic gauging.	**04**
UNIT-3	*Module-4*	Surface quality features measurement and analysis. Quality and reliability;	**08**
UNIT-4	*Module-5*	Basic principles of statistical quality control; General theory of control charts for variable and attributes.	**10**
UNIT-5	*Module-6*	Concept of acceptance sampling; Computer applications in inspection and quality control, ISO 9000 requirements.	**10**
Total No. of Hours			**40**

Learning Outcomes:	1. On completing the course, students should be able to understand the Inspection and control of product and able to quality maintain the quality. 2. To Test kinematic and Geometric accuracy of Machine Tool • Alignment, Location, Orientation errors between Spindle, Slides, Tool/ work Holders • Certification, Maintenance tasks.

Suggested books:

S.	Name of Authors /Books /Publisher	Year of

No.		publication
1.	Ellis R. Ott, Edward G. Schilling, Dean V. Neubauer ,Process Quality Control: Troubleshooting and Interpretation of Data, Fourth Edition, ISBN-10-0873896556	2005
2.	Walter A. Shewhart Economic Control of Quality of Manufactured Product ISBN-10-1614278113	2015
3.	Dennis R. Arter Quality Audits for Improved Performance, Third Edition, ISBN-10-0873895703	2002

Effective from session 2022-23

Course Code: BME-C711
Course Name: Refrigeration & Air Conditioning

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Fundamental Knowledge of Thermodynamics.
Objectives:	• To familiarize with the terminology associated with refrigeration systems and air conditioning. • To understand basic refrigeration processes. • To understand the basics of psychrometry and practice of applied psychometrics. • To acquire the skills required to model, analyse and design different refrigeration as well as air conditioning processes and components.
Course Coordinator	Dr. Shobhit Srivastava

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Refrigeration:** Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect & C.O.P.	**02**
	Module-2	**Air Refrigeration Cycle:** Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART).	**06**
UNIT-2	*Module-3*	**Vapour Compression System:** Single stage system, Analysis of vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling, Advanced vapour compression cycles, Different configuration of multistage system, Cascade system	**08**

UNIT-3	*Module-4*	**Vapour Absorption System:** Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentration diagram, Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium- Bromide water vapour absorption system, Comparison.	**06**
	Module-5	**Refrigerants:** Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants. Ozone depletion and global warming issues	**02**
UNIT-4	*Module-6*	**Air Conditioning:** Introduction to air conditioning, Psychometric properties, Psychometric chart, Different Psychometric processes, Thermal analysis of human body, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal heat gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP).	**08**
UNIT-5	*Module-7*	**Refrigeration Equipment & Application:** Elementary knowledge of refrigeration & air conditioning equipments eg compressors, condensers, evaporators & expansion devices, Air washers, Cooling, towers & humidifying efficiency, Food preservation, Cold storage, Refrigerates Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning	**08**
Total No. of Hours			**40**

Learning Outcomes:	A student who has done the course will have a good understanding of • The working principles of Refrigeration system, different types of air conditioning systems and their working, different types of refrigerants and air-conditioning systems.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Manohar Prasad, ***"Refrigeration and Air conditioning",*** 3rd edition, New Age International (P) Ltd. Publication ISBN- 978-8122436945	2020
2.	C P Arora***, "Refrigeration and Air conditioning",*** 3rd edition, McGraw Hill Education, ISBN- 978-9351340164	2017
3.	W. F. Stoecker, J. W. Jones, ***"Refrigeration and Air conditioning",*** McGraw Hill India, Publisher, ISBN- 9789332902954	2014
4.	P.L. Ballaney***, "Refrigeration and Air conditioning",***16th edition, Khanna Publishers , ISBN- 978-8174091369	1972

Effective from session 2022-23

Course Code: BME-C712
Course Name: Maintenance Management

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	English language
Objectives:	• To ensure that equipment and infrastructure are always in good condition. • To carry out prompt emergency repair of equipment and infrastructure so as to secure the best possible availability for production. • To ensure the operation of equipment for production and for the distribution of energy and fluids.
Course Coordinator	Mr. Sunil Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction:** Introduction, operating life cycle, reliability, Failure analysis, failure rate curve, elements in series, parallel, logic diagrams, improving reliability, maintainability, availability, reliability and maintainability.	**08**
UNIT-2	*Module-2*	**Maintenance Strategies**: Break down maintenance, planned maintenance, strategies, preventive maintenance, design out maintenance, planned lubrication, total productive maintenance, and zero break down.	**08**
UNIT-3	*Module-3*	Replacement planning maintain or replace decision, replacement of items that deteriorate identical equipment, replacement of items that fail without deterioration individual, group replacement, replacement in anticipation of failure.	**08**
UNIT-4	*Module-4*	Break down maintenance planning, assignment model, minimum cost service rate.	**08**
UNIT-5	*Module-5*	Maintenance Management, production maintenance system, objectives and functions, forms, policy, planning, organization, economics of maintenance, manpower planning, materials planning, spare parts planning and control, evaluation of maintenance management.	**08**
Total No. of Hours			**40**

Learning Outcomes:	• Understand the maintenance function and its objectives and know how to prepare report about the maintenance function. • Gain the necessary knowledge about the types of maintenance and know how to use them when design maintenance systems.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Nauhria & Prakash, ***Management of systems***, Wheeler publishing, ISBN-9788185814520	1998
2.	V. Venkataraman , ***Maintenance engineering and management,*** *Prentice Hall India Learning Private Limited*, ISBN- 978-8120331303	2007
3	H P Garg, ***Industrial Maintenance,*** S. Chand Publishing, ISBN- 9788121901680	2010
4.	R.C Mishra, ***Maintenance Engineering and Management,*** Prentice Hall India Learning Private Limited; 2nd edition, ISBN- 978-8120345737	2012

Effective from session 2022-23

Course Code: BME-C761
Course Name: Refrigeration & Air Conditioning Lab

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit : 1**

Prerequisites:	Fundamental Knowledge of Refrigeration cycle and air conditioning equipment.
Objectives:	• To understand the practical knowledge of vapour compression cycle. • To understand the practical knowledge of air conditioning test rig. • To understand the practical knowledge of ice plant test rig. • To understand the practical knowledge of different devices used in industry.
Course Coordinator	Dr. Shobhit Srivastava

Module	Course Content	No. of Hours
Module-1	Experiment on refrigeration test rig and calculation of various performance parameters	**02**
Module-2	Experiment on air-conditioning test rig & calculation of various performance parameters.	**02**
Module-3	Experiment on Ice-plant test rig & calculation of various performance parameters.	**02**
Module-4	To study different types of expansion devices used in refrigeration system.	**02**
Module-5	To study different types of evaporators used in refrigeration systems.	**02**
Module-6	To study basic components of air-conditioning system.	**02**
Module-7	To study air washer system and processes.	**02**
Module-8	To study the window air conditioner	**02**
Total No. of Hours		**16**

Learning Outcomes:	At the end of this course students will be able to: • Demonstrate the fundamental principles of vapour compression cycle used in refrigeration and air conditioning cycle. • Learn the importance of various important components of refrigeration and air conditioning system. • Represent the various processes of the vapour compression cycle of psychometric chart. • Operate and maintain the refrigeration and air conditioning system.

NOTE:	1. Apart from the above practical listed any eight practical can be conducted by each student. 2. In practical examination the student shall be required to perform one experiment. 3. A teacher shall be assigned 20 students for daily practical work in laboratory. 4. No batch for practical class shall consist of more than 20 students. 5. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students. 6. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

Course Code: BME-C770
Course Name: Project-III

MM: 200 **Time: 2 Hr.** **L T P** **0 0 8**	**Sessional: 60** **ESE: 140** **Credit : 4**

COURSE OBJECTIVE:

- To enable the student to take up investigative study in the broad field of Mechanical Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor.
- To provide a good initiation for the student(s) in R&D work.
- Survey and study of published literature on the assigned topic.
- Working out a preliminary Approach to the Problem relating to the assigned topic
- Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility.
- Preparing a Written Report on the Study conducted for presentation to the Department.
- Preparing a Written Report on the Study conducted for presentation to the Department.
- Improve upon the communication and presentation skills.

Each student shall be assigned a Minor Project by Departmental committee. The student is required to perform his project work under the supervision of the supervisor(s). There shall be a presentation on the project work of the student to be evaluated by a departmental committee chaired by H.O.D. The student is required to submit his project report along with a research paper in the form of Dissertation 15 days before the end of VII semester. The student is required to submit three copies of the project work with a certificate from the supervisor(s) that the work is an authentic record of the work performed by him. The report shall be forwarded by H.O.D. The report of the project work shall be evaluated by the external examiner(s). The same external examiner(s) shall hold the viva-voce examination.

COURSE OUTCOME:

- Students will get knowledge of problem identification and use their skills for teambuilding and project development.
- Develop a solution for any real world problem.
- Students will get equipped with knowledge of latest/upcoming problems and solutions.
- Students will also be able to improve skills for project planning, implementation and communication.

NOTE:

- Marks for the project work shall be awarded jointly by the external and internal examiners after viva-voce examination.
- There shall be a seminar on the project work of the student to be evaluated by the Departmental committee chaired by H.O.D.

TEXTBOOKS:

1. Ford, Neal, Matthew McCullough and Nathaniel Schutta, Presentation patterns: Techniques for crafting better presentations (1 ed.), Addison- Wesley, 2012. ISBN 978-0321820808.

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Effective from session 2022-23

Course Code: BME-P721
Course Name: Computer Aided Design

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Programming in C and Basic Algebra
Objectives:	The primary objective of the course is to introduce the student to working with discretised geometry in design of mechanical components and representations of shapes. It is intended to be a first course on Finite Element Techniques and CAD tools like surface and solid modelling. They will also practice on AUTOCAD and CREO.
Course Coordinator	Mr. Sanjeev Kumar Lambha

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction and Review of Computer Programming:** Introduction to CAD/CAE, Element of CAD, Concepts of integrated CAD/CAM, CAD Engineering applications, its importance & necessity. Review of C, C++, statements such as if else for while & switch, functions, pointer notations, structure & class, concept of OOP.	**04**
	Module-2	**Computer Graphics I -** Computer systems, Graphics input devices- cursor control devices, Digitizers, Scanners, speech oriented devices and touch panels, Graphics display devices CRT, colour CRT monitors, DVST, Flat- panel display, Graphics output Devices.	**04**
UNIT-2	*Module-3*	**Computer Graphics-II:** Graphics software, Graphics functions, output primitives- Bresenhams line drawing and Mid-point circle algorithms.	**03**
	Module-4	**Geometric Transformations -** Word/device co-ordinate representations, 2D and 3D geometric transformations, Matrix representation-translation, scaling, shearing, rotation and reflection, composite transformations, concatenation, rotation about arbitrary axis. Exercise and programs.	**05**
UNIT-3	*Module-5*	**Plane Curves:** Curve representation, Interpolations Vs approximation, Parametric	**05**

		Continuity conditions, Spline Curves- Hermit spline, Bezier spline and B- spline Curves and its Properties.	
	Module-6	**3-D Graphics:** Polygon surfaces Polygon mesh representations, Quadric and Super quadric surfaces and Blobby objects, Fractals. Solid modelling- wire mesh and sweep representation, constructive solid geometry, Boolean operations, Boundary representations. Colour models.	**05**
UNIT-4	*Module-7*	**Computer Aided Design of Machine Elements and other Systems:** CAD of machine elements such as shaft, springs, bearings and problems from other systems such as heat exchanger, inventory control etc. Writing Computer program in C, Drafting/Design of software such as Auto-CAD and Pro-E.	**06**
UNIT-5	*Module-8*	**Numerical Methods:** Introduction, Errors in numbers, Binary, octal and Hexadecimal number representation. Root-finding & Optimisation. Interactive methods- Bisection method, Regula-Falsi method, Newton Raphson method, Interpolation- Lagrange and Newton s interpolation, Curve fitting-Least Square method, Numerical differentiation-interpolation methods, Numerical integration- Trapezoidal and Simpson Method.	**05**
	Module-9	**Finite Element Methods -** Introduction and Application of FEM, Stiffness Matrix/ Displacement Matrix, One/Two Dimensional bar & beam element (as spring system) analysis.	**03**
Total No. of Hours			**40**

Learning Outcomes:	❖ By completing this module, the student should be able to understand the basic concepts in CAD. ❖ They will be able to write computer programs and use them in Mechanical Engineering Design

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	McConnell, J. J., "***Computer graphics theory into practice****", Illustrated edition,* Jones and Bartlett Publishers, ISBN- 978-0763722500	2005
2.	Davis, M. J., "***Computer Graphics****",* UK Ed., Nova Science Pub Inc, ISBN- 978-1617618116	2011
3.	Rogers, D. F., Earnshaw, R. A., Graphics, B. C. S. C., Group, D., & Society, C. G. "***Computer graphics techniques theory and practice****", 1990 Ed.* Springer-Verlag, ISBN- 978-0387972374	1990
4.	Salomon, D., "***Transformations and projections in computer graphics****"* Springer, ISBN- 978-1846283925	2006

5.	Bethune, J. D., "***Engineering Design and Graphics with SolidWorks****"* Prentice Hall, ISBN- 978-0135024294	2009
6.	Zeid, I., "***Mastering CAD/CAM (Engineering Series)****",* 2nd Ed., McGraw-Hill Higher Education, ISBN- 978-0070634343	2006
7.	NPTEL courses *http//nptel.iitm.ac.in/courses.php*- web and video resources on *Computer Aided Design and Manufacturing.*	

Effective from session 2022-23

Course Code: BME-P722
Course Name: Advanced Machining Processes

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Conventional Machining Processes.
Objectives:	• To identify the classification of unconventional machining processes. • To understand the principle, mechanism of metal removal of various unconventional machining processes. • To understand the applications of different processes. • To study the various process parameters and their effect on the component machined on various unconventional machining processes
Course Coordinator	Mr. Rishi Kumar Prajapati

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction:** Limitations of conventional manufacturing processes, need of unconventional manufacturing processes and its classification.	**08**
	Module-2	**Unconventional Machining Process**: Principle and working and applications of unconventional machining process such as Electro-Discharge machining, Electro-chemical machining, ultrasonic machining, Abrasive jet machining etc.	
UNIT-2	*Module-3*	**Principle and working and application of unconventional machining processes** such as laser beam machining, Electron beam machining, Ultrasonic machining etc.	**08**
UNIT-3	*Module-4*	**Unconventional Welding Processes:** Explosive welding, Cladding etc. Under water welding, Metallizing, Plasma arc welding/cutting etc.	**08**
UNIT-4	*Module-5*	**Unconventional Forming Processes**: Principle, working and applications of High energy forming processes such as Explosive Forming, Electromagnetic forming, Electro-Discharge forming, water hammer forming, explosive compaction etc.	**08**
UNIT-5	*Module-6*	**Introduction to the Basic Principles of Additive Manufacturing/ digital Manufacturing**: Advantages and limitations of AM technologies AS	**08**

		developing new engineering systems, identifying emerging opportunities in developing products for mass customization. Additive Manufacturing Processes	
Total No. of Hours			**40**

Learning Outcomes:	At the end of the course students are able to: • Summarize the needs and classification of unconventional machining process. • Understand the various input and output parameters that influence in the performance. • Explain the working principle of energy based machining process. • Compare the merits, demerits and applications of unconventional machining process. • Identify the electric discharge machining and wire cut electric discharge machining process • Select the material and tool with respect to the process.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	P.C. Pandey***, Modern Machining Processes,*** McGraw Hill Education, ISBN- 978-0070965539	1980
2.	V.K Jain, ***Unconventional Machining,*** Allied Publishers Pvt. Ltd.; 1st Ed., ISBN-978-8177642940	2019
3.	Ian Gibson, David W. Rosen, Brent Stucker, "***Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing***", 1st Ed., Springer Publ., ISBN- 978-1-4419-1119-3	2010

Effective from session 2022-23

Course Code: BME- P723
Course Name: Advanced Welding Processes

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Conventional welding and Weld Design
Objectives:	• Able to get the knowledge of various conventional and advanced welding techniques which make them interested to choose a career in the field of welding. • To impart knowledge on various advanced welding processes so that the students can apply them in engineering industry applications. • To develop the knowledge on the design of welded joints and the quality control of weldments.
Course Coordinator	Mr. Yogesh Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction:** Importance and application of welding, classification of welding process. Selection of welding process.	**03**
	Module-2	**Review of conventional welding process:** Gas welding, Arc welding, MIG, TIG welding. Resistance welding. Electro slag welding, Friction welding etc. Welding of MS.CI, Al, Stainless Steel & Maurer/Schacfflar Diagram. Soldering & Brazing	**05**
UNIT-2	*Module-3*	**Advanced welding Techniques:** Principle and working and application of advanced welding techniques such as Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding etc.	**07**
UNIT-3	*Module-4*	**Advanced welding Techniques (continued):** Principle and working and application of advanced welding techniques such as explosive welding/ cladding,	**03**
	Module-5	Underwater welding, Spray-welding /Metallizing, Hard facing.	**06**
UNIT-4	*Module-6*	**Weld Design:** Welding machines/equipments and its characteristics. Weld defects and distortion and its remedies, Inspection/testing of welds	**05**

	Module-7	Macrostructure & microstructure of welds, HAZ, Weld Design, Welding of pipe-lines and pressure vessels. Life predication.	**04**
UNIT-5	*Module-8*	**Thermal and Metallurgical Consideration:** Thermal considerations for welding, temperature Distribution, Analytical analysis, heating & cooling curves. Metallurgical consideration of weld, HAZ and Parent metal, micro & macro structure. Solidification of weld and properties.	**08**
Total No. of Hours			**40**

Learning Outcomes:	At the end of the course students are able to: • Apply the knowledge of solid state welding process for engineering applications. • Understand the principles of radiant energy metal joining process • Understand the fundamental principles of special arc welding process. • Understand the knowledge of plasma arc in metal joining and cutting process. • Understand the knowledge of design principles in weld joints. Apply the concept of quality control and testing of weldments in industrial environment.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Bruce Stirling **,** ***Text Book Of Welding Technology,*** Dhanpat Rai Publications, ISBN- 978-8189928360	2013
2.	Richard L. Little,***Welding and Welding Technology,*** McGraw-Hill Inc., ISBN- 978-0070380950	1973
3	Parmer R. S., ***'Welding Engineering and Technology'***, Khanna Publishers, 2nd Ed., ISBN- 978-8174091260	1996
4	Bowditch, William A., Bowditch, Kevin E., Bowditch, Mark A, ***Welding Technology Fundamentals,*** **4th Ed.,** Goodheart-Willcox Co., ISBN- 978-1605252568	2009

Effective from session 2022-23

Course Code: BME-P724
Course Name: Non-Traditional and Computer Aided Manufacturing

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	The student should have completed 2 semesters of UG Engg.
Objectives:	• To acquaint and equip with the Computer Aided Design and manufacturing of farm machinery with the help of CAD
Course Coordinator	Mr. Kapil Dev Sharma

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	***Non-Traditional Manufacturing*** **Introduction**: Classifications of material removal processes. Characteristics of conventional material removal (machining) processes. Need for non-conventional or non-traditional processes.	**8**
UNIT-2	*Module-2*	***Non-Traditional Manufacturing*** **Process Description, Modelling, Application and Product Quality Related Issues**: Abrasive Jet Machining, Ultrasonic Machining, Water Jet Machining, Abrasive Water Jet Machining, Electro-Discharge Machining, Chemical & Photo Chemical Machining, Electro-Chemical Machining, Electron Beam Machining, Laser Beam Machining.	**8**
UNIT-3	*Module-3*	***Non-Traditional Manufacturing*** **Advanced Topics:** Basic introduction to Chemical, physical vapour deposition processes, Thermal spraying processes, Hybrid processes like electro-jet drilling, electro chemical grinding, electro-chemical discharge machining. Rapid prototyping.	**8**
UNIT-4	*Module-4*	***Computer Aided Manufacturing*** **Introduction**: Relation between production volume and flexibility. Various manufacturing systems – batch, mass, group, cellular and flexible manufacturing systems; Type of automation and benefits of soft or flexible automation.	**6**

	Module-5	Automation in Material Handling and Assembly	**2**
UNIT-5	*Module-6*	***Computer Aided Manufacturing*** **CNC Machines**: Introduction, classification, design and control features including interpolations.	**3**
	Module-7	NC Part-Programming	**2**
	Module-8	**Introduction to Robotics**: Definitions, motivation, historical development. Basic structure, classification, workspace, drives, controls, sensors, grippers, specifications.	**3**
Total No. of Hours			**40**

Learning Outcomes:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course • Understanding the implementation of automation in production system and ability to know the role of computer in the area of manufacturing. • Ability to design and develop various parts of CNC Machines for improving their effectiveness and implementation of adaptive control. • Ability to develop manual part program and computer assisted part program for the production of components. • Ability to understand the various modules of FMS and apply the concept of group technology and computer assisted process planning.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Mishra P. K., "***Non-Conventional Machining***", Narosa Publishing House, ISBN-9788173191381	1997
2.	Pandey and Shan, "***Modern Machining Processes***", McGraw Hill, ISBN- 0070965536	1980
3.	Bhattacharya A., "***New Technology***", Institution of Engineers (I), ISBN-10: 0521735882	2010
4.	Jain S. K. and Schmid S. R., "***Manufacturing Engg. & Technology***", Addison Wesley Ltd., ISBN-10:8177581708	2002
5.	NPTEL courses, http://www.nptel.iitm.ac.in/courses.php?disciplineId=112 web and video resources on Manufacturing Processes & Advanced manufacturing processes.	

Effective from session 2022-23

Course Code: BME-P725
Course Name: Power Plant Engineering

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Engineering Thermodynamics, Fluid Mechanics, Heat Transfer
Objectives:	To introduce students to different aspects of power plant engineering • To familiarize the students to the working of power plants based on different fuels. • To expose the students to the principles of safety and environmental issues.
Course Coordinator	Mr. Praveen Kumar Pandey

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction**: Analysis of steam cycles, optimization of reheat pressure and degree of regeneration, coupled cycles and combined plants, process heat and power. Fuels and their properties, stoichiometric and actual air requirements, flue gas analysis.	**08**
UNIT-2	*Module-2*	**Boilers**: Different types of boilers, boiler mountings, feed water treatment, boiler loading and manner of operation. Boiler energy balance, draft system. Different types of furnaces for burning coal, fuel oil and gas. Circulation theory, down-comers and risers, economizers and super-heaters, air pre-heater, drum and its internals.	**08**
UNIT-3	*Module-3*	**Steam Turbines**: Convergent and convergent-divergent nozzles - theory and design. Impulse and reaction turbines, compounding of turbines, optimum velocity ratio, reheat factor and condition line, parallel exhaust, losses in steam turbines, steam turbine governing.	**08**
UNIT-4	*Module-4*	**Plant Components**: Theory and design of condensers, air ejector and cooling towers. Types and applications.	**08**
UNIT-5	*Module-5*	**Power Plant Economics & Environmental Considerations**: Plant energy studies: concepts and resources, procedures and implementation. Energy accounting. Various thermal systems and energy management. Electrical load management.	**08**

		Economic analysis. Waste heat recovery. Multi objective energy management- conservation, pollution control and evaluation of alternative energy sources. Cost of energy management and payback.	
Total No. of Hours			**40**

Learning Outcomes:	After learning the course the students should be able to: • Understand the different power generation methods, its economics and global energy situation • Apply the basic thermodynamics and fluid flow principles to different power generation methods • Analyze thermodynamic cycles of steam power plant and understand construction, working and significance of its various systems • Analyze thermodynamic cycles of gas turbine power plant, nuclear power plant and jet propulsion systems

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Nag P.K., "***Power plant engineering***", 3rd Ed., Tata McGraw-Hill., ISBN-978-0070648159	2007
2.	Arora S. C., & Domkundwar S., "***A course in power plant engineering***",8th Ed., Dhanpat Rai, ISBN- 978-8177001952	2016
3.	Elanchezhian C., "***Power Plant Engineering***", I.K. International Pub. House, ISBN-978-8189866303	2013
4.	Sharma P. C., "***Power Plant Engineering***", S. K. Kataria & Sons, ISBN- 978-9350143841	2013
5.	Drbal L. F., Boston P. G., Westra K. L., Black, & Veatch, "***Power plant engineering***", Chapman & Hall, ISBN- 978-0412064012	1995
6.	Skrotzki B. G. A., & Vopat W. A., "***Power station engineering and economy****",* 2nd Ed., McGraw- Hill, ISBN- 978-0070579408	1960

Effective from session 2022-23

Course Code: BME-P726
Course Name: Simulation of Mechanical Systems

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Mathematics
Objectives:	The objective of this course is that students will learn to model and solve mechanical design problems.
Course Coordinator	Dr. Jasbir Singh

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction**: A review of basic probability and statistics, random variables and their properties, Estimation of means variances and correlation.	**06**
UNIT-2	*Module-2*	**Physical Modeling**: Concept of System and environment, Continuous and discrete systems, Linear and nonlinear systems, Stochastic activities, Static and Dynamic models, Principles of modeling, Basic Simulation modeling, Role of simulation in model evaluation and studies, advantages of simulation.	**08**
UNIT-3	*Module-3*	**System Simulation and Approach**: Techniques of simulation, Monte Carlo method, Experimental nature of simulation, Numerical computation techniques, Continuous system models, Analog and Hybrid simulation, Feedback systems, Computers in simulation studies, Simulation software packages. System Dynamics: Growth and Decay models, Logistic curves, System dynamics diagrams. Probability Concepts in Simulation: Stochastic variables, discrete and continuous probability functions, Random numbers, Generation of Random numbers.	**09**
UNIT-4	*Module-4*	Variance reduction techniques, Determination of length of simulation runs. Simulation of Mechanical Systems: Building of Simulation models, Simulation of translational and rotational mechanical systems, Simulation of hydraulic	**09**

		systems.	
UNIT-5	*Module-5*	Simulation of Manufacturing Systems: Simulation of waiting line systems, Job shop with material handling and Flexible manufacturing systems, Simulation software for manufacturing, Case studies.	**08**
Total No. of Hours			**40**

Learning Outcomes:	The students are expected to have : • Practical and simulation exposure to understand the complexity in design and manufacturing systems. • Key simulation techniques that are going to be useful while solving complex problems.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Geoffrey Gordon, "***System Simulation***", Prentice Hall, ISBN-9780138817978	1978
2.	Robert E. Shannon, "***System Simulation: The Art and Science****",* Prentice Hall, ISBN-9780138818395	1975
3.	J. Schwarzenbach and K.F. Gill, Edward Arnold, "***System Modelling and Control",*** Edward Arnold, ISBN-9780713135183	1984
4.	M Close and Dean K. Frederick, "***Modeling and Analysis of Dynamic Systems",*** Houghton Mifflin, ISBN-9780395551141	1993
5.	P. D. Cha, J. J. Rosenberg and C. L. Dym - ***'Fundamentals of Modeling and Analyzing Engineering Systems***, Cambridge University, ISBN-9780521594431	2000

Effective from session 2022-23

Course Code: BME-P727
Course Name: Additive Manufacturing

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	The student should have completed 2 semesters of UG Engg.
Objectives:	• In this course students will learn the importance of additive manufacturing (3D Printing/ Rapid Prototyping/ Green Manufacturing) and its huge role in global product development and innovation. • The students will learn the latest trends and opportunities in 3D printing, including ―personal‖ 3D printing, localized services, production parts, mass customization, and how to commercialize your ideas.
Course Coordinator	Mr. Rishi Kumar Prajapati, Mr. Mayank Pokhriyal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	Introduction to the Basic Principles of Additive Manufacturing/ digital Manufacturing: advantages and limitations of AM technologies AS developing new engineering systems, identifying emerging opportunities in developing products for mass customization.	**04**
	Module-2	Additive Manufacturing Processes	**02**
UNIT-2	*Module-3*	**AM Technology:** Extrusion, Beam Deposition, Jetting, Sheet Lamination, Direct-Write, Photo polymerization, Metal Technology & Processes, Sintering, and Powder Bed Fusion.	**06**
UNIT-3	*Module-4*	**Design/Fabrication Processes**: Data Sources, Software Tools, File Formats, Model Repair and Validation, Pre- & Post-processing, design practices for additive manufacturing.	**05**
	Module-5	**Designing for Additive Manufacturing**: Scaffolds, bio printing, tissue and organ engineering	**04**
UNIT-4	*Module-6*	Multiple Materials, Metals, polymers, ceramics, Hybrids, Composite Materials, current and material Selection & future directions, Process & Material Selection.	**05**
	Module-7	Direct Digital Manufacturing and Distributed Manufacturing, Related Technologies: 3D	**06**

		scanning, sintering, Mold making, Casting, Scanning, rapid tooling (RT), rapid manufacturing (RM).	
UNIT-5	*Module-8*	**Applications of AM**: Aerospace, Automotive, Manufacturing, Architectural Engineering, Art, Jewelry, Toys, Packaging, Architecture, Design and Entertainment and many more.	**02**
	Module-9	**Biomedical Applications of AM**: Medical, Biomedical, Dental, Bio-printing, Tissue & Organ Engineering and many others.	**02**
	Module-10	Future Trends and Directions in Additive Manufacturing, Business Opportunities, Standards and standardization in 3D Printing and the Future of Manufacturing, Intellectual Property, Product Development, Commercialization	**04**
Total No. of Hours			**40**

Learning Outcomes:	• Understanding the evolution and need of AM processes. It will develop the ability of select the process for particular application. • Understanding the basic principle of curing type, extrusion and layer deposition type AM processes. The students will learn the pros & cons of these processes and their applications. • The students will understand the use of pre requirement of AM process. Basic knowledge about the software requirement and processing of drawing. • The students will learn about the post processing requirements of different AM processes • Appreciate the operating principles, capabilities and limitations of powder based additive manufacturing system, including 3D printing and laser sintering. • Describe the important process parameters for bio-manufacturing and determine the suitable additive technique for bio manufacturing.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Ian Gibson, David W. Rosen, Brent Stucker, "***Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing***", 1st Ed., Springer Publ., ISBN-978-1-4419-1119-3	2010
2.	Hopkinson, N, Haque, R., and Dickens, P., "***Rapid Manufacturing: An Industrial Revolution for a Digital Age: An Industrial Revolution for the Digital Age***", Wiley, ISBN- 978-0470016138	2005
3.	Bartolo P J (editor), "***Virtual and Rapid Manufacturing: Advanced Research in Virtual and Rapid Prototyping***", 1st Ed , Taylor and Francis, ISBN- 9780203931875	2007
4.	Chua C. K., Leong K. F., Lim C. S., "***Rapid Prototyping***", World Scientific, ISBN-978-981-3106-04-8	2003
5.	Pique A., Chrisey D. B., "***Direct Write Technologies for RP Applications: Sensors, Electronics and Integrated Power Sources***", 1st Ed, Academic Press, ISBN-9780121742317	2001
6.	Venuvinod P. K., Ma W., "***Rapid Prototyping – Laser Based and Other Technologies***", Kluwer, ISBN- 978-1-4757-6361-4	2004
7.	Andreas Gebhardt, "***Understanding Additive Manufacturing***", Hanser Publ., ISBN-978-1569905074	2012
8.	Gibson, "***Advanced Manufacturing Technologies for Medical Applications"***, Wiley, ISBN- 978-0-470-01688-6	2005

Effective from session 2022-23

Course Code: BME-P728
Course Name: Finite Element Methods

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Matrix Algebra & Basic Mathematics courses.
Objectives:	• The objective of the course is to apprise the students about the basics of the Finite Element Technique, a numerical tool for the solution of different classes of problems in solid mechanics. • Different application areas will be dealt with after introducing the basic aspects of the method.
Course Coordinator	Mr. Sanjeev Kumar Lambha

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Basic concepts**: The standard discrete system, Finite elements of an elastic continuum displacement approach, Generalization of the finite element concepts- weighted residual and variational approaches.	**08**
UNIT-2	*Module-2*	**Element Types**: Triangular, rectangular, quadrilateral, sector, curved, iso-parametric elements and numerical integration. Automatic mesh generation schemes.	**12**
UNIT-3	*Module-3*	**Application to structural mechanics problems**: Plane stress and plane strains, Axisymmetric stress analysis, three dimensional stress analyses, bending of plates.	**06**
UNIT-4	*Module-4*	**FEM in Steady State Field Problems**: Introduction, heat conduction, fluid flow and nonlinear material problems, plasticity, creep etc.	**08**
UNIT-5	*Module-5*	Computer procedures for Finite element analysis.	**06**
Total No. of Hours			**40**

Learning Outcomes:	After the completion of the course, the students will be able to: • Describe the fundamental ideas of FEM and know the behavior and usage of different elements. • Prepare a FEM model for structures. • Analyze structure using a software. • Interpret and evaluate the results.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Chandrupatla T. R., and Belegundu A. D., "***Introduction to Finite Elements in Engineering***", 4th Ed, Pearson Education, ISBN- 978-0132162746	2011
2.	David V Hutton, "***Fundamentals of Finite Element Analysis****",* International Ed. McGraw-Hill Int., ISBN- 978-0071218573	2003
3.	Rao S.S., "***The Finite Element Method in Engineering***", 5th Ed, Pergammon Press, ISBN- 978-1856176613	2010
4.	Logan D.L., "***A First course in the Finite Element Method***, 5th Ed., Thomson Learning, ISBN- 978-0495668251	2010
5.	Robert D. Cook., David. S, Malkucs Michael E Plesha, "***Concepts and Applications of Finite Element Analysis****",* 4th Ed., Wiley, ISBN- 978-0471356059	2001
6.	Reddy J.N, "***An Introduction to Finite Element Method***", 3rd Ed, McGraw-Hill International Student Edition, ISBN- 978-0072466850	2005
7.	O. C. Zienkiewicz and R. L. Taylor, "***The Finite Element Methods, The basic formulation and linear problems Vol.1****",* Ed, McGraw-Hill College;, ISBN- 978-0070841741	1987

Effective from session 2022-23

Course Code: BME-P729
Course Name: AUTOMOBILE ENGINEERING

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Rigid Body Dynamics (done in 1st year B.Tech.), Thermodynamics, Fluid Mechanics
Objectives:	The anatomy of the automobile in general. 2. The location and importance of each part. 3. The functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels. 4. Suspension, frame, springs and other connections. 5. Emissions, ignition, controls, electrical systems and ventilation.
Course Coordinator	Mr. Kapil Dev Sharma

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Power Unit**: Principles of Design of main components. Valve mechanism. Power and Torque characteristics. Rolling, air and gradient Resistance. Tractive effort.	**04**
	Module-2	**Gear Box** Gear ratio determination. Design of Gear box.	**03**
UNIT-2	*Module-3*	**Transmission System:** Requirements. Clutches. Toque converters. Over drive and free wheel, Universal joint. Differential Gear Mechanism of Rear Axle. Automatic transmission, Steering and Fron t Axle.	**06**
	Module-4	Castor Angle, wheel camber & Toe in Toe out etc. Steering geometry. Ackerman mechanism, Understeer and Over steer.	**03**
UNIT-3	*Module-5*	**Braking System:** General requirements, Road, tyre adhesion, weight transfer, Braking ratio. Mechanical brakes, Hydraulic brakes. Vaccum and air brakes. Thermal aspects.	**05**
	Module-6	Chassis and Suspension System: Loads on the frame. Strength and stiffness. Various suspension systems	**03**
UNIT-4	*Module-7*	**Electrical System:** Types of starting motors,	**04**

		generator & regulators, lighting system, Ignition system Horn, Battery etc. BS4 and BS6.	
	Module-8	Performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles, application of fuel cells.	**04**
UNIT-5	*Module-9*	**Automobile Air Conditioning:** Requirements, Cooling & heating systems Cooling & Lubrication System: Different type of cooling system and lubrication system.	**04**
	Module-10	Maintenance System: Preventive maintenance, break down maintenance, and over hauling system	**04**
Total No. of Hours			**40**

Learning Outcomes:	At the end of the course students are able to: • Identify the different parts of the automobile. • Explain the working of various parts like engine, transmission, clutch, brakes. • Describe how the steering and the suspension systems operate. • Understand the environmental implications of automobile emissions. • Develop a strong base for understanding future developments in the automobile industry

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year
1.	Hietner, ***Automotive Mechanics Principles And Practices,*** 2 Ed., ISBN- 978-8123908915	2004
2.	Kripal Singh, ***Automobile Engineering Vol-1,*** ISBN- 978-8180141966	2020
3.	Narang***, Automobile Engineering,*** Khanna Publishers - ISBN- 9387394255	1995
4.	K.K. Ramalingam, ***"Automobile Engineering",*** Scitech Publication, Chennai, ISBN-978-8188429486	2011

Effective from session 2022-23

Course Code: BME-P730
Course Name: Flexible Manufacturing System

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	The student should have completed 2 semesters of UG Engg.
Objectives:	• Understand the role of Flexible Manufacturing Systems (FMS) in manufacturing. Understand the concept of Group Technology. • Understand the concept of Cellular Manufacturing Systems. • Understand the benefits of automation, • Know types of manufacturing industries.
Course Coordinator	Mr. Rishi Kumar Prajapati

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Understanding of FMS:** Evolution of Manufacturing Systems, Definition, objective and Need, Components, Merits, Demerits and Applications Flexibility in Pull and Push type	**04**
	Module-2	Classification of FMS Layout: Layouts and their Salient features, Single line, dual line, loop, ladder, robot Centre type etc.	**04**
UNIT-2	*Module-3*	**Processing and Quality Assurance Equipment** Processing stations: Salient features Machining Centers, Turning Centre, Coordinate measuring machine (CMM), Washing/ Deburring station	**08**
UNIT-3	*Module-4*	**Material Handling System:** An introduction, Conveyor, Robots, Automated Guided Vehicle (AGV), Automated Storage Retrieval System (ASRS)	**08**
UNIT-4	*Module-5*	**Management technology:** Tool Management, tool magazine, Tool preset, identification, Tool monitoring and fault detection, routing, Production Planning and Control, Scheduling and loading of FMS.	**05**
	Module-6	**FMS Computer Hardware, Software, and Communication Networks,** NC Programming , Programmable Logic Control (PLC), Sensory Systems and Actuator Devices , Servo Systems	**04**
UNIT-5	*Module-7*	**Design of FMS:** Performance Evaluation of	**08**

		FMS, Analytical model and Simulation model of FMS **Case studies:** Typical FMS problems from research papers	
Total No. of Hours			**41**

Learning Outcomes:	• Classify and distinguish FMS and other manufacturing systems including job-shop and mass production systems. • Explain processing stations and material handling systems used in FMS environments. • Design and analyze FMS using simulation and analytical techniques • Understand tool management in FMS. • Analyze the production management problems in planning, loading, scheduling, routing and breakdown in a typical FMS.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	William W Luggen, "***Flexible Manufacturing Cells and System***", New Ed., Prentice Hall of Inc New Jersey,ISBN- 978-0133217384	1990
2.	Reza A Maleki "***Flexible Manufacturing system***" Prentice Hall of Inc New Jersey, ISBN- 978-0133217612	1990
3	John E Lenz "***Flexible Manufacturing"*** marcel Dekker Inc New York , ISBN- 978-0824776831	1988
4.	Groover, M.P "***Automation, Production Systems and Computer Integrated Manufacturing***", 4th Ed., Prentice Hall of India Pvt.Ltd. , ISBN- 978-9332572492	2016

Effective from session 2022-23

Course Code: BME-O731
Course Name: Nanotechnology and Nano computing

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	First two years of undergraduate course of Engineering (Introductory, undergraduate level Physics, Chemistry and Mathematics)
Objectives:	• To foundational knowledge of the Nanocomputing and related fields. • To make the students acquire an understanding the Nanocomputing and Applications • To help them understand in broad outline of Nanocomputing and Nanotechnology
Course Coordinator	Dr. Jasbir Singh

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Nanotechnology:** Nano systems, Molecular machinery and manufacturing, quantum mechanics, mechanosynthesis, Ideas of Richard Feynman	**04**
	Module-2	**Nanocomputing:** Introduction, Nanocomputing Technologies, Carbon nanotubes, Nano Information processing, Silicon Nano electronics, prospects and Challenges.	04
UNIT-2	*Module-3*	**Carbon Nanotubes:** Properties, Molecular structure, Chiral Vector, carbon nanotube Electronics, Carbon Nanotube Field effect Transistors	**08**
UNIT-3	*Module-4*	**Nanocomputing with Imperfections:** Nanocomputing in presence of defects and faults, redundancy, Error control coding, reconfiguration, Fault Simulation, Defect Tolerance, Reconfigurable Hardware, Overcoming Manufacturing defects	**05**
	Module-5	**Reliability of Nanocomputing:** Markov Random Fields, examples, reliability Evaluation strategies, Law of large Numbers, Nano prism.	**03**
UNIT-4	*Module-6*	**Nanoscale Quantum Computing** Quantum Computers, Challenges to Physical Realization, Quantum-dot Cellular Automata	**08**

		(QCA), QCA Clocking, Design Rules, Placement, Basic QCA Circuits using QCA Designer Software and their implementation	
UNIT-5	*Module-7*	**Molecular Computing:** Background of molecular electronics, Alderman's Experiment, DNA Computation, Bacteriorhodopsin, challenges before molecular computing. Optical Computing: Introduction, use of Optics for Computing, Optical Computing Paradigms, Ultrafast Pulse Shaping, Photonic Switches	**08**
Total No. of Hours			**40**

Learning Outcomes:	After completing this course students will be able to: • Learn about the background on Nanocomputing • Understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment • Apply their learned knowledge to develop Nanomaterial's.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	G. Schmidt , ***Nanoparticles: From theory to applications*** , Wiley Weinheim, ISBN-978-3-527-60404-3	2006
2.	S K Shukla and R I Bahar , ***Nano, Quantum and Molecular Computing- Implications to High level design and Validation***, Illustrated Ed., Kluwer Academic Publishers, ISBN- 978-1402080678	2004
3.	V Sahni and D Goswami, ***Nanocomputing – an Introduction***, Tata McGraw Hill, ISBN- 978-0070248922	2008
4.	Leon L. Shaw***, "Processing & properties of structural naonmaterials",*** Wiley , ISBN-978-0873395588	2003

Effective from session 2022-23

Course Code: BME-O732
Course Name: Artificial Intelligence and Robotics

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	: Knowledge of "Kinematics of Machine" & Passion to learn the Subject
Objectives:	• To present a problem oriented in depth knowledge of Artificial Intelligence and Robotics. • To address the underlying concepts, methods and application of different Artificial Intelligence and Robotics.
Course Coordinator	Mr. Sanjeev Kumar Lambha

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Scope of AI**: Games, theorem proving, natural language processing, vision and speech processing, robotics, expert systems, AI techniques- search knowledge, abstraction.	**04**
UNIT-2	*Module-2*	**Problem solving**: State space search; Production systems, search space control: depth first, breadth-first search, heuristic search - Hill climbing, best-first search, branch and bound. Problem Reduction, Constraint Satisfaction End, Means-End Analysis.	**08**
UNIT-3	*Module-3*	**Knowledge Representation**: Predicate Logic: Unification, modus pones, resolution, dependency directed backtracking. Rule based Systems: Forward reasoning: conflict resolution, backward reasoning: use of no backtrack. Structured Knowledge Representation: Semantic Nets: slots, exceptions and default frames, conceptual dependency, scripts.	**10**
UNIT-4	*Module-4*	**Handling uncertainty and learning**: Non-Monotonic Reasoning, Probabilistic reasoning, use of certainty factors, fuzzy logic. Concept of learning, learning automation, genetic algorithm, learning by inductions, neural nets.	**08**
UNIT-5	*Module-5*	**Robotics**: Robot Classification, Robot Specification, notation; Direct and Inverse Kinematics: Co-ordinates Frames, Rotations,	**10**

		Homogeneous Coordinates, Arm Equation of four Axis SCARA Robot, TCV, Inverse Kinematics of Four Axis SCARA Robot.	
Total No. of Hours			**40**

Learning Outcomes:	• The student can identify different areas of Artificial Intelligence and Robotics. • Can find the applications of all the areas in industry.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	E. Rich and K. Knight, "***Artificial intelligence***", 2nd Ed., TMH, ISBN- 978-0070522633	1991
2.	N.J. Nilsson, "***Principles of AI***", Reprint Ed, Narosa Publ. House, 978-0934613101	1993
3.	Robin R Murphy, "***Introduction to AI Robotics***", 1st Ed., PHI Publication, ISBN-978-0262133838	2001
4.	D.W. Patterson, "***Introduction to AI and Expert Systems***", PHI, ISBN- 978 0134771007	1990
5.	R. J. Schalkoff, "***Artificial Intelligence - an Engineering Approach***", Int. Ed., McGraw Hill, Singapore, ISBN- 978-0071009324	1992
6.	George Lugar, "***AI-Structures and Strategies for and Strategies for Complex Problem solving***", 6th Ed., Pearson Educations, ISBN- 978-0321545893	2008

Effective from session 2022-23

Course Code: BME-O733
Course Name: ENERGY RESOURCES AND MANAGEMENT

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	First two years of undergraduate course of Engineering (Introductory, undergraduate level Physics and Chemistry)
Objectives:	• To provide students with a general awareness on the importance of energy and its conservation, its impact on society, various energy sources, energy conversion processes, energy management.
Course Coordinator	Mr. Praveen Pandey

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Energy Resources and Their Utilization:** Indian and global energy sources, Energy exploited, Energy planning, Energy parameters (energy intensity, energy-GDP elasticity), Introduction to various sources of energy, Solar thermal, Photovoltaic, Water power, Wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal energy, Hydrogen energy systems, Fuel cells, Decentralized and dispersed generation.	**04**
	Module-2	**Solar Radiations:** Extra-terrestrial radiation, Spectral distribution, Solar constant, Solar radiations on earth, Measurement of solar radiations, Solar radiation geometry, Flux on a plane surface, Latitude, Declination angle, Surface azimuth angle, Hour angle, Zenith angle, Solar altitude angle expression for angle between incident beam and the normal to a plane surface (no derivation), Local apparent time, Apparent motion of sun, Day length, Solar radiation data for India.	**04**
UNIT-2	*Module-3*	**Solar Energy:** Solar thermal power and it's conversion, Solar collectors, Flat plate, Performance analysis of flat plate collector, Solar concentrating collectors, Types of concentrating collectors, Thermodynamic limits to concentration, Cylindrical collectors, Thermal	**0**

		analysis of solar collectors, Tracking CPC and solar swing Solar thermal energy storage, Different systems, Solar pond. Applications, Water heating, Space heating & cooling, Solar distillation, solar pumping, solar cooking, Greenhouses, Solar power plants.	
	Module-4	**Solar Photovoltaic System:** Photovoltaic effect, Efficiency of solar cells, Semiconductor materials for solar cells, Solar photovoltaic system, Standards of solar photovoltaic system, Applications of PV system, PV hybrid system.	**04**
UNIT-3	*Module-5*	**Biogas:** Photosynthesis, Bio gas production Aerobic and anaerobic bio-conversion process, Raw materials, Properties of bio gas, Producer gas, Transportation of bio gas, bio gas plant technology & status, Community biogas plants, Problems involved in bio gas production, Bio gas applications, Biomass conversion techniques, Biomass gasification, Energy recovery from urban waste, Power generation from liquid waste, Biomass cogeneration, Energy plantation, Fuel properties, Biomass resource development in India.	**04**
	Module-6	**Wind Energy:** Properties of wind, Availability of wind energy in India, wind velocity, Wind machine fundamentals, Types of wind machines and their characteristics, Horizontal and Vertical axis windmills, Elementary design principles, Coefficient of performance of a wind mill rotor, Aerodynamic considerations in wind mill design, Selection of a wind mill, Wind energy farms, Economic issues, Recent development.	**04**
UNIT-4	*Module-7*	**Electrochemical Effects and Fuel Cells:** Principle of operation of an acidic fuel cell, Reusable cells, Ideal fuel cells, Other types of fuel cells, Comparison between acidic and alkaline hydrogen-oxygen fuel cells, Efficiency and EMF of fuel cells, Operating characteristics of fuel cells, Advantages of fuel cell power plants, Future potential of fuel cells .	**04**
	Module-8	**Tidal power:** Tides and waves as sources of energy, Fundamentals of tidal power, Use of tidal energy, limitations of tidal energy conversion systems. **Hydrogen Energy:** Properties of hydrogen in respect of its use as source of renewable energy,	**04**

		Sources of hydrogen, Production of hydrogen, Storage and transportation, Problems with hydrogen as fuel, Development of hydrogen cartridge, Economics of hydrogen fuel and its use.	
UNIT-5	*Module-9*	**Thermoelectric Systems:** Kelvin relations, power generation, Properties of thermoelectric materials, Fusion Plasma generators.	**04**
	Module-10	**Geothermal Energy:** Structure of earth's interior, Geothermal sites, earthquakes & volcanoes, Geothermal resources, Hot springs, Steam ejection, Principal of working, Types of geothermal station With schematic representation, Site selection for geothermal power plants. Advanced concepts, Problems associated with geothermal conversion.	**04**
	Module-11	**Ocean Energy:** Principle of ocean thermal energy conversion, Wave energy conversion machines, Power plants based on ocean energy, Problems associated with ocean thermal energy conversion Systems, Thermoelectric OTEC, Developments of OTEC, Economics. Impact of renewable energy generation on environment, Kyoto Protocol, Cost of electricity production from different energy Sources, Energy options for Indian economy.	**04**
Total No. of Hours			**44**

Learning Outcomes:	After completion of this course • The students shall have an understanding of the impact of energy on society, the need for sustainable energy, global and Indian energy policies. • They would have gained knowledge on various techniques of energy management and conservation.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Bansal Keemann, Meliss***," Renewable energy sources and conversion technology"***, Tata Mc Graw Hill, Publisher, ISBN- 978-0074600238	1989
2.	Kothari D.P., ***"Renewable energy resources and emerging technologies", 2nd Ed., Prentice Hall of India Pvt. Ltd***., ISBN- 978-8120344709	2011
3.	Rai G.D, ***"Non-Conventional energy Sources",*** Khanna Publishers., ISBN- 978-8174090737	1988
4.	Ashok V. Desai, ***"Nonconventional Energy",*** New Age International Publishers Ltd., ISBN- 978-8122402070	1990

Effective from session 2022-23

Course Code: BME-O734
Course Name: Engineering System Design Optimization

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Mathematics
Objectives:	• The primary objective of this course is for students to gain knowledge to translate practical engineering design problems into mathematical optimization problems that can be solved using numerical methods for optimization.
Course Coordinator	Dr. Jasbir Singh, Dr. Lokesh Joshi

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction**: Optimization problem formulation, optimization algorithms, applications and examples, different optimization methods available.	**07**
UNIT-2	*Module-2*	**Single Variable Optimization**: Optimization criteria, bracketing methods – Exhaustive search method, bound phase method; Region Elimination methods – Fibonacci search method, Golden search method; Gradient based methods – Newton Raphson method, Bisection method; Root finding using optimization technique.	**09**
UNIT-3	*Module-3*	**Multi objective optimization**: Optimization criteria, Different search methods, Unidirectional search, Direct search method – Evolutionary optimization method, Powell's conjugate direction method; Gradient based methods – Newton's method and Variable metric method.	**09**
UNIT-4	*Module-4*	**Specialized Methods**: Integer programming, Geometric programming, simulated annealing, Global optimization using - steep descent method, simulated annealing.	**06**
UNIT-5	*Module-5*	**Genetic algorithms and evolutionary Approaches**: Differences and similarities between Genetic algorithms and traditional techniques, operators of GA"s, Computer program for simulated annealing, Newton Raphson method,	**09**

		Evolutionary optimization method.	
Total No. of Hours			**40**

Learning Outcomes:	At the end of this course, students will be able to • Demonstrate an understanding of how design optimization fits into the overall engineering design process. • To formulate practical engineering design problems as well-posed optimization problems. • To determine the advantages and disadvantages of applying different optimization techniques for a specific problem. • To model and analyze multiobjective and multidisciplinary optimization problems.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	P. Y. Papalambros and D. J. Wilde, ***Principles of Optimal Design: Modeling and Computation***, 2nd edition, Cambridge University Press, ISBN: 0521627273.	2000
2.	S. S. Rao***, Engineering Optimization: Theory and Practice***, 4th edition, John Wiley & Sons, ISBN: 0470183527.	2009
3.	K. Deb***, Optimization for Engineering Design,*** 2nd edition, PHI Learning Pvt. Ltd., ISBN: 8120346785.	2009
4.	K. Deb, ***Multi objective optimization using Evolutionary algorithms***", John Wiley, ISBN: 9780471873396	2001
5.	H. A. Taha, ***Operations Research-An Introduction***, Prentice Hall, ISBN: 9780134480176	2017

Effective from session 2022-23

Course Code: BME-O735
Course Code: Rural Technology & Community Development

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Rural development technology and development improvement different Analysis
Objectives:	• To serve as a national and regional hub of knowledge connectivity for rural development; • To support developmental plans and policies for rural development by research, training and demonstration and create functioning packages of social and physical technologies and economic policy strategies • To facilitate the development of techno-managerial cadres needed for the rural development. • To create innovative academic programmes. • To help create special institutional structures and schemes for nurturing the leadership in regional development/agripreneurship/Coopreneurship with special focus on the most Socio-economically backward and drought regions
Course Coordinator	Mr. Kapil Dev Sharma, Mr. Yogesh Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	Data Analysis and Measures of Central Tendency-Meaning, nature, scope and limitations of statistics, collection of statistical data, classification, tabulation and diagrammatic representation of data, Measures of central tendency: Statistical averages Mean, Median, Mode.	**07**
UNIT-2	*Module-2*	Data, Information and Knowledge; concept of information, need of information (professional, educational, research), qualities of information, value of information, difference between data and information, properties of the needed information. Information and Management; planning, organizing, co-ordinating and controlling.	**08**
UNIT-3	*Module-3*	Concepts of marketing; difference between marketing selling and retailing; marketing mix, market-segmentation, marketing planning. Strategy and Approaches; modern concept of marketing.	**08**
UNIT-4	*Module-4*	Community development; concept, definition,	**07**

		meaning, need, history, principles, objectives and scope. Community Building: Coming of Age, Regenerating Community, Community Model.	
UNIT-5	*Module-5*	Consensus Organizing Model, What's Behind Building Healthy Communities? Participatory Democracy, The Role of various NGOs in Community Development. The Role of Business and Government in Community Development Initiatives How to Form a Non-profit Corporation Fund Raising and Grant Writing.	**09**
Total No. of Hours			**40**

Learning Outcomes:	• They will learn about how to come up with ideas and transform them to visual format. • Show their ability to design and present the output in different categories Understand the methods of visual presentation, which will help them in making their research output presentable.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year
1.	Biddle, William Wishart***. Encouraging Community Development: A Training Guide for Local Workers***. New York: Holt, Rinehart and Winston. ISBN- 34067017905679	1968
2.	M.S. Virdi ***, Sustainable Rural Technology***, Daya Publishing House,ISBN:8170355656	2008
3.	Punia Rd Roy, ***Rural Technology***, Satya Prakashan ISBN- 81-7684-451-9	2015

Effective from session 2022-23

Course Code: BME-C870
Course Name: Project-IV

MM: 400 **Time: 2 Hr.** **L T P** **0 0 16**	**Sessional: 120** **ESE: 280** **Credit : 8**

COURSE OBJECTIVE:

1. To enable the student to extend further the investigative study taken up under EC P1, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry.
2. To provide a good training for the student(s) in R&D work and technical leadership.
3. Review and finalization of the Approach to the Problem relating to the assigned topic.
4. Preparing an Action Plan for conducting the investigation, including team work.
5. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed.
6. Final development of product/process, testing, results, conclusions and future directions.
7. Preparing a paper for Conference presentation/Publication in Journals, if possible.
8. Preparing a Dissertation in the standard format for being evaluated by the Department.
9. Final Seminar Presentation before a Departmental Committee.

Each student shall be assigned a Major Project by departmental committee. The student is required to perform his project work under the supervision of the supervisor(s). There shall be a presentation on the project work of the student to be evaluated by a departmental committee chaired by H.O.D. The student is required to submit his project report along with a research paper in the form of Dissertation 15 days before the end of VIII semester. The student is required to submit three copies of the project work with a certificate from the supervisor(s) that the work is an authentic record of the work performed by him. The report shall be forwarded by H.O.D. The report of the project work shall be evaluated by the external examiner(s). The same external examiner(s) shall hold the viva-voce examination.

COURSE OUTCOME:

1. Students will get knowledge of problem identification and use their skills for team building and project development.
2. Develop a solution for any real world problem.
3. Students will get equipped with knowledge of latest/upcoming problems and solutions.
4. Students will also be able to improve skills for project planning, implementation and communication.

NOTE:

- Marks for the project work shall be awarded jointly by the external and internal examiners after viva-voce examination.
- There shall be a seminar on the project work of the student to be evaluated by the Departmental committee chaired by H.O.D.

TEXTBOOKS:

1. Ford, Neal, Matthew McCullough and Nathaniel Schutta, Presentation patterns: Techniques for crafting better presentations (1st Ed.), Addison- Wesley, 2012. ISBN 978-0321820808.