GURU KASHI UNIVERSITY

Bachelor of Technology in Mechanical Engineering
Single Major (Annexure-III)

Session: 2025-26

Department of Mechanical Engineering

Graduate Attributes of the Programme: -

Type of learning outcomes	**The Learning Outcomes Descriptors**
Graduates should be able to demonstrate the acquisition of:	
Learning outcomes that are specific to disciplinary/interdisciplinary areas of learning	A strong grasp of the chosen discipline(s), their connections to related fields, and awareness of current and emerging trends in a multidisciplinary context.
	Extensive procedural knowledge for professional tasks, self-employment, entrepreneurship, and innovative organizational strategies.
	Skills in the chosen specialization, including practical abilities for both routine and non-routine tasks in a broad multidisciplinary context.
	Ability to apply learned competencies in new contexts to solve problems, rather than just replicating curriculum content.
Generic learning outcomes	Complex problem-solving: Graduates should demonstrate the ability to solve problems in both familiar and unfamiliar contexts and apply their learning to real-life situations.
	Critical thinking: Graduates should analyze and evaluate knowledge, policies, and evidence, identify assumptions, spot logical flaws, and synthesize data to draw valid conclusions.
	Creativity: Graduates should be able to approach tasks diversely, solve complex problems, innovate, and generate creative solutions in unfamiliar contexts.
	Communication Skills: Graduates should be able to listen, read analytically, and present complex information clearly; express ideas effectively in writing and speaking; share views confidently; construct logical arguments using technical language; and communicate respectfully with sensitivity to gender and minority groups.
	Analytical reasoning: Graduates should evaluate evidence, identify logical flaws, synthesize data from various sources, draw valid conclusions, and address opposing viewpoints with evidence.
	Research skills: Graduates should demonstrate strong observation and inquiry, design research proposals, formulate research questions and hypotheses, test them using data, develop appropriate methodologies, use analytical tools, plan and report experiments, and understand and practice research ethics.
	Coordinating/collaborating: Graduates should work

	effectively with diverse teams, facilitate cooperation, and contribute efficiently to a common goal.
	Leadership qualities: Graduates should be able to set direction, formulate an inspiring vision, build and motivate a team, and use management skills to guide others toward goals.
	'Learning how to learn' skills: Graduates should be able to acquire new knowledge and skills for lifelong learning, adapt to changing work demands, work independently, identify resources for further learning, and develop a lifelong learning attitude.
	Digital literacy: Graduates should be able to use ICT in learning and work, access and evaluate information, and use software for data analysis.
	Multicultural competence: Graduates should understand diverse values and beliefs, engage respectfully in multicultural settings, and lead diverse teams to achieve common goals.
	Value inculcation: Graduates should embrace ethical and humanistic values, practice responsible global citizenship, address ethical issues from multiple perspectives, follow ethical practices, promote sustainability, and act with integrity and objectivity in all work.
	Autonomy, responsibility, and accountability: Graduates should apply knowledge independently, manage projects, and demonstrate responsibility and accountability in work and learning, ensuring safety and security.
	Environmental awareness and action: Graduates should apply knowledge and skills to mitigate environmental degradation, manage waste, conserve biodiversity, and promote sustainable development.
	Community engagement and service: Graduates should be able to actively participate in services and activities that promote societal well-being.
	Empathy: Graduates should be able to understand and relate to the perspectives and emotions of others.

Programme Learning outcomes: An Undergraduate Certificate is awarded to students who have demonstrated the achievement of the outcomes located at level 4.5:

Element of the Descriptor	**Programme learning outcomes relating to Undergraduate Certificate**
Knowledge and understanding	The graduates should be able to master multidisciplinary knowledge, recognize interconnections among learning areas, and acquire procedural skills for effective task performance.
General, technical and professional skills required to perform and accomplish tasks	The graduates should be able to apply cognitive and technical skills to perform multidisciplinary tasks, critically analyze diverse information, and select appropriate methods to enhance problem-solving.
Application of knowledge and skills	The graduates should be able to demonstrate the ability to solve problems in your field, integrate operational, technical, and theoretical knowledge with cognitive and practical skills to choose appropriate methods and tools.
Generic learning outcomes	The graduates should to excel in your field, communicate effectively, engage in self-directed learning, analyze data critically, and make informed, responsible decisions.
Constitutional, humanistic, ethical, and moral values	Uphold constitutional, ethical, and moral values in practice, and effectively articulate related arguments within your field
Employability and job-ready skills, and entrepreneurship skills and capabilities/qualities and mindset	Develop essential knowledge and skills for effective job performance in your field, while taking responsibility for individual tasks and contributing to group outcomes.
Credit requirements	54
Entry requirements	A candidate who has passed Senior Secondary Certificate Examination (Class XII level) of the Board of School Education, Punjab; or any other examination recognized as equivalent thereto with minimum passing marks in aggregate, shall be eligible to join First Semester of the Undergraduate (UG) Programme.

Semester: I									
Course Code	**Course Name**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
BME1100	Engineering Mathematics–I	Major Core Course	3	1	0	4	30	70	100
BME1101	Engineering Chemistry	Major Core Course	3	0	0	3	30	70	100
BME1102	Engineering Chemistry Lab	Major Core Course	0	0	2	1	30	70	100
BME1103	Elements of Mechanical Engineering	Minor Course	3	1	0	4	30	70	100
BME1104	Communications Skill-I	Ability Enhancement Course	2	0	0	2	30	70	100
BME1105	Manufacturing Practices	Skill Enhancement Course	0	0	6	3	30	70	100
BME1106	Principle of Economics	Multidisciplinary Course	3	0	0	3	30	70	100
BME1107	Entrepreneurship Setup & Launch	Skill Enhancement Course	0	0	4	2	30	70	100
VAC0001	Environment Education	Value Added Course	2	0	0	2	30	70	100
Total			16	2	12	24	**270**	630	**900**

Semester: 2nd									
Course Code	**Course Name**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
BME2150	Engineering Mathematics–II	Major Core Course	3	1	0	4	30	70	100
BME2151	Engineering Physics	Major Core Course	3	0	0	3	30	70	100
BME2152	Engineering Physics Lab	Major Core Course	0	0	2	1	30	70	100
BME2153	Basics of Thermodynamics	Minor Course	3	1	0	4	30	70	100
BME2154	Engineering Graphics & Drawing	DSEC	4	0	0	4	30	70	100
BME2155	Computer Proficiency	Skill Enhancement Course	2	0	0	2	30	70	100
BME2156	Computer Proficiency Lab	Skill Enhancement Course	0	0	2	1	30	70	100
BME2157	Indian Constitution	Multidisciplinary Course	3	0	0	3	30	70	100
BME2158	Communications Skill-II	Ability Enhancement Course	2	0	0	2	30	70	100
VAC0002	Human Values and Professional Ethics	Value Added Course	2	0	0	2	30	70	100
Total			22	2	4	26	300	700	**100**

Note:- 8 week Internship(4 Credits) is compulsory to exit the program after second semester.

Programme learning outcomes: An Undergraduate Diploma is awarded to students who have demonstrated the achievement of the outcomes located at level 5:

Element of the Descriptor	**Programme learning outcomes relating to Undergraduate Diploma**
Knowledge and understanding	The graduates should be able to develop a broad multidisciplinary theoretical and technical knowledge base, gain in-depth understanding of a specific area, and acquire procedural skills for performing specialized tasks within your program.
Skills required to perform and accomplish tasks	Graduates should to acquire cognitive and technical skills to perform complex tasks and analyze diverse information to generate effective solutions.
Application of knowledge and skills	Graduates should be able to apply specialized knowledge and practical skills to collect and analyze data, selecting appropriate methods and tools to solve field-specific problems.
Generic learning outcomes	The graduates should be able to demonstrate the ability to: • Analyze and communicate complex information effectively to diverse audiences while pursuing self-directed learning to enhance their knowledge and skills. • Evaluate critically theories and practices, make informed decisions, and take responsibility for solving unpredictable problems in their field.
Constitutional, humanistic, ethical, and moral values	The graduates should demonstrate the willingness and ability to: • Embrace the constitutional, humanistic, ethical, and moral values, and practice these values in life, and take a position regarding these values, • Formulate arguments in support of actions to address issues relating the ethical and moral issues relating to the programme of learning , including environmental and sustainable development issues, from multiple perspectives.
Employability and job-ready skills, and entrepreneurship skills and capabilities/qualities and mindset	The graduates should be able to demonstrate the acquisition of knowledge and essential skills set that are necessary to: • Take full responsibility for their tasks and outputs, both individually and as team members, while exercising self-management within their work and study contexts. • Supervise routine work of others, contributing to the evaluation and improvement of activities.

Credit requirements	101
Entry requirements	A student can re-enter into second year of a programme if she/he has taken an exit option after first year (UG Certificate).

Semester: 3rd									
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
BME3200	Mechanics of Deformable Solids	Major Core Course	3	1	0	4	30	70	100
BME3201	Basic Electrical & Electronics Engineering	Minor Course	3	0	0	3	30	70	100
BME3202	Basic Electrical & Electronics Engineering Lab	Minor Course	0	0	2	1	30	70	100
BME3203	Engineering Mechanics	Skill Enhancement Course	3	0	0	3	30	70	100
BME3204	Applied Thermodynamics	DSEC	3	1	0	4	30	70	100
IKS0015	Indian Metallurgy	Value Added Course	2	0	0	2	30	70	100
BME3205	Professional Communication	Ability Enhancement Course	2	0	0	2	30	70	100
BME3206	Sustainable Development	Multidisciplinary Course	3	0	0	3	30	70	100
Total			19	2	2	22	240	560	800

Semester: 4th									
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**	**Int**	**Ext**	**Total Marks**
BME4250	Fluid Mechanics & Hydraulic Machines	Major Core Course	3	0	0	3	30	70	100
BME4251	Numerical Methods	Major Core Course	3	1	0	4	30	70	100
BME4252	Kinematics & Dynamics of Machines	Major Core Course	3	1	0	4	30	70	100
BME4253	Engineering Materials & Applications	Vocational Course	3	1	0	4	30	70	100
BME4254	Fluid Mechanics & Hydraulic Machines Lab	Major Core Course	0	0	2	1	30	70	100
BME4255	Report Writing	Ability Enhancement Course	2	0	0	2	30	70	100
IKS0012	Indian Agriculture	Value Added Course	2	0	0	2	30	70	100
Discipline Specific Elective – 1(Select anyone from the following)									
BME4256	IC Engine & Automobile Engineering	Discipline Specific Elective	4	0	0	4	30	70	100
BME4257	Energy Conservation And Management								
Total			20	3	2	24	240	560	800

Note:- 8 week Internship(4 Credits) is compulsory to exit the program after fourth semester.

Programme learning outcomes: The Bachelor's degree is awarded to students who have demonstrated the achievement of the outcomes located at level 5.5:

Element of the Descriptor	**Programme learning outcomes relating to Bachelor of Vocational**
Knowledge and understanding	The graduates should be able to demonstrate the comprehensive multidisciplinary knowledge with specialized depth in their field, stay informed on emerging developments, and acquire procedural skills for professional tasks.
General, technical and professional skills required to perform and accomplish tasks	Graduates should be able to develop cognitive and technical skills to perform complex tasks, evaluate intricate ideas, and generate solutions to specific problems within their program.
Application of knowledge and skills	Graduates should be able to apply specialized knowledge and skills to gather and analyze data, assess problem-solving approaches, and employ appropriate strategies to generate effective solutions.
Generic learning outcomes	The graduates should be able to demonstrate the ability to: • Analyze and communicate complex information effectively, present study findings clearly, and engage in self-directed learning to adapt to evolving workplace demands. Evaluate critically evidence, make informed decisions, and exercise sound judgment to generate solutions for field-specific and real-life problems.
Constitutional, humanistic, ethical, and moral values	Graduates should be able to uphold constitutional, humanistic, ethical, and moral values, identify and address ethical issues in their field, and adhere to ethical research practices, avoiding misconduct such as fabrication, falsification.
Employability and job-ready skills, and entrepreneurship skills and capabilities/qualities and mindset	The graduates should be able to demonstrate the acquisition of: Acquire essential knowledge and skills for professional roles in their chosen field, including entrepreneurship abilities for self-employment and business management. Capable of supervising others, managing tasks in unpredictable environments, and taking full responsibility for individual and group outcomes.
Credit requirements	149
Entry requirements	A student can re-enter into third year of a programme if she/he has taken an exit option after second year (UG Diploma).

Semester: 5th									
Course Code	**Course Title**	**Type of Course NEP 2020**	**L**	**T**	**P**	**No. of Credits**	**Int**	**Ext**	**Total Marks**
BME5300	Machine Elements & System Design	Major Core Course	3	0	0	3	30	70	100
BME5301	Manufacturing Processes	Major Core Course	3	0	0	3	30	70	100
BME5302	Machine Elements & System Design Lab	Major Core Course	0	0	2	1	30	70	100
BME5303	Manufacturing Processes Lab	Major Core Course	0	0	2	1	30	70	100
BME5304	Artificial Intelligence	Major Core Course	4	0	0	4	30	70	100
BME5305	Measurements & Metrology	Vocational Course	3	0	0	3	30	70	100
BME5306	Measurements & Metrology Lab	Vocational Course	0	0	2	1	30	70	100
Discipline Specific Elective – 1I(Select anyone from the following)									
BME5307	Renewable Energy Engineering	Discipline Specific Elective	4	0	0	4	30	70	100
BME5308	Design for Manufacturing & Assembly								
Discipline Specific Elective – III (Select anyone from the following)									
BME5309	Additive Manufacturing	Discipline Specific Elective	4	0	0	4	30	70	100
BME5310	Composite Materials Manufacturing								
Total			21	0	6	24	270	630	900

Semester: 6th									
Course Code	**Course Title**	**Type of Course NEP 2020**	**L**	**T**	**P**	**No. of Credits**	**Int**	**Ext**	**Total Marks**
BME6350	Heat Transfer & Thermal Machines	Major Core Course	3	0	0	3	30	70	100
BME6351	Heat Transfer & Thermal Machines Lab	Major Core Course	0	0	2	1	30	70	100
BME6352	Refrigeration and Air Conditioning	Major Core Course	3	1	0	4	30	70	100
BME6353	Hybrid & Electric Vehicles	Major Core Course	4	0	0	4	30	70	100
BME6354	Computer Aided Design & Analysis	Vocational Course	3	0	0	3	30	70	100
BME6355	Computer Aided Design & Analysis Lab	Vocational Course	0	0	2	1	30	70	100
Discipline Specific Elective – IV(Select anyone from the following)									
BME6356	Computational Fluid Dynamics	Discipline Specific Elective	4	0	0	4	30	70	100
BME6357	Non Traditional Machining Methods								
Discipline Specific Elective – V (Select anyone from the following)									
BME6358	Computer Integrated Manufacturing	Discipline Specific Elective	4	0	0	4	30	70	100
BME6359	Die, Mold and Tool Engineering								
Total			21	1	4	24	240	560	800

Note:- 8 week Internship(4 Credits) is compulsory to exit the program after sixth semester.

Programme learning outcomes: The Bachelor's degree is awarded to students who have demonstrated the achievement of the outcomes located at level 6:

Element of the Descriptor	**Programme learning outcomes relating to Bachelor Degree**
Knowledge and understanding	The graduates should be able to demonstrate the comprehensive multidisciplinary knowledge with specialized depth in their field, stay informed on emerging developments, and acquire procedural skills for professional tasks.
General, technical and professional skills required to perform and accomplish tasks	Graduates should be able to develop cognitive and technical skills to perform complex tasks, evaluate intricate ideas, and generate solutions to specific problems within their program.
Application of knowledge and skills	Graduates should be able to apply specialized knowledge and skills to gather and analyze data, assess problem-solving approaches, and employ appropriate strategies to generate effective solutions.
Generic learning Outcomes	The graduates should be able to demonstrate the ability to: • Analyze and communicate complex information effectively, present study findings clearly, and engage in self-directed learning to adapt to evolving workplace demands. • Evaluate critically evidence, make informed decisions, and exercise sound judgment to generate solutions for field-specific and real-life problems.
Constitutional, humanistic, ethical, and moral values	Graduates should be able to uphold constitutional, humanistic, ethical, and moral values, identify and address ethical issues in their field, and adhere to ethical research practices, avoiding misconduct such as fabrication, falsification.
Employability and job-ready skills, and entrepreneurship skills and capabilities/qualities and mindset	The graduates should be able to demonstrate the acquisition of: • Acquire essential knowledge and skills for professional roles in their chosen field, including entrepreneurship abilities for self-employment and business management. • Capable of supervising others, managing tasks in unpredictable environments, and taking full responsibility for individual and group outcomes.
Credit requirements	189
Entry requirements	A student can re-enter into fourth year of a programme if she/he has taken an exit option after third year(B. Voc.) .

Semester: 7th									
Course Code	**Course Title**	**Type of Course NEP 2020**	**L**	**T**	**P**	**No. of Credits**	**Int**	**Ext**	Total Marks
BME7400	Operation Research	Major Core Course	3	1	0	4	30	70	100
BME7401	Product Design & Development	Major Core Course	4	0	0	4	30	70	100
BME7402	Total Quality Managements	Major Core Course	4	0	0	4	30	70	100
BME7403	Mechatronics, Automation & Robotics	Minor Course	3	0	0	3	30	70	100
BME7404	Mechatronics, Automation & Robotics Lab	Minor Course	0	0	2	1	30	70	100
BME7405	Engineering Project	Minor Course	0	0	8	4	30	70	100
Discipline Specific Elective – V (Select anyone from the following)									
BME7406	Supply Chain Management	Discipline Specific Elective	4	0	0	4	30	70	100
BME7407	Process Planning & Cost Estimation								
Total			18	1	10	24	210	490	700

Semester: 8th									
Course Code Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	Credits	**Int**	**Ext**	Total Marks
BME8450	Internship	Internship	0	0	0	20	30	70	100
Total			**0**	**0**	**0**	**20**	30	70	100
Grand Total			**137**	**11**	**30**	**188**			

Mandatory Visits/ Workshop/Expert Lectures

1. It is mandatory to arrange one industrial visit every semester for the students of each branch.
2. It is mandatory to organize at least one expert lecture per semester for each branch by inviting resource persons from domain specific industry.

SEMESTER- I

Course Title: Engineering Mathematics-I	L	T	P	Cr.
Course Code: BME1100	3	1	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.
2. Classify of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
3. Illustrate the Tool of power series and Fourier series for learning advanced Engineering Mathematics.
4. Use of functions of several variables that is essential in most branches of engineering and tools of matrices and linear algebra in a comprehensive manner.

Course Content

UNIT I **16 Hours**

a. Calculus:
Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L'Hospital's rule; Maxima and minima.

b. Advanced Calculus
Differentiation: Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Integration: Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration) Center of mass and Gravity (constant and variable

densities). Theorems of Green, Gauss and Stokes, orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

UNIT II **14 Hours**

Trigonometry

Hyperbolic and circular functions, logarithms of complex number resolving real and imaginary parts of a complex quantity, De Moivre's Theorem.

Theory of equations: Relation between roots and coefficients, reciprocal Equations, transformation of equations and diminishing the roots.

UNIT III **15 Hours**

Sequences and series

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

UNIT IV **15 Hours**

Algebra

Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank- nullity theorem, composition of linear maps, Matrix associated with a linear map.

Eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigen bases. Diagonalization; Inner product spaces, Gram-Schmidt orthogonalization.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.*
- *Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.*
- *Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.*
- *N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.*
- *B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.*

- *G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.*
- *Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.*
- *Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.*
- *N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.*
- *B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.*

1. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

- *2. V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.*
- *Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.*
- *Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.*
- *N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.*
- *B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.*

Course Title: Engineering Chemistry	L	T	P	Cr.
Course Code: BME1101	3	0	0	3

Total Hours-45

Learning Outcomes:

On successful completion of this course, the students would be able to:

1. Demonstrate Schrodinger equation, Particle in a box solution and their applications
2. Conjugated molecules and Nanoparticles,
3. Evaluate band structure of solids and the role of doping on band structures.
4. Distinguish the ranges of Vibrational and rotational spectroscopy of diatomic molecules,
5. Applications, Nuclear magnetic resonance and magnetic resonance imaging
5. Rationalize periodic properties such as ionization potential, electro-negativity, Oxidation states and electro-negativity.
6. List the Thermodynamic functions: energy, entropy and free energy and also Estimations of entropy and free energies.

Course Content

UNIT I **15 Hours**

Atomic and molecular structure

Schrodinger equation, Particle in a box solution and their applications for conjugated molecules and Nanoparticles, Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations, Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

UNIT II **10 Hours**

1.Spectroscopic techniques and applications

Principles of spectroscopy and selection rules, Electronic spectroscopy, Fluorescence and its applications in medicine, Vibrational and rotational spectroscopy of diatomic molecules, Applications, Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques, Diffraction and scattering.

***2.*Intermolecular forces and potential energy surfaces**

Ionic, Dipolar and Vander Waals interactions, Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.

UNIT III **10 Hours**

1. Use of free energy in chemical equilibria

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria, Water chemistry, Corrosion, Use of free energy considerations in metallurgy through Ellingham diagrams.

2. Periodic properties

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

UNIT IV **10 Hours**

1. Stereochemistry

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

2. Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Mahan, B. H. (1987). University chemistry.*
- *Sienko, M. J. & Plane, R. A. Chemistry. (1979): Principles and Applications. New York: McGraw-Hill.*
- *Banwell, C. N. (1966). Fundamentals of Molecular Spectroscop. New York, McGraw-Hill.*
- *Tembe, B. L., Kamaluddin& Krishnan, (2008). M. S. Engineering Chemistry (NPTEL Web- book).*

Course Title: Engineering Chemistry Lab	L	T	P	Cr.
Course Code: BME1102	0	0	2	1

Total Hours-30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Evaluate the estimate rate constants of reactions from concentration of reactants/products as a function of time.
2. Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc.
3. Apply the theoretical concepts for result analysis and interpret data obtained from experimentation.
4. Identify the compound using a combination of qualitative test and analytical methods

Course Content

List of Experiments:

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Colligative properties using freezing point depression
6. Determination of the rate constant of a reaction
7. Determination of cell constant and conductance of solutions
8. Potentiometry - determination of redox potentials and emfs
9. Synthesis of a polymer/drug
10. Saponification/acid value of an oil
11. Chemical analysis of a salt
12. Lattice structures and packing of spheres
13. Models of potential energy surfaces
14. Chemical oscillations- Iodine clock reaction
15. Determination of the partition coefficient of a substance between two immiscible liquids
16. Adsorption of acetic acid by charcoal
17. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

Course Title: Element Of Mechanical Engineering	L	T	P	Cr.
Course Code: BME1103	3	1	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand a problem oriented introductory knowledge of Elements of Mechanical Engineering
2. Apply the concepts and methods behind mechanical engineering
3. Analyze concepts of energy; its sources and behavior; its Conversion, laws governing these processes and applications

Course Content

UNIT I **14 Hours**

Introduction: Concept of Mass, Weight, Force, Pressure, Work, Power, Energy, Heat, Temperature, Specific Heat, Interchange of heat, Change of state, Mechanical equivalent of heat, Internal energy, Enthalpy, Entropy, Efficiency, Statement of zeroth law, First law and Second Law of Thermodynamics. Properties of Gases: Gas laws, Boyle's law, Charle's law, Combined gas law, Gas constant, Internal energy, Relation between Cp and Cv, Non flow process, Constant volume process, constant pressure process, Isothermal process, Polytropic process, Adiabatic process. Fuels and Combustion: Introduction, Classification, Solid fuels, Liquid Fuels, Gaseous fuels, LPG, CNG and biofuels, calorific values.

UNIT II **15 Hours**

Heat Engines: Thermal prime movers, Elementary heat engines, sources of heat, Working substances, Converting machines, Classification of heat engines, heat engine cycles, Carnot cycle, Rankine cycle, Otto cycle, Diesel cycle. Power Producing Devices: Internal Combustion Engines :Introduction, Classification, Engine details, Otto and Diesel four stroke cycle ,Comparison of otto and diesel cycle, Indicated Power ,Brake Power, Efficiencies (Elementary Numerical Treatment) Turbines Introduction and Working Principles of Steam turbines, Gas turbines, Hydraulic turbines (Elementary Treatment) Power Absorbing Devices: Air Compressor: Introduction, Uses of Compressed air, Reciprocating Compressors, Operation of a compressor, Work for Compression, power required, Reciprocating compressor efficiency, Multistage reciprocating compressor, Rotary compressors. Pump: Introduction, Classification of pump, Reciprocating pump, Rotary Positive Displacement pump, Centrifugal pump, axial flow pump, specific speed ,Concept of priming and cavitations Refrigeration and Air conditioning: Introduction, Refrigerant, Types of refrigerators, Vapor compression refrigeration system, Window and Split air conditioners Intermolecular forces and potential energy surfaces Ionic, Dipolar and Vander Waals interactions, Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.

UNIT III **15 Hours**

Power Transmission Methods and Devices: Introduction to Power transmission, Belt, Rope, Chain and Gear drive. Types and functioning of clutches, brakes and Dynamometer Speed control: Introduction, Governors, I.C. engine governing, Flywheel, Engineering Materials: Introduction, classifications, ferrous metallic and nonferrous metallic materials, nonmetallic and other materials Welding ,Brazing and Soldering: Introduction of welding ,Brazing and Soldering , Comparison of welding ,brazing and soldering Mechanical Working of Metals and Press Operations: Hot and cold working of metals ,Mechanical working operations, Press working operations, A comparison between hot and cold working processes Foundry Practice: Introduction, Pattern, Molding, Molding materials, Cores, Casting methods

UNIT IV **16 Hours**

Steam and Steam Generator: Introduction, Formation of steam, properties, use of steam tables, Mollier charts (Elementary Numerical Treatment), Introduction and classification of steam generators, Cochran type, Lancashire boiler, Babcock and Wilcox boiler, high pressure boiler, boiler details, boiler performance, functioning of different mountings and accessories, Types of calorimeter Heat Transfer: Introduction, Modes of heat transfer

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Fundamental of Mechanicl Engineering by G.S.Sawhney, Prentice Hall of India Publication New Delhi*
- *Thermal Engineering by R.K.Rajput , S.Chand Publication New Delhi*
- *J.P. Holman, 'Thermodynamics', Mc. Graw Hill Inc., 1990 or later edition*
- *. Introduction to Engineerng Materials by B.K.Agrawal Tata Mcgrahill Publication, New Delhi*
- *Elements of Mechanical Engineering K.P.Roy and Prof. S.K. Hajra Chaudhary Media Promoters and Publishers Pvt.Ltd, Bombay*

Course Title: Communication Skills–I	L	T	P	Cr.
Course Code: BME1104	2	0	0	2

Total Hours-30

Learning Outcomes

Learning Outcomes: After completion of this course, the learner will be able to:

1. Develop vocabulary and improve the accuracy in Grammar.
2. Apply the concepts of accurate English while writing and become equally ease at using good vocabulary and language skills.
3. Develop and Expand writing skills through Controlled and guided activities.
4. Compose articles and compositions in English.

Course Content

UNIT I **8 Hours**

Vocabulary Building

The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, and standard abbreviations.

UNIT II **7 Hours**

Basic Writing Skills

Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely

UNIT III **8 Hours**

Identifying Common Errors in Writing

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés

UNIT IV **7 Hours**

1. **Nature and Style of sensible Writing)**

Describing, Defining, Classifying, providing examples or evidence, Writing introduction and conclusion

2. **Writing Practices):** Comprehension, Précis Writing, Essay Writing

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Swan, Michael. (1995). Practical English. OUP.*
- *Wood, F.T. (2007). Remedial English Grammar.Macmillan.*
- *Zinsser, W. (2001). On Writing Well. Harper Resource Book.*
- *Lyons, L. H.&Heasly, B.(2006). Study Writing. Cambridge University Press.*
- *Kumar, S &Lata, P. (2011). Communication Skills. Oxford University Press.*
- *CIEFL, Hyderabad. Exercises in Spoken English. Parts. I-III. Oxford University Press.*

Course Title: Manufacturing Practices	L	T	P	Cr.
Course Code: BME1105	0	0	6	3

Total Hours-90

Learning Outcomes: After completion of this course, the learner will be able to:

1. Apply the various manufacturing methods in different fields of engineering.
2. Use the different fabrication techniques
3. Learn about the practices in manufacturing of simple components using different materials.
4. Understand the advanced and latest manufacturing techniques being used in engineering industry

Course Content

UNIT I **19 Hours**

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. CNC machining, Additive manufacturing

UNIT II **19 Hours**

1. Fitting operations & power tools
2. Electrical & Electronics
3. Carpentry

UNIT III **18 Hours**

1. Plastic moulding, glass cutting
2. Metal casting

UNIT IV **19 Hours**

Welding (arc welding & gas welding), brazing [More hours can be given to Welding for Civil Engineering students as they may have to deal with Steel structures fabrication and erection; 3D Printing is an evolving manufacturing technology and merits some lectures and hands-on training. (1 hour)

Workshop Practice:

1. Machine shop - 10 hours
2. Fitting shop - 8 hours
3. Carpentry - 6 hours
4. Electrical & Electronics - 8 hours
5. Welding shop - 8 hours (Arc welding 4 hours) + gas welding 4 hours))
6. Casting - 8 hours
7. Smithy - 6 hours
8. Plastic moulding& Glass Cutting -6 hours

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Raghuwanshi, B.S.(2009). A Course in Workshop Technology, Vol 1 &II. Dhanpat Rai &Sons.*
- *Jain, R.K.(2010).Production Technology. Khanna Publishers.*
- *Singh, S.(2003).Manufacturing Practice. S.K. Kataria & Sons.*

Course Title: Principle Of Economics	L	T	P	Cr.
Course Code: BME1106	3	0	0	3

Total Hours: 45

Course Learning Outcomes: After completing all the units, students will learn:

1. Understand the core micro and macroeconomic concepts, theories, models, principles, tools, and techniques
2. Understanding the role of market and prices in influencing key economic activities
3. Develop the skills to interpret, analyze the economic concepts and variables through diagrams, tables and graphs
4. Relate the key economic principles to real life situations, especially in the context of development challenges which would help students to make informed decisions

Course Content

Unit-I. 8 Hours

Basic concepts of Economics - Understanding the philosophy o of economics - Nature of economics: Is economics a science or an art? - Definitional pluralities and distinctions such as micro-versus macro, theories versus models - A brief history of ideas in economics - Techniques of economic analysis: theories, models and tools.

Unit-II: 10 Hours

Demand, Supply, Elasticities, and Market Efficiency - The economic problem of scarcity, choice, and opportunity cost - Demand, supply, and market equilibrium - Demand and supply applications - Consumer surplus and producer's surplus - Market efficiency and their applications - Elasticity: its various forms and estimation methods, elasticity, and total revenue - Elasticity applications in the field of energy and environment - Utility, Preferences and Choice - Budget constraints, determination of optimal choices using indifference curve analysis and its applications - Behavioral economics as an alternative framework of consumer choice

Unit-III: 12 Hours

Production and Cost - Production Theory - Production function and different forms - Short-run and long-run production function, Isoquants, MRTS - Total, average, and marginal products Economies of scale and scope - Theory of cost - Short-run and long run costs, cost minimization - Total, average and marginal costs - Applications of production and costs theory.

Unit-IV: 15 Hours

Market structure and regulation - Market equilibrium and price determination under different market structure - Perfect and Imperfect market structure, welfare costs of monopoly - Market structure, efficiency, and regulation - Regulation of public monopolies - Application in case of infrastructure industries such as energy and water.

National Income Accounting - Measuring national income, output, and employment – different approaches - Determination of aggregate output, price level and interest rate – classical, Keynesian, and modern theories and approaches - GDP estimation in India

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings: -

- *Principles of Economics, Karl Case, Ray Fair, and Sharon Oster, 12th Edition, Pearson Education Inc., 2017.*
- *Principles of Economics, Mankiw, N. Gregory, 4th edition. South-Western College Publications, 2006.*
- *Principles of Economics, Stiglitz, J.E. and C.E. Walsh, 3rd Edition. New York: W.W. Norton & Company, 2002.*
- *Macro Economics, R. Dornbusch, S. Fischer, and R. Startz, 10th Edition, Tata-McGraw-Hill, 2012.*
- *Macroeconomics, Olivier Blanchard, 5th edition, Pearson Education Inc., 2009.*

Course Title: Entrepreneurship Setup & Launch	L	T	P	Cr.
Course Code: BME1107	0	0	04	02

Introduction:

This semester lays the foundation for the learner to understand what entrepreneurship is, beyond just starting a business. It introduces key ideas like problem-solving, value creation, and self-awareness. The learner will begin exploring basic business concepts while discovering their own interests and strengths.

Learners Objective:

1. Understand the core concepts of entrepreneurship through relatable, real-life examples.
2. Begin to see themselves as problem-solvers and creators.
3. Learn about business paths and choose one to try based on interest or local fit.
4. Launch a micro-hustle (online or offline) to earn their first income.
5. Build confidence and self-belief by doing.

Outcome: By the end of this semester, learners will start a simple business activity, earn their first income, and build belief in their ability to do business.

Guiding Principles/Approach:

This syllabus is built on principles of **experiential learning, growth mindset development**, and **identity-first learning**. Drawing from learning science and behavior design, the course shifts students from passive learning to *active doing*, where they try out small business activities in real contexts. The design helps students not just learn entrepreneurship, but begin to see themselves as entrepreneurs. Emphasis is placed on *small wins, peer collaboration, and locally relevant opportunities* to ensure learning feels achievable and connected to their realities. The curriculum focuses on conceptual understanding without heavy theory, combining *practical action, reflection, and*

collaboration. By making progress visible and success feel possible, it plants the seeds of self-reliance, initiative, and long-term motivation.

Semester Syllabus:

Format: 12 weeks, 4 hours/week | 2 credits
Revenue Target: ₹10,000

Week	Learning Goal	Measurable Outcome
1	Understand what entrepreneurship is and who can be an entrepreneur	Students define entrepreneurship in their own words and list 2 entrepreneurs from their local area or community
2	Connect personal identity to entrepreneurship (strengths, interests, struggles)	Students create a "value map" showing how a skill/interest/problem from their life could become a business opportunity
3	Learn about 5 business paths: content creation, dropshipping, cloud kitchen/food business, gig economy and local services	Students explore 1–2 examples from each domain and share one they're most curious to try and why
4	Choose a path and generate a basic business idea	Students write down a clear offer (what, for whom, why) and one way to reach their customer
5	Take first real action: message, post, pitch, or sell	Students reach out to or serve 1 real potential customer and record what happened

6	Reflect on first attempt and share with peers	Students share their result, a challenge faced, and one idea to improve next time
7	Improve and try again: aim for first ₹100	Students apply a change, try again, and aim to make their first ₹100 or get meaningful response
8	Learn how to identify and understand your target customer	Students talk to 2 potential customers or observe them and list 3 insights about their needs
9	Learn how to serve your target audience better	Students improve one part of their offer (product, delivery, messaging, or interaction) based on customer feedback or need
10	Explore core entrepreneurial values (resilience, honesty, effort)	Students reflect on 1 value they're building and show it in a business task or peer story
11	Focus on earning and staying consistent	Students complete a second earning task and track their consistency (e.g., same product or message for 3 days)
12	Reflect on earnings, grit, and how to keep going	Students record total earnings, one resilience moment, and one support system or habit they'll continue with

Weekly Component:

Component	**Duration**	**Description**
Learning Module	~1.5 hrs	- Introduces key concepts in a simple and engaging way - Includes, examples, and 1–2 interactive discussions or quizzes

Action Lab	~2 hrs	- Hands-on task on the weekly concept - Includes step-by-step guidance, templates, and worksheets - Ends with a submission (e.g., video, reflection, or proof of action)
Resources	Self-paced	- Supplementary videos, short readings, real-life stories, and tools to deepen understanding at their own pace

Evaluation Criteria

Evaluation Component	Description	Weightage
Weekly Task Completion	Timely submission of weekly tasks including reflections, activities, quizzes etc.	40%
Target Completion	Performance-based evaluation on hitting **revenue or profit targets** (e.g., generating ₹10,000 revenue)	30%
Final Project	A comprehensive project based on the semester's theme	30%

Course Title: Environment Education	L	T	P	Cr.
Course Code: VAC0001	2	0	0	2

Total Hours: 30

Course Learning Outcomes: After completing all the units, students will learn:

1) Grasp the concept of Environmental Science, its components, types of natural resources, their distribution, and usage, with a focus on India.
2) Discuss the factors impacting biodiversity loss and ecosystem degradation in India and the world.
3) An overview of Contemporary Environmental Issues i.e National and Global efforts to address climate change adaptation and mitigation.
4) To understand environmental laws for monitoring pollution.
5) Principles guiding human responsibility toward the environment.
6) Toxic chemicals and analytical methods for monitoring environmental pollutants.

Course Content

Unit-I. 6 Hours

Human – Environment Interaction, Natural Resources, and Sustainable Development

The man-environment interaction: Humans as hunter-gatherers; Mastery of fire; Origin of agriculture; Emergence of city-states; Great ancient civilizations and the environment, Indic Knowledge and Culture of sustainability; Middle Ages and Renaissance; Industrial revolution and its impact on the environment; Population growth and natural resource exploitation; Global environmental change. Environmental Ethics and emergence of environmentalism: Anthropocentric and eco-centric perspectives (Major thinkers); The Club of Rome- Limits to Growth; UN Conference on Human Environment 1972; World Commission on Environment and Development and Rio Summit. Natural resources: Definition and Classification. Microbes as a resource; Status and challenges. Environmental impact of over-exploitation, issues and challenges; Water scarcity and Conflicts over water. Mineral resources and their exploitation; Environmental problems due to extraction of minerals and use; Soil as a resource and its degradation. Energy resources: Sources and their classification. Implications of energy use on the environment. Introduction to sustainable development: Sustainable Development Goals (SDGs)- targets and indicators, challenges and strategies for SDGs.

Unit-II: 8 Hours

Biodiversity Conservation and Environmental Issues

Biodiversity as a natural resource; Levels and types. Biodiversity in India and the world; Biodiversity hotspots; Species and ecosystem threat categories. Major ecosystem types in India, their services, classification, significance and characteristics of forests, wetlands, grasslands, agriculture, coastal and marine; Threats to biodiversity and ecosystems: Land use and land cover change; Commercial exploitation of species; Invasive species; Fire, disasters and climate change. Major conservation policies: in-situ and ex-situ approaches; National and International Instruments for biodiversity conservation; the role of traditional knowledge, community-based conservation; Gender and conservation. Environmental issues and scales: micro-, meso-, synoptic and planetary scales; Temporal and spatial extents of local, regional, and global phenomena. Pollution: Types of Pollution- air, noise, water, soil, thermal, radioactive ;municipal solid waste, hazardous waste; transboundary air pollution; acid rain; smog. Land use and Land cover change: land degradation, deforestation, desertification, urbanization. Biodiversity loss: past and current trends, impact. Global change: Ozone layer depletion; Natural Disasters – Natural and Man-made (Anthropogenic).

Unit-III: 8 Hours

Environmental Pollution, Health, Climate Change: Impacts, Adaptation and Mitigation
Definition of pollution; Point and non-point sources. Air pollution: sources, Impacts, Primary and Secondary pollutants; Criteria pollutants- carbon monoxide, lead, nitrogen oxides, ground-level ozone, particulate matter and sulphur dioxide; Other important air pollutants- Volatile Organic compounds (VOCs), Peroxyacetyl Nitrate (PAN), Polycyclic aromatic hydrocarbons (PAHs) and Persistent organic pollutants (POPs); Indoor air pollution; National Ambient Air Quality Standards. Water pollution: Sources; River, lake and marine pollution, groundwater pollution, impacts ; Water quality parameters and standards. Soil pollution: sources and pollutants. Solid and hazardous waste, its impacts. Noise pollution: Definition, Unit of measurement, sources, noise standards; adverse impacts. Thermal and Radioactive pollution: Sources and impacts. Climate change: natural variations in climate due to greenhouse gas emission- past, present & future. Structure of atmosphere. Projections of global climate change with special reference to temperature, rainfall, climate variability and extreme events; Importance of 1.5 °C and 2.0 °C limits to global warming; Climate change projections for the Indian sub-continent. Impacts, vulnerability and adaptation to climate change: Observed impacts of climate change on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests, natural ecosystems, animal species, agriculture, health, urban infrastructure; the concept of vulnerability and its assessment; Adaptation vs. resilience; Climate-resilient development; Indigenous knowledge for adaptation to climate change. Mitigation of climate change: Synergies between adaptation and mitigation measures; Green House Gas (GHG) reduction vs. sink enhancement; Concept of carbon intensity, energy intensity and carbon neutrality; National and international policy instruments for mitigation, decarbonizing pathways and net zero targets for the future; Energy efficiency measures; Carbon capture and storage, National climate action plan and Intended Nationally Determined Contributions (INDCs); Climate justice.

Unit-IV: 8 Hours

Environment Management, Treaties and Legislation
Introduction to environmental laws and regulation: Article 48A, Article 51A (g) and other environmental rights; Introduction to environmental legislations on the forest, wildlife and pollution control. Environmental management system: ISO 14001 Concept of Circular Economy, Life cycle analysis; Cost-benefit analysis Environmental audit and impact assessment; Environmental risk assessment Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability; Ecolabeling /Ecomark scheme. Bilateral and multilateral agreements on international co-operation of instruments; conventions and protocols; binding and nonbinding measures; Conference of the Parties (COP) Major International Environmental Agreements:- Convention on Biological Diversity (CBD); Cartagena Protocol on Biosafety; Nagoya Protocol on Access and Benefit-sharing; Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES); Ramsar Convention on Wetlands of International Importance; United Nations Convention to Combat Desertification (UNCCD); Vienna Convention for the Protection of the Ozone Layer; Montreal Protocol on Substances that Deplete the Ozone Layer and the Kigali Amendment; Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal; Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade; Stockholm Convention, Minamata Convention, United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Paris Agreement; India's status as a party to major conventions Major Indian Environmental Legislations: The Wild Life

(Protection) Act, 1972; The Water (Prevention and Control of Pollution) Act, 1974; The Forest (Conservation) Act, 1980; The Air (Prevention and Control of Pollution) Act, 1981; The Environment (Protection) Act, 1986; The Biological Diversity Act, 2002; The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006; Noise Pollution (Regulation and Control) Rules, 2000; Industry-specific environmental standards; Waste management rules; Ramsar sites; Biosphere reserves; Protected Areas; Ecologically Sensitive Areas; Coastal Regulation Zone; Production and consumption of Ozone Depleting substances, Green Tribunal; Some landmark Supreme Court judgements Major International organisations and initiatives: United Nations Environment Programme (UNEP), International Union for Conservation of Nature (IUCN),World Commission on Environment and Development (WCED), United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Panel on Climate Change (IPCC), and Man and the Biosphere (MAB) programme.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings: -

- *Chahal, M. K. (2024). Environmental Science and Hazards Management (Ecology and Risk Management), ISBN:978-93-6440-586-7.*
- *Baskar, S. and Baskar, R. (2009). Natural Disasters (Earth's Processes & Geological Hazards), ISBN: 978-81-7806-168-9.*
- *Tiefenbacher, J (ed.) (2022), Environmental Management - Pollution, Habitat, Ecology, and Sustainability, Intech Open, London. 10.5772/*
- *Kanchi Kohli and Manju Menon (2021) Development of Environment Laws in India, Cambridge University Press.*
- *Bhagwat, Shonil (Editor) (2018) Conservation and Development in India: Reimagining Wilderness, Earthscan Conservation and Development, Routledge.*
- *Manahan, S.E. (2022). Environmental Chemistry (11th ed.). CRC Press. https://doi.org/10.1201/9781003096238.*
- *William P.Cunningham and Mary A. (2015) Cunningham Environmental Science: A Global Concern, Publisher (Mc-Graw Hill, USA)*
- *Central Pollution Control Board Web page for various pollution standards. https://cpcb.nic.in/ standards/*
- *Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.*
- *Ministry of Environment, Forest and Climate Change (2019) A Handbook on International Environment Conventions & Programmes. https://moef.gov.in/wp- content/uploads/2020/02/ convention-V-16-CURVE-web.pdf*

SEMESTER- II

Course Title: Engineering Mathematics –II	L	T	P	Cr.
Course Code: BME2150	3	1	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate the methods of forming and solving Ordinary differential equations and solve linear differential equations with constant and variable coefficients
2. Explain the concept of differential equation and classifies the differential equations with respect to their order and linearity.
3. Solve first-order ordinary and exact differential equations and converts separable and homogeneous equations to exact differential equations by integrating factors.
4. Apply the method of undetermined coefficients to solve the non-homogeneous linear differential equations with constant coefficients.

Course Content

UNIT-I **14 Hours**

First order ordinary differential equations: Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary differential equations of higher orders:

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

UNIT-II **15 Hours**

Complex Variable – Differentiation

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

UNIT-III **15 Hours**

Complex Variable – Integration

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

UNIT-IV **16 Hours**

Transform Calculus

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method.

Fourier transforms.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Reading

- *Thomes, G.B.and Finney, R.L. (2010) Calculus and Analytic Geometry; Ninth Edition; Pearson Education*
- *Kreyszig, E. (1998) Advanced Engineering Mathematics; Eighth Edition, John Wiley and sons.*
- *Grewal, B.S. (1965) Higher Engineering Mathematics; Khanna Publishers, New Delhi.*
- *BabuRam (2009) Advance Engineering Mathematics; First Edition; Pearson Education.*
- *Richard Courant and Fritz John (2012) Introduction to Calculus and Analysis, Volume II , V Springer Publication*
- *Harold M. Edwards (2013) Advanced Calculus: A Differential Forms Approach, Birkhauser*

Course Title: Engineering Physics	L	T	P	Cr.
Course Code: BME2151	3	0	0	3

Total Hours:45

Learning Outcomes: After completion of this course, the learner will be able o:

1. Apply knowledge of electricity and magnetism to explain natural physical processes and related technological advances.
2. Use the knowledge regarding calculus along with physical principles to effectively solve problems encountered in everyday life, further study in science, and in the professional world.
3. Design experiments and acquires data in order to explore physical principles, effectively communicate results, and evaluate related scientific studies.
4. Assess the contributions of physics to our evolving understanding of global change and sustainability while placing the development of physics in its historical and cultural context.

Course Content

UNIT I 10 Hours

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

UNIT II 11 Hours

Magneto statics: Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; vector potential and its solution for given current densities. Properties of magnetic materials: magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials.

Time Varying Field and Maxwell's Equation: Laws of Electromagnetic Induction, Self and Mutual induction, Concept of Displacement Current, Difference between Conduction Current and Displacement Current, Eddy Current, Maxwell's Equations, Derivation of Maxwell's Equations, Propagation of Electromagnetic Waves in Free Space, Solution of propagation of Plane Electromagnetic Wave in free space.

UNIT III 12 Hours

Semiconductors: Intrinsic and extrinsic semiconductors, Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Semiconductor materials of interest for optoelectronic devices.

Modern Physics: Particle properties of wave: Planck's hypothesis, Qualitative discussion of Photoelectric effect and Compton Effect. Wave properties of particle: De Broglie wave as mater waves, Heisenberg's uncertainty principle and its application. Quantum Mechanics: Interpretation of wave function, Schrödinger equation (time dependent and time independent), particle in a box,

UNIT IV 12 Hours

Wave Optics: Interference due to division of wavefront, Young's double slit expt., Principle of Superposition, Interference from parallel thin films, Newton rings, Michelson interferometer. Diffraction: Fresnel Diffraction, Diffraction at a straight edge, Fraunhoffer diffraction due to N slits, Diffraction grating, dispersive and resolving power of Grating. Polarization**:** production of plane polarized light by different methods, Brewster and Malus Laws. Double refraction, Quarter & half wave plate, Nicol prism, specific rotation, Laurent's half shade polarimeter.

Laser: Introduction, principle of Laser, stimulated and spontaneous emission, Einstein's Coefficients, He-Ne Laser, Ruby Laser, Application of Lasers.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *David J Griffths, Introduction to Electrodynamics. Prentice Hall, 2015.*
- *Saslow, W.,Electricity, magnetism and light. e-book.*
- *Subramaniam N & BrijLal, Optics, S Chand & Co. Pvt. Ltd., New Delhi*
- *R Murugeshan, Kiruthiga, Sivaprasath, Modern Physics, S Chand & Co. Pvt. Ltd., New Delhi.*
- *M.N.Avadhanulu, Engineering Physics, S.Chand& Company Ltd.*
- *Arthur Beisser, Concepts of Modern Physics, McGraw Hill Publications, 1981.*

Course Title: Engineering Physics Lab	L	T	P	Cr.
Course Code: BME2152	0	0	2	1

Total Hours-30

Learning Outcomes On successful completion of this course, the students would be able to:

1. Illustrate the working p-n junction diode.
2. Analyze and solve various engineering problems.
3. Understand principle, concept, working and application of new technology and comparison of results with theoretical calculations.
4. Design new instruments with practical knowledge.

Course Content List of experiments

1. To study the V-I characteristics of P-N junction.
2. To verify the logic gates.
3. To calculate the acceleration due to gravity “g” using simple pendulum.
4. To find the moment of inertia of flywheel.
5. To measure the diameter of a small spherical/cylindrical body using Vernier calipers/screw gauge.
6. To draw V-I characteristics of Zener diode and determine reverse breakdown voltage.
7. To study the controls and obtain a wave using Cathode Ray Oscilloscope.
8. To find the resolving power of the prism.
9. To determine the angle of the given prism.
10. To determine the refractive index of the material of a prism.
11. To understand the phenomenon Photoelectric effect as a whole.
12. To draw kinetic energy of photoelectrons as a function of frequency of incident radiation.
13. To determine the Planck's constant from kinetic energy versus frequency graph.
14. To plot a graph connecting photocurrent and applied potential.
15. To determine the stopping potential from the photocurrent versus applied potential graph.

Note : Students will perform any 7-8 experiments from the syllabus.

Course Title: Basic Of Thermodynamics	L	T	P	Cr.
Course Code: BME2153	3	1	0	4

Total Hours-60

Learning Outcomes On successful completion of this course, the students would be able to:

1. To understand the concepts of energy transformation, conversion of heat into work.
2. To acquire knowledge about the fundamentals of thermodynamic laws, the concept of entropy, and principles.
3. To understand how the change of state results in a process.
4. To understand the various gas laws, psychrometric properties and chart.
5. To learn the importance of thermodynamic cycles, and the derivation of efficiency.

UNIT-I **15 Hours**

Basics of thermodynamics:

System - Types of Systems - Control Volume - Macroscopic and Microscopic viewpoints - Thermodynamic Equilibrium- State, Property, Process, Cycle – Reversibility – Quasi static Process, Irreversible Process, Causes of Irreversibility – Work and Heat, Point and Path functions. Zeroth Law of Thermodynamics – Principles of Thermometry –Constant Volume gas Thermometer – Scales of Temperature – PMM I - Joule's Experiment – First law of Thermodynamics – Corollaries – First law applied to a Process – applied to a flow system
– Steady Flow Energy Equation.

UNIT-II **15 Hours**

Limitations of the First Law - Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, Carnot's principle, Carnot cycle and its specialties, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.

UNIT-III **15 Hours**

Pure Substances: p-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry. Perfect Gas Laws – Equation of State, specific and Universal Gas constants – Various Non-flow processes, properties, end states, Heat and Work Transfer, changes in Internal Energy – Throttling and Free Expansion Processes – Flow processes – Deviations from perfect Gas Model – Vander Waals Equation of State.

UNIT-IV **15 Hours**

Mixtures of perfect Gases : Mole Fraction, Mass fraction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes – Mole fraction , Volume fraction and partial pressure, Equivalent Gas constant, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases, Vapour, and Atmospheric air

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Engineering Thermodynamics, Special Edition. MRCET, McGrahill Publishers.*
- *Engineering Thermodynamics / PK Nag / TMH, III Edition*
- *Thermodynamics – J.P.Holman / McGrawHill*
- *Engineering Thermodynamics – Jones & Dugan*
- *Thermodynamics – An Engineering Approach – Yunus Cengel & Boles / TMH*
- *An introduction to Thermodynamics / YVC Rao / New Age*
- *Engineering Thermodynamics – K. Ramakrishna / Anuradha Publisher*

Course Title: Engineering Graphics & Drawing	L	T	P	Cr.
Course Code: BME2154	4	0	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand about engineering drawing applications and its importance in society.
2. Learn about the visual aspects of engineering design.
3. Discuss the engineering graphics standards.
4. Classify the concept of solid modeling techniques.

Course Content

UNIT I **22 Hours**

1. Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.
2. Orthographic Projections covering, Principles of Orthographic Projections- Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes.

UNIT II **22 Hours**

1. Projections of Regular Solids covering, those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.
2. Sections and Sectional Views of Right Angular Solids covering, 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)

UNIT III **24 Hours**

1. Isometric Projections covering, 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;
2. Overview of Computer Graphics covering, listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [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 CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

3. Customization & CAD Drawing consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

UNIT IV **22 Hours**

1. Annotations, layering & other functions covering applying dimensions to objects, applying annotations to drawings; 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); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software 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, multi view, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerance techniques; dimensioning and scale multi views of dwelling;
2. Demonstration of a simple team design project that illustrates Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerance; 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. Applying color coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modeling (BIM).

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Gill, P.S.(2001).Engineering Drawing. S.K; Kataria and Sons, Ludhiana.*
- *Bhatt, N.D.(2012). Engineering Drawing. Charotar Book Stall, TulsiSadan, Anand.*
- *French, T.E. and Vierck. C.J.(1993).Graphic Science. McGraw-Hill, New York.*
- *Zozzora, F.(1958). Engineering Drawing. McGraw Hill, NewYork.*
- *(Corresponding set of) CAD Software Theory and User Manuals*

Course Title: Computer Proficiency	L	T	P	Credits
Course Code: BME2155	2	0	0	2

Total hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Develop the ability to analyze and solve AI-related problems using intelligent agents, search strategies, optimization techniques, and decision-making frameworks, preparing for real-world applications in diverse fields
2. Acquire practical knowledge and skills in PC maintenance, security, and troubleshooting, including software updates, hardware cleaning, file management, and resolving basic technical issues to ensure efficient computer performance.
3. Develop foundational knowledge of computer networks, internet applications, web security, and troubleshooting, along with practical skills in using web browsers, search engines, and online collaboration tools.
4. Understand the latest trends in IECT, e-Governance, cloud and mobile computing, digital signatures, and their applications in governance and project management, ensuring a comprehensive foundation for modern digital systems.

Course Content

UNIT I **5 Hours**

Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

Problem solving Methods – Search Strategies- Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems – Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search – Game Playing – Optimal Decisions in Games – Alpha – Beta Pruning – Stochastic Games.

UNIT II **10 Hours**

PC Maintenance, Security & Troubleshooting: Computer Maintenance and Security: Overview of Computer Maintenance and Security, Inbuilt PC Security, tools, Securing documents, Antivirus, Upgrading Operating System and Application software. security; Cleaning the monitor, keyboard, CPU; Deleting unnecessary programs and files: Disk cleanup, deleting toolbars; defrag hard drive; Computer maintenance programs: Ccleaner, myDefrag, Spinrite etc.; Basic troubleshooting: restart computer, checking cables, uninstalling a software, start windows in safe mode etc.; Windows installation and upgrades, CPUs and motherboards, Memory systems, Expansion cards, Data storage devices, Ports, connectors, and cables, Printers and scanners, Display devices, Portable computers and devices, Networking, Security, Maintaining the PC environment.

UNIT III **10 Hours**

Basic of Computer Networks: LAN, WAN, Wi-Fi, Broadband, Bluetooth; Internet: Concept of Internet, Applications of Internet, Connecting to the Internet, Troubleshooting; WWW, TCP/IP, DNS, Search Engine; Key web browser features, Brief about switch, router, gateway; Various applications of Internet: e-mail, information gathering, retailing etc.; Methods of connecting to the Internet: Dial up, ISDN and broadband; Brief introduction to Internet addressing, Internet

protocols (TCP/IP, FTP and HTTP); Define and understand the terms: Internet Service Provider (ISP), Uniform Resource Locator (URL), hyperlink; Internet protocols (TCP/IP, FTP and HTTP); Define and understand the terms: Internet Service Provider (ISP), Uniform Resource Locator (URL), hyperlink; Know how to identify a secure web site:https, lock symbol; Security Considerations: Know about security threats from web sites like: viruses, worms, Trojan horses, spyware.

Using Favorites Folder, Downloading Web Pages, Printing Web Pages, Understanding URL, Set the web browser Home Page/Start page; Bookmark a web page, Delete a bookmark, Publishing on the Web, Downloading Web Pages, Printing Web Pages; Complete a web-based form using: text boxes, drop-down menus, list boxes, check boxes, radio buttons; Understanding benefits of Search Engines and Popular Search Engines (Google, Alta Vista, Excite); Commerce on Internet, Impact of Internet on Society.

Overview of use of search engines and e-mail messages; Instant Messaging and Collaboration: Using Instant messaging, Instant messaging providers, Use of Social Networking Sites viz. Facebook, Twitter etc.; Introduction to the concepts of IPv4 and IPv6 networks; Network troubleshooting.

UNIT IV **5 Hours**

Latest trends in IECT & e-Governance: Applications of IECT: e-governance, Multimedia and Entertainment; Project Management using IT tools & related applications; Introduction to Cloud Computing: What is cloud computing, Properties & Characteristics, Service models, Deployment models; Concepts of: IaaS (Infrastructure as a Service), PaaS (Platform as a Service), SaaS (Software as a service), DaaS (Desktop as a Service); Introduction to Mobile Computing, its components and characteristics; Digital signature: definition as per ITA 2000, how digital signature works; role of certifying authorities: Digital Certificates and their uses, Certifying Authority regulation in India, Obtaining a trial version of a Digital Certificate; legal aspect covering digital signatures in India; how to use digital signatures on electronic documents. Legal aspects covering digital signatures in India.

e-Governance: Definition of e-Governance, Pillars of e-Governance, Infrastructure for e-Governance, Mission Mode Projects (At least 5), Familiarization with terminology like change management, processing engineering, Govt. Processing engineering and Governance, e-Governance project life cycle, electronically delivery of services, messaging system and case study of any 5 public utility portal related with the Department (especially, public grievance redressal system, RTI, Vigilance, Department working and financial inclusion, linkage with Aadhar etc.)

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Stuart Russell and Peter Norvig. (2020). Artificial Intelligence: A Modern Approach. PHI.*
- *David L. Poole and Alan K. Mackworth. (2017). Artificial Intelligence: Foundations of Computational Agents. Cambridge University Press.*
- *Scott Mueller. (2015). Upgrading and Repairing PCs. QUE.*
- *Behrouz A. Forouzan. (2017). Data Communications and Networking. McGraw Hill.*

- *Thomas Erl et al. (2013). Cloud Computing: Concepts, Technology & Architecture. Pearson Education.*
- *Darrell M. West. (2005). Digital Governance: Leveraging Digital Technology for Governance, Growth and Inclusion. Princeton University Press.*
- *C.S.R. Prabhu. (2006). e-Governance: Concepts and Case Studies. PHI.*

Course Title: Computer Proficiency Lab	L	T	P	Credits
Course Code: BME2156	0	0	2	1

Total Hours: 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the concept of input and output devices of Computers
2. Study to use the Internet safely, legally, and responsibly.
3. discuss an operating system and its working, and solve common problems related to operating systems
4. Learn basic word processing, Spreadsheet and Presentation Graphics Software skills

Course Content

1. Various Components of a Computer.
2. Introduction to Microsoft Word & Presentation.
3. use 3D effects on prescribed presentation
4. Applications of MS-Office MS-Word, MS-Excel, MS-PowerPoint.
5. Create web pages using different tags.
6. Web Browser and E-Mail
7. Conversion of a word documents into PDF/ Image conversion using image file format.
8. Computer Hardware.

Course Title: Indian Constitution	L	T	P	Cr.
Course Code: BME2157	3	0	0	3

Total Hours-45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Identify and explore the basic features and modalities about Indian constitution.
2. Differentiate and relate the functioning of Indian parliamentary system at the center and state level.
3. Differentiate different aspects of Indian Legal System and its related bodies.
4. Discover and apply different laws and regulations related to engineering practices.
5. Correlate role of engineers with different organizations and governance models

Course Content

UNIT I 10 Hours

Introduction and Basic Information about Indian Constitution

Meaning of the constitution law and constitutionalism, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947,Enforcement of the Constitution, Indian Constitution and its Salient Features, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India.

UNIT II 12 Hours

Union Executive and State Executive: Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Judicial Activism, LokPal, Lok Ayukta, The Lokpal and Lok ayuktas Act 2013, State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts,

UNIT III 12 Hours

Introduction and Basic Information about Legal System: The Legal System: Sources of Law and the Court Structure: Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law, Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court). Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration. Contract law, Tort, Law at workplace.

UNIT IV 11 Hours

Intellectual Property Laws and Regulation to Information: Intellectual Property Laws: Introduction, Legal Aspects of Patents, Filing of Patent Applications, Rights from Patents, Infringement of Patents, Copyright and its Ownership, Infringement of Copyright, Civil Remedies for Infringement, Regulation to InformationIntroduction, Right to Information Act, 2005, Information Technology Act, 2000, Electronic Governance, Secure Electronic Records and Digital Signatures, Digital Signature Certificates, Cyber Regulations Appellate Tribunal, Offences, Limitations of the Information Technology Act.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Brij Kishore Sharma: Introduction to the Indian Constitution, 8th Edition, PHI Learning Pvt. Ltd.*
- *Granville Austin: The Indian Constitution: Cornerstone of a Nation (Classic Reissue), Oxford University Press.*
- *Subhash C. Kashyap: Our Constitution: An Introduction to India's Constitution and constitutional Law, NBT, 2018.*
- *Madhav Khosla: The Indian Constitution, Oxford University Press.*
- *PM Bakshi: The Constitution of India, Latest Edition, Universal Law Publishing.*
- *V.K. Ahuja: Law Relating to Intellectual Property Rights (2007)*
- *Suresh T. Viswanathan: The Indian Cyber Laws, Bharat Law House, New Delhi-88*

Course Title: Communication Skills -II	L	T	P	Credits
Course Code: BME2158	2	0	0	2

Total hours 30

Learning Outcomes: On successful completion of this course, the students would be able to:

1. Start conversations, respond appropriately, use visuals, and build vocabulary with various tools like synonyms and idioms.
2. Develop techniques for skimming, scanning, guessing meanings, and critical reading and master professional writing formats like resumes, emails, and technical reports.
3. Strengthen oral and written presentation skills with seminars, posters, and assignments.
4. Improve group dynamics, body language, and prepare with mock interviews.

Course Content

Unit I **5 Hours**

Fundamentals of Inter-personal Communication and Building Vocabulary:
Starting a conversation – responding appropriately and relevantly – using the right body language – Role Play in different situations & Discourse Skills- using visuals - Synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy, idioms and phrases, collocations & usage of vocabulary.

Unit II **10 Hours**

Reading Comprehension: General Vs Local comprehension, reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, critical reading& effective googling.

Writing Skills: Structure and presentation of different types of writing – letter writing/Resume writing/ e-correspondence/Technical report writing/ – planning for writing – improving one's writing

Unit III **8 Hours**

Presentation Skills: Oral presentations (individual and group) through JAM sessions/seminars/PPTs and written presentations through posters/projects/reports/ emails/assignments etc.

Unit IV **7 Hours**

Group Discussion and Interview Skills: Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conference and Mock Interviews.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning.

Suggested Readings:

- *M Asharaf Rizvi. (2022). Effective Technical Communication. McGraw Hill Education (India) Pvt. Ltd.*
- *Stephen Bailey. (2018). Academic Writing: A Handbook for International Students. Routledge.*
- *Shiv K. Kumar and Hemalatha Nagarajan. (2007). Learn Correct English – A Book of Grammar, Usage and Composition. Pearson.*
- *Aruna Koneru. (2016). Professional Communication. McGraw Hill Education (India) Pvt. Ltd.*
- *Meenakshi Raman & Sangeeta Sharma. (2009). Technical Communication. Oxford University*

Press.

- *Paul V. Anderson. (2007). Technical Communication. Cengage Learning pvt. Ltd. New Delhi.*
- *English Vocabulary in Use series, Cambridge University Press 2008.*
- *David A. McMurrey & Joanne Buckley. (2012). Handbook for Technical Communication. Cengage Learning.*
- *Leena Sen. (2009). Communication Skills. PHI Learning Pvt Ltd.*
- *Colm Downes. (2008). Job Hunting.Cambridge University Press.*
- *Aysha Vishwamohan. (2009). English for Technical Communication for Engineering Students. Tata McGraw Hill.*

Course Title: Human Values and Professional Ethics	L	T	P	Cr.
Course Code: VAC0002	2	0	0	2

Total Hours: 30

Course Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the essence of Indian ethos, cultural values and ethical principles derived from scriptures, integrating self-exploration with scientific inquiry.
2. Analyze human values, self-awareness and ethical decision-making by distinguishing between perspectives, ideologies and universal moral principles.
3. Evaluate constitutional values, global responsibilities and the role of ethics in citizenship while promoting inclusivity and social welfare.
4. Develop essential life skills, stress management techniques and holistic well-being through mindfulness, self-discipline and personality development.

Course Content

Unit-I Introduction to Indian Ethos **7 Hours**

Meaning of ethos and cultural essence of India, Scriptures as the base of the Indian Knowledge System (IKS), Integrating the two methodologies: interiorization process for self-exploration and exterior scientifc pursuit for the prosperity of world, The Law of Karma and Nishkama Karma (The Law of action and selfless action), Practical: Five hours of Yoga practice per week, Ethics through Music and Indian Poetry, Community Engagement

Unit-II Human Values and Ethics **8 Hours**

Knowing the Self and the universal values that we stand for. This is self-enquiry & self-discovery, Background conversations and deep listening, recognizing the assumptions that we make, the biases we have and the implications for ethical action. Self-identity: distinguishing and embracing oneself (and others) four profiles (inner potential, social, professional, personality), Distinguish ideology, perspectives beliefs from embodying values. Practical: Self discovery, self enquiry and Mindfulness, Yama & Niyama of Ashthang Yoga

Unit-III Constitutional Values, Global Responsibility & Skills for Youth **7 Hours**

Values embedded in the Preamble of the Indian Constitution, Integration of Human Rights and duties. Principles and responsibilities: as citizens of India, towards global environment, Loksangraha and Vasudhaiva Kutumbakam, Conscious Full Spectrum Response model. Distinguishing judgement from discernment, Practical: Development of concentration among students through music, fine arts, mathematics, sports, yoga and mindfulness

Unit-IV Integrated Personality and Well-being **8 Hours**

The three gunas (qualities of sattva—purity and harmony, rajas —activity and passion, tamas — darkness and chaos), the four antah-karanas (inner instruments) and panch kosha (five sheaths), Stress management, Oneness, non-duality and equanimity, Physical, mental, social and spiritual well-being. Practical: Talks on importance of the Ayurvedic concept of well-being and nutrition, sports activities.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Mahadevan, B., Bhat, V.R. and Nagendra, P.R.N. 2022. Introduction to Indian Knowledge System. Delhi: PHI.*
- *Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.*
- *Kashyap, Subhash C. 2019. Constitution of India. A handbook for students. New Delhi: National Book Trust.*
- *Dr. Awadesh Pradhan, Mahamana ke Vichara". (B.H.U., Vanarasi 2007)*
- *Harold Koontz & Heinz Weihrich, Essentials of Management, Tata McGraw Hill.*
- *Lama, D. 2012. Beyond Religion: Ethics for a Whole World. India: Harper Collins.*
- *Shrimad Bhagavad-Gita (Part of the Mahabharata). 1994. Gorakhpur: Gita Press. Swami Harshananda. 2000. The Birds' Eye View of the Vedas. Bangalore: Ramakrishna Math.*
- *Fontaine, D. K., Rushton, C. H. and Sharma, M. 2013. Cultivating Compassion and Empathy. In: M. Plews-Ogan and G. Beyt (Eds.), Wisdom Leadership in academic Health Science Centers-Leading Positive Change. London: Radcliffe Publishing.*
- *Blanchard, Kenneth and Peale, Norman Vincent. 1988. The Power of Ethical Management. New York: William Morrow and Company, Inc.*
- *Gandhi, Mohandas Karamchand. 1971. Pathway to God compiled by MS Deshpande. Ahmedabad: Navajivan Mudranalaya, Navjivan Trust.*
- *Gardner, H. 2006. Five Minds for the Future. Boston: Harvard Business School Press.*
- *Rodriguez, S. and Juvva, S. 2018. Embodying Universal Values and Ethical Leadership in Higher Education: Creating Change Agents for Social Transformation. In B. Chatterjee, A. Banerji and P. Arya (Eds.). Resolution to Resolve: Sustainability Practices in Industry and Education. New Delhi: Bloomsbury*
- *[ISBN: 978-938-74-7168-9]*
- *Sharma, M. 2017. Radical Transformational Leadership: Strategic Action for Change Agents. Berkeley, US: North Atlantic Books.*

Web Sources:

- *https://www.holy-bhagavad-gita.org/*
- *https://iksindia.org/*
- *NPTEL Course: Exploring Human Values: Visions of Happiness and Perfect Society*
- *https://ebooks.inflibnet.ac.in/hrmp01/*

Semester-III

Course Title: Mechanics Of Deformable Solids	L	T	P	Cr.
Course Code: BME3200	3	1	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Recognize various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components
2. Evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading
3. Analysis and design beams, shafts and hollow cylinders.

Course Contents

UNIT I — 15 Hours

Deformation of bars: Hooke's law, stress, strain, and elongation; Tensile, compressive and shear stresses in 2D solids; Elastic constants and their relations; Volumetric, linear and shear strains; Principal stresses and strain; Principal planes; Mohr's circle. Transverse loading on beams, point and distributed loads; Shear force and bend moment diagrams;

UNIT II — 13 Hours

Types of beam supports – simply supported, over-hanging, cantilevers, fixed and guided beams; Static determinacy and indeterminacy; Theory of bending of beams, pure bending stress distribution and neutral plane, second moment of area; Different cross-sections of beams; Shear stress distribution.

UNIT III — 17 Hours

Deflection of a beam using the double integration method; Computation of slopes and deflection in beams; Myosotis method for computing deflections and slopes.
Critical loads using Euler's theory; Different boundary conditions; Eccentric columns. Torsion stresses and deformation of circular and hollow shafts; Polar moment of area, stepped shafts; Deflection of shafts fixed at both ends; Stresses and deflection of helical springs.

UNIT IV — 15 Hours

Principle of virtual work; Minimum potential energy theorem; Castigliano's theorems; Maxwell reciprocity theorem. Axial and hoop stresses in cylinders subjected to internal pressure; Deformation of thin and thick cylinders; Deformation in spherical shells subjected to internal pressure; Combined thermo- mechanical stress; Examples and case studies (boilers).

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *E. P. Popov, "Engineering Mechanics of Solids," Pearson, 2015.*
- *Timoshenko and Gere, "Mechanics of Materials", CBS Publishers, 2011.*
- *R. Subramanian, "Strength of Materials," Oxford University Press, 2007.*
- *D.S. Bedi, "Strength of Materials", Khanna Book Publishing. 2022.*
- *D.S. Bedi, "Engineering Mechanics", Khanna Book Publishing. 2021.*
- *F. P. Been, R. Johnson Jr and J. J. Dewole, "Mechanics of Materials," Tata Mc Graw Hill,Delhi 2005.*
- *L.S Srinath, Advanced Mechanics of Solids, McGraw Hill, 2017.*

Course Title: Basic Electrical & Electronic Engineering	L	T	P	Cr.
Course Code: BME3201	3	0	0	3

Total Hours-45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Calculate and measure basic electrical quantities and parameters.
2. Use different electrical machines by making connections.
3. Use electrical safety devices in electrical circuit
4. Use relevant diode in different electronic circuits.
5. Use BJT and FET in various electronic circuits.
6. Use various types of sensors and transducers.

Course Contents

UNIT I **8 HOURS**

ELECTRICAL CIRCUITS

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law – Kirchhoff's Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state)

Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only)

.

UNIT II **12 Hours**

ELECTRICAL MACHINES

Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, Working principle and Applications of Transformer, Three phase Alternator, Synchronous motor and Three Phase Induction Motor..

UNIT III **15 Hours**

ANALOG ELECTRONICS

Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET,IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters

DIGITAL ELECTRONICS

Review of number systems, binary codes, error detection and correction codes, Combinational logic – representation of logic functions-SOP and POS forms, K-map representations – minimization using K maps (Simple Problems only)

UNIT IV **10 Hours**

MEASUREMENTS AND INSTRUMENTATION

Functional elements of an instrument, Standards and calibration, Operating Principle, types -Moving Coil and Moving Iron meters, Measurement of three phase

power, Energy Meter, Instrument Transformers-CT and PT, DSO- Block diagram-Data acquisition..

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *N.Mittle "Basic Electrical Engineering". Tata McGraw Hill Edition, New Delhi, 1990.*
- *A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2004.*
- *Jacob Millman and Christos C-Halkias, "Electronic Devices and Circuits", Tata McGraw Hill*
- *Edminister J.A. "Theory and problems of Electric Circuits" Schaum's Outline Series.*
- *McGraw Hill Book Compay, 2nd Edition, 1983.*
- *Hyatt W.H and Kemmerlay J.E. "Engineering Circuit Analysis", McGraw Hill*
- *Internatinal Editions, 1993.*
- *D. P. Kothari and I. J. Nagrath "Electric machines" Tata McGraw-Hill Education, 2004*
- *Millman and Halkias, "Integrated Electronics", Tata McGraw Hill Edition, 2004.*

Course Title: Basic Electrical & Electronic Engineering Lab	L	T	P	Cr.
Course Code: BME3202	0	0	2	1

Total Hours-30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Analysis of Resistive Circuits and Solution of resistive circuits with independent sources.
2. Understand the Two Terminal Element Relationships for inductors and capacitors and analysis of magnetic circuits.
3. Analysis of Single-Phase AC Circuits, the representation of alternating quantities and determining the power in these circuits.
4. Compare different types of Electrical machines and classify different electrical measuring equipment's and understanding their principles

Course Contents

List of Experiments

Electrical

1. Verification of ohms and Kirchhoff's Laws.
2. Load test on DC Shunt Motor.
3. Load test on Self-excited DC Generator
4. Load test on Single-phase Transformer
5. Load Test on Induction Motor

Electronics

6. Experiment on Transistor based application circuits (Inverting and non-inverting amplifier or switching circuits)
7. (Or)
8. Experiments on Operational Amplifier-based Inverting and non-inverting amplifier.
9. Experiments on ADC.
10. Experiments on 555 timer
11. Measurements
12. Study on function of DSO.
13. Measurement of Amplitude, Frequency, Time, Phase Measurement using DSO.

Course Title: Engineering Mechanics	L	T	P	Cr.
Course Code: BME3203	3	0	0	3

Total Hours-45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand vector representation of forces and moments in static equilibrium.
2. Learn to analyze rigid bodies under various force systems in static equilibrium.
3. Grasp the concepts of trusses, frames, and machines, and analyze their stability.
4. Explore friction forces and their effects on bodies in translational and rotational motion.
5. Understand particle motion, kinematics, and basic principles of dynamics for engineering systems.

Course Contents

UNIT I — 10 Hours

Transformation of scalars and vectors under Rotation transformation; Forces in Nature; Newton's laws and its completeness in describing particle motion; Form invariance of Newton's Second Law; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates.

UNIT II — 12 Hours

Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical, parabolic and hyperbolic orbits; Kepler problem; Application: Satellite manoeuvres; Non-inertial frames of reference; Rotating coordinate system: Five- term acceleration formula. Centripetal and Coriolis accelerations; Applications: Weather systems, Foucault pendulum;

UNIT III — 13 Hours

Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly- damped oscillators; Forced oscillations and resonance. Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinatesystem rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body motion;

UNIT IV **10 Hours**

Introduction to three-dimensional rigid body motion — only need to highlight the distinction from two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner: e.g. Rod executing conical motion with center of mass fixed — only need to showthat this motion looks two-dimensional but is three-dimensional, and two-dimensional formulation fails.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *AICTE's Prescribed Textbook: Physics (Introduction to Mechanics) with Lab ManualISBN: 978-93-91505-059*
- *Engineering Physics, Bhattacharya & Nag, 2021.*
- *Engineering Mechanics, DS Bedi & MP Poonia, 2018.*
- *Engineering Mechanics, 2nd edition — MK Harbola, 2018.*
- *Introduction to Mechanics — MK Verma, 2008.*
- *An Introduction to Mechanics — D Kleppner & R Kolenkow, 1973.*
- *Principles of Mechanics — JL Synge & BA Griffiths, 1959.*
- *Mechanics — JP Den Hartog, 1961.*
- *Engineering Mechanics - Dynamics, 7th ed. - JL Meriam, 2012.*
- *Mechanical Vibrations — JP Den Hartog, 1936.*
- *Theory of Vibrations with Applications — WT Thomson, 1966.*

Course Title: Applied Thermodynamics	L	T	P	Cr.
Course Code: BME3204	3	1	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand of various practical power cycles and heat pump cycles.
2. Analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors
3. Understand phenomena occurring in high speed compressible flows
4. Analyze and interpret compressor and steam turbines.

Course Contents

UNIT I **13 Hours**

IC Engines – SI, CI, two- and four-stroke engines, MEP, efficiency and specific fuel consumption, conventional and alternative fuels, pressure-crank angle diagram, carburetor and fuel injection systems.

UNIT II **14Hours**

Steam Power Plant – Reheat, regenerative steam power cycles, low temperature power cycles, ideal working fluid and binary/multi-fluid cycles; Types of boilers and their attachments, Steam Turbine types and analysis using velocity triangles. UNIT III 16 Hours

Gas turbine (Brayton) cycle; description and analysis. Regenerative gas turbine cycle. Intercooling and reheating in gas turbine cycles. Introduction to Jet Propulsion cycles.

UNIT IV **14Hours**

Psychometric properties of Air, Psychometric Chart, Analyzing Air-conditioning Processes; Heating, Cooling, Dehumidification and Humidification, Evaporative Cooling. Adiabatic mixing of two moist air streams. Cooling towers.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.*
- *Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India*
- *Moran, M. J. and Shapiro, H. N., 1999, Fundamentals ofEngineering Thermodynamics, JohnWiley and Sons.*
- *Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd*

Course Title: Indian Metallurgy	L	T	P	Cr.
Course Code: IKS0015	2	0	0	2

Total Hours: 30

Course Learning Outcomes: On the completion of the course, the students will be able to

1. Understand the significance of metallurgy in ancient Indian texts.
2. Analyze historical accounts of Metals and metal working. Mining and manufacturing of different minerals.
3. Explore the significance and wide prevalence of ironsmiths.
4. Assess European techniques impact on the high quality and quantity on Indian iron and steel

Course Content

Unit-I **7 Hours**

Introduction about the metallurgy, Important specimens of metal workmanship preserved/found in different parts of India.

Unit – II: **7 Hours**

Metals and metal working. Mining and manufacture in India of Zinc, Iron, Copper, Gold, etc., from ancient times.

Unit – III: **8 Hours**

The significance and wide prevalence of ironsmith and other metal workers in the pre-modern era.

Unit – IV: **8 Hours**

European techniques impact on the high quality and quantity of Indian iron and steel in the 18/19th centuries.

Transactional Mode

Seminars, Group discussion, Team teaching, Focused group discussion, Assignments, Project-based learning, Simulations, reflection and Self-assessment

Suggested Readings

- *Knowledge Traditions and Practices of India, Book code 11151, Chemistry and Metallurgy in India, Class XI, NCERT Publication*
- *Jyoti Pathak, Chemistry in Ancient India, International Research Journal of Management Science & Technology, Vol 7 Issue 3, 2016, ISSN 2250 – 1959 (0nline) 2348 – 9367 (Print)*
- *Saxena, R. C., S.L. Choudhary, and Y.L. Nene. Textbook on Ancient History*

Course Title: Professional Communication	L	T	P	Credits
Course Code: BME3205	2	0	0	2

Total hours 30

Course Learning Outcomes: After completion of this course, student will be able to:

1. Use English Language effectively in spoken and written forms.
2. Comprehend the given texts and respond appropriately.
3. Communicate confidently in various contexts and different cultures.
4. Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Course Content

UNIT I **10 Hours**

Introduction to Soft Skills– Hard skills & soft skills – employability and career Skills—Grooming as a professional with values—Time Management—General awareness of Current Affairs.
Self-Introduction-organizing the material – Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice - presenting the visuals effectively – 5 minute presentations.

UNIT II **10 Hours**

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics – brainstorming the topic — questioning and clarifying -GD strategies- activities to improve GD skills.

UNIT III **5 Hours**

Interview etiquette – dress code – body language – attending job interviews- telephone/skype interview – one to one interview & panel interview – FAQs related to job interviews.

UNIT IV **5 Hours**

Recognizing differences between groups and teams- managing time – managing stress – networking professionally – respecting social protocols-understanding career management – developing a long-term career plan – making career changes.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Butterfield. (2015). Jeff Soft Skills for Everyone. Cengage Learning: New Delhi.*
- *E. Suresh Kumar et al. (2015). Communication for Professional Success. Orient Blackswan: Hyderabad.*
- *Interact English Lab Manual for Undergraduate Students. Orient Black Swan: Hyderabad, 2016.*
- *Raman, Meenakshi and Sharma. S. (2014). Professional Communication. Oxford University Press: Oxford.*
- *S. Hariharanetal. Soft Skills. (2010). MJP Publishers: Chennai.*

Course Title: Sustainable Development	L	T	P	Cr.
Course Code: BME3206	3	0	0	3

Total Hours: 45

Course Learning Outcomes: On the completion of the course, the students will be able to

1. Elucidate the basics of sustainable development, sustainable engineering and its role in engineering
2. Application of Sustainable Engineering Concepts and Principles in Engineering
3. Apply the Principle, and methodology of Life Cycle Assessment Tool to engineering systems
4. Understand integration methods of sustainability to Engineering Design

Course Content

Unit-I **7 Hours**

Sustainable Development and Role of Engineers: Introduction, Why and What is Sustainable Development, THE SDFs, Paris Agreement and Role of Engineering, Sustainable Development and the Engineering Profession, Key attributes of the Graduate Engineering Sustainable Engineering Concepts: Key concepts – Factor 4 and Factor 10: Goals of sustainability, System Thinking, Life Cycle Thinking and Circular Economy

Unit-I **8 Hours** Sustainable Engineering and Concepts, Principles and Frame Work: Green Economy and Low Carbon Economy, Eco Efficiency, Triple bottom Line, Guiding principles of sustainable engineering, Frameworks for sustainable Engineering. Tools for sustainability Assessment: Environmental Management System, Environmental Auditing, Cleaner Production Assessment, Environmental Impact Assessment, Strategic Environmental Assessment Life Cycle Management

Unit-I **8 Hours**

Fundamentals of Life Cycle Assessment Why and What is LCA, LCA Goal and Scope, Life cycle inventory, Life Cycle Impact Assessment, Interpretation and presentation of Results, Iterative Nature of LCA, Methodological Choices, LCI Databases and LCA Software's, Strength and Limitations of LCA.

Unit-I **7 Hours** Environmental Life Cycle Costing, Social Life Cycle Assessment, and Life Cycle Sustainability Assessment: Introduction, Environmental Life Cycle Costing, Social Life Cycle Assessment, Life Cycle Sustainability, LCA Applications in Engineering: Environmental Product Declarations and Product Category Rules, Carbon and Water Foot Printing, Energy systems, Buildings and the Built Environment, Chemical and Chemical Production Food and Agriculture Introduction to Environmental Economics

Transactional Mode

Seminars, Group discussion, Team teaching, Focused group discussion, Assignments, Project-based learning, Simulations, reflection and Self-assessment

Suggested Readings

- *Franco, I.B. and Tracey, J. (2019), "Community capacity-building for sustainable development: Effectively striving towards achieving local community sustainability targets", International Journal of Sustainability in Higher Education, Vol. 20 No. 4, pp. 691-725*
- *Our Common Journey: A Transition Toward Sustainability. National Academy Press, Washington D.C. Soubbotina, T. P. 2004.*
- *Elliott, Jennifer. 2012. An Introduction to Sustainable Development. 4th Ed. Routledge, London.*
- *Rogers, Peter P., Kazi F. Jalal, and John A. Boyd. "An introduction to sustainable*
- *development." (2012).*
- *Sachs, J. D. 2015. The Age of Sustainable Development. Columbia University Press, New York.*
- *Soubbotina, Tatyana P. 2004. Beyond Economic Growth: An Introduction to Sustainable Development. WBI learning resources series. Washington DC ; World Bank.*
- *Kerr, Julie. Introduction to energy and climate: Developing a sustainable environment. CRC Press, 2017.*
- *Saito, Osamu. Sharing Ecosystem Services. Springer Singapore, 2020.*
- *Nhamo, Godwell, and Vuyo Mjimba. Sustainable Development Goals and institutions of higher education. Springer, 2020.*

Semester: IV

Course Title: Fluid Mechanics & Hydraulic Machines	L	T	P	Cr.
Course Code: BME4250	3	0	0	3

Total Hours-45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the concept of Comprehend the fundamental properties and behavior of fluids, including viscosity, pressure, and buoyancy.
2. Analysis the Master fluid flow principles, equations of motion, and Bernoulli's theorem for analyzing fluid behavior in various scenarios.
3. Learn techniques to measure fluid flow rates and pressures, and explore methods for controlling fluid flows.
4. Apply fluid mechanics principles to solve real-world engineering problems, from pipe design to energy conversion in hydraulic systems.

Course Contents

UNIT I **12 Hours**

Definition of fluid; Newton’s law of viscosity; Units and dimensions; Physical properties of fluids; Control volume; Continuity equation and momentum equation; Incompressible flow; Bernoulli’s equation and its applications. Dimensionally homogeneous equations; Buckingham Pi Theorem; Calculation of dimensionless parameters. Similitude and complete similarity; Model scales; Basic boundary layer theory and analysis.

UNIT II **11 Hours**

Different approaches; Reynolds transport theorem; Flow visualization; Types of flow; Strain rate, stream line, streak line, path lines and stream tubes; Continuity equation in Cartesian coordinates in 3D forms; Velocity and acceleration of fluid particles; Velocity potential function and stream function. Momentum equation; Nervier Stoke equation; Development of Euler's equation; Bernoulli's equation and application; Steady and unsteady flow through orifice; Orifice placed in pipe; Venturimeter; Flow over triangular and rectangular notches; Pitot tube.

UNIT III **12 Hours**

Viscous/Laminar flow – Plane Poiseuille flow and Coutte flow; Laminar flow through circular pipes; Loss of head and power absorbed in viscous flow; Turbulent flow – Reynolds experiment; Frictional losses in pipe flow; Shear stress in turbulent flow; Major andminor losses (Darcy's and Chezy's equation); Flow through siphon pipes; Branching pipes and equivalent pipe.

UNIT IV **12 Hours**

Euler's equation; Theory of Rotodynamic machines; Various efficiencies; Velocity components at entry and exit of the rotor; Velocity triangles; Centrifugal pumps – working principle, work done by the impeller and performance curves; Cavitation in pumps; Reciprocating pump – working principle. Classification of water turbines; Heads and efficiencies; Velocity triangles; Axial, radial and mixed flow turbines; Pelton wheel, Francis turbine and Kaplan turbines – working and design principles.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *S.S. Rattan, Fluid Mechanics & Hydraulic Machines, Khanna Book Publishing, 2019.*
- *P.J. Pritchard, A.T. McDonald and R.W. Fox, "Introduction to Fluid Mechanics," Wiley India,2012.*
- *F.M. White, "Fluid Mechanics," Tata McGraw Hill, 2011.*
- *S. K. Som, G. Biswas and S. Chakraborty, "Introduction to Fluid Mechanics and Fluid Machines,Tata McGraw Hill, 2017.*
- *R. K. Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines," Laxmi Publication, 2005.*
- *Mechanics of Fluids, Shames, McGraw Hill Book Co., New Delhi, 1988*

Course Title: Numerical Methods	L	T	P	Cr.
Course Code: BME4251	3	1	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Find roots of a nonlinear equation, and interpolate a function and analyze the variety of direct and iterative methods for solving systems of linear equations.
2. Identify different methods to find the approximate integration by quadrature rules.
3. Solve ordinary and partial differential equations by finite difference methods.
4. Solve initial and boundary value problems by using Laplace and Fourier transform techniques.
5. Understand the approximation of a function in terms of Sine and Cosine functions.

Course Contents

UNIT I **15 Hours**

Finite Differences and Interpolation: Difference Table and its usage. The difference operators Δ, ∇ and the operator E. Interpolation with equal intervals, Newton's advancing difference formula. Newton's backward difference formula. Interpolation with unequal intervals. Newton's divided difference formula. Lagrange's interpolation formula.

UNIT II **13 Hours**

Gauss forward and backward interpolation formula, . Inverse interpolation by (i) Langrange's (ii) Methods of successive e approximation. Numerical solution of simultaneous equations and Eigen value problem: Gauss elimination method, Gauss Jordon method, Gauss- Jacobi and Gauss- Seidel iteration methods

UNIT III **16 Hours**

Numerical solution of algebraic and Transcendental Equations and Numerical differentiation & Numerical Integration: Graphic Method, Regula-Fast method, Balzano's Process of bisection of intervals, Newton-Raphson Method and its geometrical significance. Numerical differentiation of a function. Differential coefficient of a function in terms of its differences. Numerical Integration, General Quadrature Formula, Trapezoidal rule, Simpson's one-third and three-eight rules.

UNIT IV **16 Hours**

Difference Equations and Numerical Solution of ordinary differential equations: Linear homogeneous and non-homogeneous difference equations of order n with constant coefficient, and their solution, methods of undetermined coefficient. Numerical solution of ordinary differential equations, Picard's method. Taylors series method, Euler's method, Runge-Kutta Method. Numerical solution of simultaneous equations and Eigen value problem: Gauss elimination method, Gauss Jordon method, Gauss- Jacobi and Gauss- Seidel iteration methods, power methods for solving Eigen value problems.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Jain M. K., Iyengar S. R., Jain R. K., Numerical Methods for Scientists and Engineering, Wiley Eastern Ltd.*
- *Scarborough S. C., Mathematical Numerical Analysis, Oxford and IBH publishing Company.*
- *Sastry S. S., Introductory methods in Numerical Analysis, Prentice Hall of India.*
- *Jain M. K., Numerical Solution of Differential equations, New Age International Publishers.*
- *Stanton R. G., Numerical Methods for Science & Engineering, Prentice Hall of India.*

Course Title: Kinematics & Dynamics of Machines	L	T	P	Cr.
Course Code: BME4252	3	1	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Develop proficiency in analyzing motion patterns and geometrical relationships in machine mechanisms.
2. Understand the concepts of velocity and acceleration analysis, determining dynamic behavior of machine components.
3. Learn techniques to analyze forces and torques in moving mechanisms, aiding in design and optimization.
4. Apply kinematics and dynamics principles to assess the performance, efficiency, and safety of machine systems.

Course Contents

UNIT I **15 Hours**

Definition and types of joints; Lower and higher pairs; Classification of mechanisms based on function and constraints; Common mechanisms such as slider crank and 4-bar mechanisms and their inversions; Quick return mechanism, Straight line generators, rocker mechanisms, universal joints, steering mechanisms, etc.

UNIT II **15 Hours**

Degree of freedom and Grübler's formula; Grashof's rule and rotatability limits; Mechanical advantage; Transmission angle; Limit positions. Graphical synthesis of dyads and crank-rocker for two- and three-position synthesis for path and motion generation. Displacement, velocity, and acceleration analysis; Velocity analysis using instantaneous centers; Position, velocity and acceleration analysis using loop closure equations; Coincident points; Coriolis component of acceleration.

UNIT III **15 Hours**

Two & three force members; Force & moment equilibrium; Inertial forces; Equations of motion for force-bar and slider-crank mechanisms. Classification and terminology; Displacement, velocity, acceleration and jerk diagrams; Uniform velocity, parabolic, simple harmonic and cycloidal motions; Derivatives of follower motions; Circular and tangent cams; Pressure angle and undercutting; Graphical and analytical disc cam profile synthesis for roller and flat face followers.

UNIT IV **15 Hours**

Involute and cycloidal profiles; gear parameters; Fundamental law of gearing

and conjugate action; Spur gear contact ratio and interference; Helical, bevel, worm, rack & pinion gears; Epicyclic and regular gear train kinematics; Force analysis of spur, helical, bevel and worm gearing.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Thomas Bevan, "Theory of Machines," CBS Publishers & Distributors, 2005.*
- *W. L. Cleghorn, "Mechanisms of Machines," Oxford University Press, 2005.*
- *R. L. Norton, "Kinematics and Dynamics of Machinery," Tata McGraw Hill, 2009.*

Course Title: Engineering Materials & Applications	L	T	P	Cr.
Course Code: BME4253	3	1	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

2. Select the range of engineering materials, their mechanical properties and applications
3. Understand the various methods to measure the mechanical properties of materials
4. Learn how to improve the properties of ferrous alloys through various heat treatments

Course Contents

UNIT I — 15 Hours

Metals, plastics, ceramics and composites; Relevant properties (physical, mechanical, thermal, electrical, chemical), cost; Range of applications; Material designation and standards; Ashby diagrams; Selection criteria and process. Tensile, compression, torsion, fatigue, fracture and wear 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 measurement their relation to strength; SN curve, endurance and fatigue limits; Introduction to non-destructive testing (NDT).

UNIT II — 15 Hours

Iron and steel; Stainless steel and tool steels; Copper & its alloys – brass, bronze& cupro-nickel; Aluminium & Al-Cu-Mg alloys; Nickel based superalloys & Titanium alloys; Phase diagrams and interpretation of microstructure; Iron Iron-carbide phase diagram and cooling (TTT) diagrams. Heat treatment of Steel; Annealing, tempering, normalizing, spheroidising, austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening

UNIT III — 18 Hours

Polymers – Classification and applications; Polymerization techniques; *Ceramics* – Oxide ceramics, ceramic insulators, bio-ceramics and Glasses; *Composites* – Reinforcement, matrix, metal matrix composites, ceramic composites, polymer composites; Other advanced materials – biomaterials, optical materials, high temperature materials, energy materials, and nanomaterials.

UNIT IV **12 Hours**

Conducting and resisting materials – types, properties and applications; *Semiconducting materials* – properties and applications; *Magnetic materials* – Soft and hard magnetic materials and applications; *Superconductors and dielectric materials* – properties and applications; Smart materials; Sensors and actuators; Piezoelectric, magnetostrictive and electrostrictive materials.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *W. D. Callister, "Materials Science & Engineering," Wiley India, 2014.*
- *K. G. Budinski and M.K. Budinski, "Engineering Materials", PHI India, 2002.*
- *V. Raghavan, "Material Science and Engineering', PHI India, 2015.*

Course Title:	Fluid Mechanics & Hydraulic Machines Lab	L	T	P	Cr.
Course Code:	BME4254	0	0	2	1

Total Hours-30

Learning Outcomes:

After completion of this course, the learner will be able to measure various properties of fluids and characterize the performance of fluid machinery.

Course Contents

1. Measurement of Coefficient of Discharge of given Orifice and Venturi meters
2. Determination of the density & viscosity of an oil and friction factor of oil flow in a pipe
3. Determination of the performance characteristics of a centrifugal pump
4. Determination of the performance characteristics of Pelton Wheel
5. Determination of the performance characteristics of a Francis Turbine
6. Determination of the performance characteristics of a Kaplan Turbine

Course Title: Report Writing	L	T	P	Cr.
Course Code: BME4255	2	0	0	2

Total hours 30

Course Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain the basic related to writing the reports.
2. Understanding the concepts related to formatting and structuring the report.
3. To comprehend the concept of proofreading, proposals and practice.

Course Content

UNIT I **8 Hours**

Introduction: An introduction to writing technical reports, technical sentences formation, using transitions to join sentences, Using tenses for technical writing.

Planning and Structuring: Planning the report, identifying reader(s), Voice, Formatting and structuring the report, Sections of a seminar/technical report, Minutes of meeting writing.

UNIT II **7 Hours**

Drafting report and design issues: The use of drafts, Illustrations and graphics.

Final edits: Grammar, spelling, readability and writing in plain English: Writing in plain English, Jargon and final layout issues, Spelling, punctuation and Grammar, Padding, Paragraphs, Ambiguity.

UNIT III **9 Hours**

Proofreading and summaries: Proofreading, summaries, Activities on summaries. Presenting final reports: Printed presentation, Verbal presentation skills, Introduction to proposals and practice. Using word processor: Adding a Table of Contents, Updating the Table of Contents, Deleting the Table of Contents, Adding an Index, Creating an Outline, Adding Comments, Tracking Changes, Viewing Changes, Additions, and Comments, Accepting and Rejecting Changes

UNIT IV **6 Hours**

Using word processor: Working with Footnotes and Endnotes, Inserting citations and Bibliography, Comparing Documents, Combining Documents, Mark documents final and make them read only., Password protect Microsoft Word documents., Using Macros.

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property.

Transaction Mode

Lecture, e-Team Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Meenakshi R and Sangeeta S. (2008). Technical Communication- Principles & Practice. Oxford.*
- *B.N. Basu. (2008). Technical writing. PHI learning.*
  - *Alok J, Pravin S.R. Bhatia, A.M. Sheikh. (2006). Professional Communication Skills. S Chand.*
- *Andrea J Rutherford. (2001). Basic Communication Skills for technology. Pearson.*
- *T. Ramappa. (2008). Intellectual Property Rights Under WTO, S. Chand Publishers.*
- *R. P. Merges, P. S. Menell, Mark A. Lemley. (1997). Intellectual Property in New Technological Age.*

Webo-graphy:

- *https://www.udemy.com/course/reportwriting/*
- *https://www.udemy.com/course/professional-business-english-and-technical-report-writing/*
- *https://www.udemy.com/course/betterbusinesswriting/*

Course Title: Indian Agriculture	L	T	P	Cr.
Course Code: IKS0009	2	0	0	2

Total Hours: 30

Course Learning Outcomes : On the completion of the course, the students will be able to

1. Understand the significance of agriculture and irrigation in ancient Indian texts.
2. Analyze historical accounts of Indian agriculture by Greek historians and travelers.
3. Explore ancient water management systems and advanced agricultural technologies.
4. Assess agricultural productivity in medieval and early modern India through historical reports.

Course Content

Unit-I **7 Hours**

Introduction, the significance of agriculture and irrigation as emphasised in the Ramayana, Mahabharata and other texts.

Unit – II: **7 Hours**

Mention of Indian agriculture by the Greek historians and later travellers. Significance of agriculture and irrigation for the kings of Indian tradition.

Unit – III: **8 Hours**

Major water-bodies of the ancient times. The Ery system of south India. Excellence of Indian agricultural technologies as observed by more recent European observers.

Unit – IV: **8 Hours**

Productivity of Indian agriculture in medieval Thanjavur and eighteenth-century Allahabad, Chengalpattu, etc. Indian attitude towards agriculture, based on Walker and later reports.

Transactional Mode

Seminars, Group discussion, Team teaching, Focused group discussion, Assignments, Project-based learning, Simulations, reflection and Self-assessment

Suggested Readings

- *Srivastava, Vinod Chandra. History of Agriculture in India, up to c. 1200 AD. Vol. 5. Concept Publishing Company, 2008.*
- *Buckley, Robert Burton. The Irrigation Works of India. E. & FN Spon, 1905.*
- *Sunil Kumar. Agriculture in Ancient India. Shivalik Prakashan.*
- *Saxena, R. C., S.L. Choudhary, and Y.L. Nene. Textbook on Ancient History of Indian Agriculture. Munshiram Manoharlal Publishers.*

Course Title: IC Engine & Automobile Engineering	L	T	P	Cr.
Course Code: BME4256	4	0	0	4

Total Hours-60

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Understand the different types of reciprocating internal combustion engines (ICE), their typical design features and performance characteristics.
2. Analyze the power cycle of internal combustion engines using ideal gas cycles, air cycles, and fuel-air cycles. Compute indicated power and thermal efficiency.
3. Illustrate the gas exchange process and power boosting by means of turbo charging.
4. Solve engine heat transfer problems and its relation to thermal loading of engine components and cooling.
5. Examine the rate of heat release based on measured dynamic cylinder pressure.

Course Content

UNIT I **13 Hours**

Introduction

Classification of IC Engine, Two Stroke and Four Stroke cycle Engines, Difference between C.I. and S.I. Engines, Engine Design and Operating Parameters, Fuels and Their Properties, Stoichiometric and Actual Air Requirements, Flue Gas Analysis.

UNIT II **16 Hours**

Combustion In S.I.& C.I Engines

Combustion in S.I. Engines, Flame Front Propagation, Flame Speed, Ignition Delay, Abnormal Combustion, Combustion Chambers for S.I. Engines.Combustion in C.I. Engines, Ignition Delay, combustion Knock, Combustion Chamber for C.I. Engines, Fuel Injection Testing.

UNIT III **16 Hours**

Performance Parameters &Emissions

Parameters, Engine Power, Engine Efficiencies, Type Of Tests And Characteristic Curves, Variables Affecting Performance Characteristics, Methods of Improving Engine Performance, Engine Economy, Air Pollution Due To IC Engines, Engine Emissions, Particulates, Emission Control Methods, EGR (Exhaust Gas Recirculation),

UNIT II **15 Hours**

Carburettion, Lubrication, Cooling and Ignition Systems

Simple and Complex Carburettors, Gasoline Injection, Combustion Design For S.I. Engines, Friction And Lubrication, Types Of Lubrication

Systems, Engine Cooling, Ignition Systems, Magneto And Battery Ignition Systems, Ignition Timing.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Heywood, B.J.(1988). Internal Combustion Engine Fundamentals. Tata McGraw Hill Book Co.*
- *Richard, S.(1985). Introduction to Internal Combustion Engines. Palgrave Macmillan.*
- *Pulkrabek, W.W.(2004). Engineering Fundamentals of the Internal Combustion Engine. Prentice Hall International, Inc.*
- *Somasundaram, S.L.(1996). Thermal Engineering. New Age International Publishers.*
- *Kumar, D.S. &Vasandhani, V.P.(1996). Heat Engineering.New Delhi Metropolitan Book Co. Pvt. Ltd.*
- *Mathur, R.P. & Sharma, M.L.(1994). A Course in IC Engine.Dhanpat Rai & Sons. NDelhi.*
- *Ganesan, V.(2003). Internal Combustion Engine. Tata McGraw Hill*

Course Title: Energy Conservation And management	L	T	P	Cr.
Course Code: BME4257	4	0	0	4

Total Hours- 60

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Calculate the efficiency of various thermal utilities.
2. Develop the suitable energy monitoring system to analyze and optimize the energy consumption in an organization.
3. Improve the thermal efficiency by designing suitable systems for heat recovery and co-generation.
4. Examine the cost- benefit analysis of various investment alternatives for meeting the energy needs of the organization.
5. Encourage the employees of the organization for various methods of energy conservation for implementation.

Course Content

UNIT I **15 Hours**

Need for Energy Conservation, Its Potentials, Fiscal Incentives, Primary Energy Sources Such as Coal, Gas, Oil, Nuclear Fuel

UNIT II **15 Hours**

Optimum Use of Prime Movers for Power Generation Such As Steam Turbines, Gas Turbines, Diesel and Gas Engines, Energy Intensive Industries i.e. Iron and Steel, Aluminum, Pulp and Paper, Textile and Oil Refineries and Their Energy Usage Pattern.

UNIT III **15 Hours**

Plant: Good Housekeeping, Measures in Air Conditioning, Boilers, Combustion System, Steam, Furnaces and General Awareness, Energy Audit, Methodology And Analysis, Energy Conservation Case Studies In Air Conditioning, Boiler And Burners

UNIT II **15 Hours**

Waste Heat Recovery Systems i.e. Recuperates, Economizers Waste Heat Boilers, Heat Pipe Heat Exchangers, Regenerators etc. Energy Storage Systems Thermal Storage, Insulation, Refractory, Specialized Processes such As Dielectric & Micro Wave Heating, Electronic Beam Welding, Fluidized Bed Technology, Laser as a Welding Tool, Alternative Sources of Energy.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and

Cooperative Learning.

Suggested Readings:

- *Reay, D.A.(1977). Industrial Energy Conservation Handbook.Pergamon Press.*
- *Richard, G.(1982). Process Energy Conservation (Chemical Engineering). Tata McGrawHill Publication Co.*

Semester: V

Course Title: Machine Element & System Design	L	T	P	Cr.
Course Code: BME5300	3	0	0	3

Total Hours-45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Develop the ability to choose appropriate materials and components for designing reliable and efficient mechanical systems.
2. Understand design factors such as stress analysis, fatigue, wear, and optimization for safe and durable machine elements.
3. Learn various methods of joining components, including welding, fasteners, and adhesives, while considering their structural integrity.
4. Familiarize yourself with industry standards and codes to ensure compliance and safety in machine element design.

Course Contents

UNIT I — 11 Hours

Anatomy of machines; Functional dissection of motorcycle, washing machine, sewing machine, etc. into machine elements including gears, rack and pinions, cams, chains, belts, pulleys, flywheels, bearings, shafts, keys, brakes, etc.; Design considerations – Limits, fits and standardization; Friction and lubrication. Force analysis of machine elements and machine systems; Application to power screws and couplings, clutches, and brakes.

UNIT II — 10 Hours

Static failure theories including normal stress theory, shear stress theory, distortion energy theory; von Mises stress; Factor of safety; Stress concentration factors; Fatigue failure theories: mean and alternating stresses, yield, ultimate, and endurance strength; Goodman, Gerber, and Soderberg lines.

UNIT III — 13 Hours

Springs – Helical compression, tension, torsional and leaf springs; Fasteners – threaded fasteners, bolted joints, preloaded bolts, rivets and welded joints; Shafts
– shafts under static and fatigue loadings; Keys; Sliding and rolling contact bearings; Transmission elements – transmission ratio and efficiency of spur, helical, bevel and worm gears; belt and chain drives; Flywheels.

UNIT IV **11 Hours**

Single degree-of-freedom systems; Natural frequency and critical damping; Forced vibration; Resonance; Balancing of reciprocating and rotating masses; Torsional vibration and critical speeds of shafts. Case studies on automobile suspensions, automatic transmissions, material conveyor systems, construction machinery, etc.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Shigley, J.E. and Mischke, C.R., "Mechanical Engineering Design," McGraw-Hill, 1989.*
- *Deutschman, D., & Wilson, C.E., "Machine Design Theory & Practice," Macmillan, 1992*
- *Juvinal, R.C., "Fundamentals of Machine Component Design," John Wiley, 1994.*
- *Spottes, M.F., "Design of Machine elements," Prentice-Hall India, 1994.*
- *R. L. Norton, "Mechanical Design – An Integrated Approach," Prentice Hall, 2009.*
- *Sadhu Singh, "Machine Design", Khanna Book Publishing, 2021.*
- *Sadhu Singh, "Machine Design Data Book", Khanna Book Publishing, 2022.*

Course Title: MANUFACTURING PROCESSES	L	T	P	Cr.
Course Code: BME5301	3	0	0	3

Total Hours-45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand various manufacturing methods to transform raw materials into finished products through shaping, joining, and finishing.
2. Learn the principles and applications of machining processes such as turning, milling, drilling, and grinding.
3. Examine the Master forming techniques like forging, casting, and forming to create complex shapes with desired properties.
4. Explore methods like welding, soldering, and adhesive bonding to efficiently join components into functional assemblies.

Course Contents

UNIT I — 10 Hours

Introduction: concept of manufacturing, need, scope, advantages, limitation, application, materials and manufacturing, classification of manufacturing, process capabilities, selection, break even analysis of manufacturing processes.

Casting: approach, steps, pattern, molding, gate and riser, melt treatment, solidification, casting processes: sand mould, shell mould, permanent mould casting, casting defect and their remedy

UNIT II — 13 Hours

Forming: approach, hot and cold forming, rolling, forging, extrusion, drawing, sheet metal forming, press, dies, types of dies and die set sheet metal operations punching, blanking, notching, nibbling.

Joining: approach, need, principle of fusion welding, gas welding, thermit welding, arc welding common arc welding processes, resistance welding, weldability of metals, solidification of weld, weld discontinuities and their remedy

UNIT III — 12 Hours

Machining: approach, mechanism, classification, cutting tool, tool material, heat generation, cutting fluid, grinding, internal and external surface grinding, centerless grinding designation and selection of grinding wheel, trueing and balancing, honing, reaming, lapping, polishing etc.

Powder Metallurgy: Introduction. Production of metal powders. Compaction and sintering processes. Secondary and finishing operations. Economics, advantages, and applications of powder metallurgy

UNIT IV **10 Hours**

New Trends in Manufacturing: Advanced machining processes (AJM, USM, ECM and EDM). Micro-fabrication processes, Additive manufacturing.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Amitabha Ghosh and A.K. Mallick, Manufacturing Science. Affiliated East- West Press Pvt.Ltd. 2010.*
- *Kalpakjian and Schmid, Manufacturing Processes for Engineering Materials, Pearson India,2014*
- *M. P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems*
- *Degarmo, Black & Kohser, Materials and Processes in Manufacturing.*

Course Title: Machine Element & System Design Lab	L	T	P	Cr.
Course Code: BME5302	0	0	2	1

Total Hours-30

Learning Outcomes:

After completion of this course, the learner will be able to understand the measurement of mechanical properties of materials and will be able to characterize the dynamic behavior of mechanical systems

Course Contents

1. Uniaxial tension test on mild steel rod
2. Torsion test on mild steel rod
3. Impact test on a metallic specimen
4. Brinnell and Rockwell hardness tests on metallic specimen
5. Bending deflection test on beams
6. Strain measurement using Rosette strain gauge
7. Microscopic examination of heat-treated and untreated metallic samples
8. Velocity ratios of simple, compound, epicyclic and differential gear trains
9. Kinematics of four bar, slider crank, crank rocker, double crank, double rocker and oscillating cylinder mechanisms
10. Cam & follower and motion studies
11. Single degree of freedom Spring-mass-damper system, determination of natural frequency and damping coefficient
12. Determination of torsional natural frequency of single and double rotor systems- undamped and damped natural frequencies

Course Title: Manufacturing Processes Lab	L	T	P	Cr.
Course Code: BME5303	0	0	2	1

Total Hours-30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the advanced manufacturing methods.
2. Acquire knowledge of the dimensional & form accuracy of products.
3. Perform some advanced manufacturing operations and also be able to evaluate the accuracy & tolerance of components produced

Course Content

1. Taper turning and external thread cutting using lathe Contour milling using vertical milling machine
2. Spur gear cutting in milling machine
3. Measurement of cutting forces in Milling/ Turning process
4. CNC part programming Drilling of a small hole using wire EDM
5. Microprocessor controlled pick & place robot
6. Use of Tool Maker's Microscope
7. Bore diameter measurement using micrometer and telescopic gauge Use of Autocollimator

Course Title: Artificial Intelligence	L	T	P	Cr.
Course Code: BME5304	4	0	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Identify and appreciate Artificial Intelligence and describe its applications in daily life.
2. Understand the technologies behind AI such as machine learning, deep learning, neural networks, and algorithms
3. Apply the knowledge representation in AI.
4. Design of Expert System for given applications

Course Contents

UNIT I **13 Hours**

Overview of History and Goals of AI: Artificial Intelligence -- Definition, components, scope, and application areas; Turing's test; Review of A I success and failure.

UNIT II **15 Hours**

State Spaces, Production Systems, and Search: State space representation of problems; Problem solving using search; Definition and examples of production systems; Heuristic search techniques i .e. generate-and-test, hill climbing, best-first search, constraint satisfaction and mean-ends analysis.

UNIT III **17 Hours**

Knowledge Representation: Definition of knowledge; Issues in knowledge representation; Procedural vs declarative knowledge and their representation; Predicate logic, production rules, semantic nets, and frames; Meta-knowledge. Forward vs backward reasoning; Depth first, breadth first, min-max etc.; Non-monotonic reasoning; Symbolic reasoning under uncertainty.

UNIT IV **15 Hours**

Expert Systems and their Applications: Justification, structure, knowledge sources; Expert knowledge acquisition; Expert system languages; E S building tools/shells; Applications of AI in CAD, CAPP, process selection, GT, M RP II, adaptive control, robotics, process control, fault diagnosis, failure analysis, et.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and

Cooperative Learning.

Suggested Readings:

- *Rich, E., Knight, K. and Nair, S. B., "Artificial Intelligence", 3rd Ed., Tata McGraw Hill, 2010*
- *Russell, S . a nd N orvig, P ., "Artificial Intelligence: A M odern Approach", 3rd Ed., Prentice-Hall, 2009*
- *Dean, T. L., Allen, J., and Aloimonos, Y. "Artificial Intelligence: Theory and Practice", Benjamin/Cummings P ublishing Company, 1995*
- *Genesereth, M . R . and N ilsson, N ., " Logical F oundations of Artificial Intelligence", Morgan Kaufmann, 1987*

Course Title: Measurements And Metrology	L	T	P	Cr.
Course Code: BME5305	3	0	0	3

Total Hours-45

Learning Outcomes: After completion of this course, the learner will be able to:

5. Basic knowledge about measurement systems and their components
6. Various instruments used for measurement of mechanical and electrical parameters
7. Integrate measurement systems for process monitoring and control
8. Design of limits, fits and tolerances for given applications

Course Contents

UNIT I **10 Hours**

Need for Metrology, Units and standards, Role in quality assurance and control, Measuring methods, measurements and instruments - Types, characteristics. Factors affecting measurement - SWIPE; Errors in Measurements – Types – Control – Measurement uncertainty – Types, Estimation, Problems on Estimation of Uncertainty, Statistical analysis of measurement data, Calibration of measuring instruments, ISO standards.

UNIT II **12 Hours**

Linear and Angular Measurements: Linear Measuring Instruments – Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, Vernier micrometer, Bore gauge, Telescoping gauge; Tolerance – Interchangeability, Selective assembly, Terminology, Limits and Fits, Problems; Design of Limit gauges, Problems, Gauge blocks – Use and precautions, Comparators – Working and advantages; Toolmaker‘s microscope – Profile projector - Angular measuring instruments – Bevel protractor, Clinometer, Angle gauges, Precision level, Sine bar, Autocollimator, Angle dekkor, Alignment telescope.

UNIT III **13 Hours**

Metrology of Surfaces: fundamentals of GD & T - Measurement of straightness, flatness and roundness, Simple problems – Measurement of Surface finish – Functionality of surfaces, Parameters, Comparative, Stylus based and Optical Measurement techniques, Filters, Introduction to 3D surface Metrology-Surface roughness tester. Scanning electron microscope, Atomic force microscopy, tunneling electron microscope Non-contact (Optical) measurement using Measuring microscope / Profile projector and Video measurement system. Measurement of form parameters – Straightness, Flatness, Roundness, Cylindricity, Perpendicularity, Run out, Concentricity – in the given component using Roundness tester.

UNIT IV **10 Hours**

Metrology of Assembly and Transmission Elements; Measurement of Screw threads – purpose – Dimensioning – Limit gauging – Size limits – Single element

measurements – Pitch Diameter, Lead, Pitch. Measurement of Gears – purpose – Analytical measurement – Run out, Pitch variation, Tooth profile, Tooth thickness, Lead – Functional checking – Rolling gear test. Measurement of properties Force, Power, Torque and Temperature. Measurement of screw thread parameters – Screw thread Micrometers, Two wire method, Three wire method in Floating gauge micrometer and Toolmaker‘s microscope.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *E.O Doebelin and Dhanesh Manik, “Measurement Systems”, McGraw Hill, 2017*
- *Bewoor & Kulkarni, “Metrology & Measurement” Tata McGraw Hill, 2009.*
- *D. James, and S, Meadow, “Geometric Dimensioning and Tolerancing”, Marcel Dekker,1995*
- *Madhav S. Phadke, Quality Engineering using Robust Design, Prentice Hall, 1989*

Course Title: Measurements & Metrology Lab	L	T	P	Cr.
Course Code BME5306	0	0	2	1

Total Hours-30

Course Contents

List of Experiments

1. Measurement with the help of vernier caliper and micrometer
1. Measurement of an angle with the help of sine bar
2. Measurement of surface roughness
3. Measurement of gear elements using profile projector
4. Three wire method to determine effective diameter of external threads
5. Measurement of thread element by Tool makers microscope
6. Calibration of a pressure gauge with the help of a dead weight gauge tester
7. Use of stroboscope for measurement of speed of shaft
8. Use of pilot tube to plot velocity profile of a fluid through a circular duct
9. Preparation of a thermocouple, its calibration and application for temperature measurement

Course Title: Renewable Energy Engineering	L	T	P	Cr.
Course Code: BME5307	4	0	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Acquire knowledge of technical competency combined with research to generate innovative solutions in Energy engineering.
2. Prepare the students to exhibit a high level of professionalism, integrity, environmental and social responsibility, and life-long independent learning ability with environment in mind.
3. Apply and share in depth knowledge in the area of Energy Engineering and Management.
4. Ability to apply engineering and scientific principles for the effective management of energy systems

Course Content

UNIT I **13 Hours**

Introduction: Basic concepts of energy; Introduction to Renewable Energy Technologies; Energy and Environment – global warming, acid rains, depletion of ozone layer; Global and Indian Scenario of renewable energy sources; Energy storage - necessity and energy storage methods.
Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Measurement of solar radiation data.

UNIT II **18 Hours**
Solar Thermal Systems: Introduction; Basics of thermodynamics and heat transfer; Flat plate collector; Evacuated Tubular Collector; Solar air collector; Solar concentrator; Solar distillation; Solar cooker; Solar refrigeration and air conditioning; Thermal energy storage systems.
Solar Photovoltaic Systems: Introduction; Solar cell Fundamentals; Characteristics and classification; Solar cell: Module, panel and Array construction; Photovoltaic thermal systems.

UNIT III **15 Hours**
Wind Energy: Introduction; Origin and nature of winds; Wind turbine siting; Basics of fluid mechanics; Wind turbine aerodynamics; wind turbine types and their construction; Wind energy conversion systems.
Fuel cells: Overview; Classification of fuel cells; Operating principles; Fuel cell thermodynamics.

UNIT IV **14 Hours**
Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies; Urban waste to energy conversion; Biomass gasification.
Other forms of Energy: Introduction: Nuclear, ocean and geothermal energy applications; Origin and their types; Working principles.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *O.P. Gupta, "Energy Technology", Khanna Book Publishing, New Delhi.*
- *V.V.N. Kishore, "Renewable Energy Engineering and Technology: Principles and Practice," Routledge, 1st Edition, 2019.*
- *N. Jenkins and J. Ekanayake, "Renewable Energy Engineering," Cambridge University Press, 1stEdition, 2017.*
- *G. Boyle, "Renewable Energy," OUP Oxford, 2nd Edition, 2009.*

Course Title: Design For Manufacturing & Assembly	L	T	P	Cr.
Course Code: BME5308	4	0	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Identify primary and secondary components through functional analysis
2. Calculate the design efficiency for their product design
3. Identify various design recommendation of design process
4. Analyze and derive the gripping, insertion and fixing values through fitting analysis of the product

Course Content

UNIT I **15 Hours**

Introduction: Design philosophy steps in design process, general design rules for manufacturability, basic principles of design Ling for economical production, creativity in design; Materials selection of materials for design developments in material technology, criteria for material selection, material selection interrelationship with process
selection process selection charts.

UNIT II **18 Hours**

Machining process: Overview of various machining processes, general design rules for machining, dimensional
tolerance and surface roughness, design for machining, ease of redesigning of components for machining ease with suitable examples. General design recommendations for machined parts
Metal casting: Appraisal of various casting processes, selection of casting processes, general design considerations for casting, casting tolerances, use of solidification simulation in casting design, product design rules for sand casting
Metal joining: Appraisal of various welding processes, factors in design of weldments, general design guidelines, pre and post treatment of welds, effects of thermal stresses in weld joints, design of brazed joints

UNIT III **14 Hours**

Forging, design factors for forging, closed dies forging design, parting lines of die drop forging die design general design recommendations. extrusion and sheet metal work: Design guidelines for extruded sections, design principles for punching, blanking, bending, deep drawing, Keeler Goodman forming line diagram, component design for
blanking.

UNIT IV **13 Hours**

Design for assembly: General design guidelines for manual assembly,

development of systematic DFA methodology, assembly efficiency, classification system for manual handling, classification system for manual insertion and fastening, effect of part symmetry on handling time.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Geoffrey Boothroyd, ―Assembly Automation and Product Design‖, Marcel Dekker Inc., NY, 1st Edition,2013.*
- *George E, Dieter, ―Engineering Design - Material & Processing Approach‖, McGraw-Hill, 2nd Edition,2000.*
- *Geoffrey Boothroyd, ―Hand Book of Product Design‖, Marcel and Dekken, 1st Edition, 2013.*
- *Geoffrey Boothroyd, Peter Dewhurst, Winston ―Product Design for Manufacturing and Assembly‖,CRC Press, 1st Edition, 2010.*
- *Geoffrey Boothroyd, ―Hand Book of Product Design‖, Marcel and Dekken, 1st Edition, 2013.*
- *Geoffrey Boothroyd, Peter Dewhurst, Winston ―Product Design for Manufacturing and Assembly‖,CRC Press, 1st Edition, 2010*

Course Title: Additive Manufacturing Processes	L	T	P	Cr.
Course Code: BME5309	4	0	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the working principle and process parameters of AM processes
2. Explore the applications of AM processes in various fields
3. Select the suitable material and process for fabricating a given product
4. Apply the knowledge in Material science in Additive Manufacturing Components.

Course Content

UNIT I **14 Hours**

Introduction to Additive Manufacturing: Introduction to AM, AM evolution, Distinction between AM & CNC machining, Steps in AM, Classification of AM processes, Advantages of AM and Types of materials for AM. Vat Photo polymerization AM Processes: Stereo lithography (SL), Materials, Process Modelling, SL resin curing process, SL scan patterns, Micro-stereo lithography, Mask Projection Processes, Two-Photon vat photo polymerization, Process Benefits and Drawbacks, Applications of Vat Photo polymerization, Material Jetting and Binder Jetting AM Processes.

UNIT II **16 Hours**

Extrusion - Based AM Processes: Fused Deposition Modelling (FDM), Principles, Materials, Process Modelling, Plotting and path control, Bio Extrusion, Contour Crafting, Process Benefits and Drawbacks, Applications of Extrusion-Based Processes. Sheet Lamination AM Processes: Bonding Mechanisms, Materials, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications

UNIT III **17 Hours**

Powder Bed Fusion AM Processes: Selective laser Sintering (SLS), Materials, Powder fusion mechanism and powder handling, Process 11 Modelling, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Process Benefits and Drawbacks, Applications of Powder Bed Fusion Processes.

UNIT IV **13 Hours**

Directed Energy Deposition AM Processes: Process Description, Material Delivery, Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam Based Metal Deposition, Processing-structure properties, relationships, Benefits and drawbacks, Applications of Directed Energy Deposition Processes. Materials science for

AM - Multifunctional and graded materials in AM, Role of solidification rate, Evolution of no equilibrium structure, microstructural studies, Structure property relationship.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", 2nd Edition, Springer, 2015.*
- *Patri K. Venuvinod and Weiyin Ma, "Rapid Prototyping: Laser-based and Other Technologies", Springer, 2004.*
- *Chua Chee Kai, Leong Kah Fai, "3D Printing and Additive Manufacturing: Principles & Applications", 4th Edition, World Scientific, 2015.*
- *D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001.*
- *Rafiq Noorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006*

Course Title: Composite Materials Manufacturing	L	T	P	Cr.
Course Code: BME5310	4	0	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Identify and understand the basic mechanical behavior of composite materials and make sound prediction on the likely behavior of new combinations of materials
2. Apply the choices made for using certain types of composites in certain applications with reference to composite properties
3. Demonstrate a practical understanding of composite properties and fabrication techniques, and to be able to make realistic suggestions for the evaluation of composite behavior, where appropriate
4. Analyze the micromechanical properties of fiber reinforced composites.

Course Content

UNIT I **14 Hours**

Introduction: Classifications of Engineering Materials, Concept of composite materials, Matrix materials, Functions of a Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermosets and Thermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc. Types of Reinforcements/Fibers: Role and Selection or reinforcement materials, Types of fibres, Glass fibers, Carbon fibers, Aramid fibers , Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers, Whiskers, Flakes etc., Mechanical properties of fibres. Material properties that can be improved by forming a composite material and its engineering potential.

UNIT II **16 Hours**

Various types of composites: Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composites (CMC); Classification based on reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites, Comparison with Metals, Advantages & limitations of Composites

UNIT III **17 Hours**

Fabrication methods: Processing of Composite Materials: Overall considerations, Autoclave curing, Other Manufacturing Processes like filament welding, compression molding, resin-transplant method, pltrusion, pre-peg layer, Fiber-only performs, Combined Fiber-Matrix performs, Manufacturing Techniques: Tooling and Specialty materials, Release agents, Peel plies, release films and fabrics, Bleeder and breather plies, bagging films.

UNIT IV **13 Hours**

Testing of Composites: Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc..

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Materials characterization, Vol. 10, ASM hand book*
- *Mechanical Metallurgy by G. Dieter Mc-Graw Hill*
- *Thermal Analysis of Materials by R.F. Speyer, Marcel Decker*
- *Engineering Materials: Polymers, Ceramics and Composites A.K Bhargava Prentice Hall India*

SEMESTER: VI

Course Title: Heat Transfer & Thermal Machines	L	T	P	Cr.
Course Code: BME6350	3	0	0	3

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Formulate and analyze a heat transfer problem involving any of the three modes of heat transfer
2. Examine exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer.
3. Design heat exchangers and estimate the insulation needed to reduce heat losses where necessary.

Course Contents

UNIT I **11 Hours**

Three modes of heat transfer; Examples of equipment (like air conditioner and air cooler) involving heat transfer; Derivation of heat balance equation. Steady 1D solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry; Concept of conduction and film resistances; Critical insulation thickness; Lumped system approximation and Biot number; Heat transfer through pin fins; 2D conduction solutions for steady and unsteady heat transfer.

UNIT II **12 Hours**

Basic equations; Boundary layers; Forced convection; External and internal flows; Natural convective heat transfer; Dimensionless parameters for forced and free convection heat transfer; Correlations for forced and free convection; Approximate solutions to laminar boundary layer equations for internal and external flow; Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection. Interaction of radiation with materials; Definitions of radiative properties; Stefan Boltzmann's law; Black and grey body radiation; Calculation of radiation heat transfer between surfaces using radiative properties; View factors and the radiosity method; Examples for two-body enclosures; Radiation shield.

UNIT III **12 Hours**

Function, classification and configuration of heat exchangers; Evaluation of mean temperature difference; Heat exchanger effectiveness; Analysis, design and selection of heat exchangers. Pool boiling; Flow boiling; Film and drop wise condensation

UNIT IV **10 Hours**

Analogy between heat and mass transfer; Mass diffusion; Fick's Law; Steady and transient mass diffusion; Simultaneous heat and mass transfer.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *A. Bejan, "Heat Transfer," John Wiley, 1993.*
- *J.P. Holman and S. Bhattacharyya, "Heat Transfer," McGraw Hill, 2017.*
- *F.P. Incropera, and D.P. Dewitt, "Fundamentals of Heat and Mass Transfer," John Wiley, 2019.*
- *Massoud Kaviany, "Principles of Heat Transfer," John Wiley, 2002.*
- *Yunus A Cengel, "Heat Transfer: A Practical Approach," McGraw Hill, 2002.*

Course Title: Heat Transfer & Thermal Machines Lab	L	T	P	Cr.
Course Code: BME6351	0	0	2	1

Total Hours-30

Learning Outcomes:

After completion of this course, the learner will be able to measure various properties of heat transfer and characterize the performance of thermal machinery.

Course Contents

1. Determination of the thermal conductivity and specific heat of given objects
2. Determination of the calorific value of a given fuel and its flash & fire points
3. Determination of the p-V diagram and the performance of a 4-stroke diesel engine
4. Determination of the convective heat transfer coefficient for flow over a heated plate
5. Determination of the emissivity of a given sample
6. Determination of the performance characteristics of a vapour compression system

Course Title: Refrigeration And Air Conditioning	L	T	P	Cr.
Course Code: BME6352	3	1	0	4

Total Hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the fundamental principles and applications of refrigeration and air conditioning systems.
2. Analyse various refrigeration cycles and evaluate their performance parameters.
3. Apply psychometric principles to design air conditioning systems for industrial and comfort applications.
4. Familiarize students with components, refrigerants, and modern trends in refrigeration and air conditioning.

Course Content

Unit I: 15 Hours

Introduction to Refrigeration

Necessity and applications of refrigeration Unit of refrigeration and Coefficient of Performance (COP)

Types of refrigeration systems: Mechanical refrigeration, non-conventional refrigeration Ideal refrigeration cycles

Air Refrigeration Systems

Bell-Coleman cycle and Brayton cycle Open and dense air systems Actual air refrigeration systems Refrigeration needs in aircraft Advantages, limitations, and applications Simple numerical problems

Unit II 15 Hours

Vapour Compression Refrigeration

Working principle and essential components (compressor, condenser, evaporator, expansion valve) Simple vapour compression refrigeration cycle Representation on T-S and P-h charts

Effects of sub-cooling and superheating Cycle analysis and performance evaluation Use of P-h charts for problem-solving

Vapour Absorption and Other Refrigeration Systems

Vapour absorption system: Principle, NH3-water system, Li-Br system Calculation of maximum COP Steam jet refrigeration: Working principle and components non-conventional systems: Thermoelectric refrigeration, Vortex tube (Hilsch tube)

Unit III 16 Hours

Introduction to Air Conditioning

Psychrometric properties and processes (sensible heating/cooling, humidification, dehumidification) Sensible and latent heat loads Concepts of RSHF, ASHF, ESHF, and ADP Human comfort and effective temperature ad concepts for comfort and industrial air conditioning

Unit VI: **14 Hours**

Air Conditioning Systems and Load Calculations

Classification of air conditioning equipment (cooling, heating, humidification, dehumidification) Components: Filters, grills, registers, fans, blowers Air conditioning load calculations Industrial and commercial air conditioning requirements

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Refrigeration and Air Conditioning by C.P. Arora, McGraw Hill Education.*
- *Principles of Refrigeration by Roy J. Dossat, Pearson Education.*
- *Refrigeration and Air Conditioning by R.C. Arora, PHI Learning.*

Course Title: Hybrid & Electric Vehicles	L	T	P	Cr.
Course Code: BME6353	4	0	0	4

Total Hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Explain performance characteristic and model dynamics of hybrid and electric vehicles.
2. Analyze the architecture of drive trains and electric propulsion units of electric and hybrid vehicles.
3. Analyze various energy storage devices used in hybrid and electric vehicles and select the electric drive system.
4. Explore energy management strategies used in hybrid and electric vehicles.

Course Content

Unit I: 15 Hours

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies - Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance Air Refrigeration Systems

Unit II 15 Hours

Hybrid and Electric Drive-trains: Basic concept of traction, introduction to various drive-train topologies, power flow control in drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiencyVapour Absorption and Other Refrigeration Systems

Unit III 16 Hours

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Analysis of various energy storage devices – Battery, Fuel Cell, Super, Flywheel - Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor and power electronics, selecting the energy storage technology, Communications, supporting subsystems

Unit VI: 14 Hours

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification, comparison and implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV) and Battery Electric Vehicle (BEV)

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Husain, Electric and Hybrid Electric Vehicles, CRC Press, 2003*
- *M. Ehsani, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2005*
- *A. E. Fuhs, Hybrid Vehicles and the Future of Personal Transportation, CRC Press, 2009*
- *C. C. Chan and K. T. Chau, Modern Electric Vehicle Technology, Oxford Science Publication, 2001*
- *Industrial Power and Automation, Department of Electrical Engineering, NIT Calicut - 673601 93*
- *G. Lechner and H. Naunheimer, Automotive Transmissions: Fundamentals, Selection, Design and Application, Springer, 1999*
- *Gianfranco, Electric and Hybrid Vehicles: Power Sources, Models, Sustainability, Infrastructure and the Market, Pistoia Consultant, Rome, Italy, 2010*
- *M. H. Rashid, Power Electronics: Circuits, Devices and Applications, 3rd ed., Pearson, 2004 8. V. R.*
- *Moorthi, Power Electronics: Devices, Circuits and Industrial Applications, Oxford University Press, 2007*
- *R. Krishnan, Electric motor drives: modeling, analysis, and control, Prentice Hall, 2001*
- *P. C. Krause, O. Wasynczuk, S. D. Sudhoff, Analysis of electric machinery, IEEE Press, 1995*
- *11.L. Guzella, A. Sciarretta, Vehicle Propulsion Systems, Springer, 2007.*

Course Title: Computer Aided Design & Analysis	L	T	P	Cr.
Course Code: BME6354	3	0	0	3

Total Hours-45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand and appreciate use of computer in product development.
2. Apply algorithms of graphical entity generation.
3. Understand mathematical aspects of geometrical modelling.
4. Analysis and use finite element methods for analysis of simple components.

Course Content

UNIT I — 10 Hours

Introduction: Role of computers in design process; Computer aided design, analysis and manufacturing; Computer integrated manufacturing; Popular CAD software used in industry; Input and output devices.
Transformations: Matrix representation of points, lines and planes; 2D transformation for translation, scaling, rotation and reflection; Homogeneous representation & concatenation; 3D transformations.

UNIT II — 12 Hours

Curves and Surfaces: Representation of curves; Hermite curves, Bezier curves, B-spline curves, Rational curves; Surface modelling – parametric representation, planar surface, surface of revolution, Coons and bicubic patches, Bezier and B-spline surfaces.

Solid Modelling: Solid modelling techniques – sweep (linear and curved), Boolean (constructive solid geometry) and other techniques; Solid model representation (Boundary and Constructive Solid Geometry); Medical modelling (pixels, scans and voxels); Exchange standards (IGES, DXF, STEP, STL etc.).

UNIT III — 13 Hours

Engineering Analysis: Introduction to finite element method; Principle of potential energy; FE analysis of 1D element problems (spring, bar, truss elements); Development of element stiffness equation and their assembly; Plain strain and plain stress problems; Domain discretization, pre-processing and post-processing; Verification and validation; Popular CAE software used in industry
Introduction to CFD and HT: Basic theoretical framework, Boundary conditions, Application Examples: thermal and fluid machines.

UNIT IV — 10 Hours

Design Optimization: Purpose and application of optimum design, Primary and subsidiary design equations, Limit Equations, Normal, redundant and incompatible specifications problems; Computer-aided design optimization.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Ibrahim Zeid, "Mastering CAD CAM," Tata McGraw Hill Publishing Co. 2007.*
- *C. McMohan and J. Browne, "CAD/CAM Principles," Pearson Education, 2nd Edition, 1999.*
- *Geometric Modeling, Michael E. Mortenson, Tata McGraw Hill, 2013.*
- *W. M. Neumann and R.F. Sproul, "Principles of Computer Graphics," McGraw Hill, 1989.*
- *D. Hearn and M.P. Baker, "Computer Graphics," Prentice Hall Inc., 1992.*

Course Title: Computer Aided Design & Analysis Lab	L	T	P	Cr.
Course Code: BME6355	0	0	2	1

Total Hours-30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand and appreciate use of computer in product development.
2. Apply algorithms of graphical entity generation.
3. Understand mathematical aspects of geometrical modelling.
4. Understand and use finite element methods for analysis of simple components.

Course Content

1. Prepare a programme for plotting lines and curves using algorithms learned.
2. Introductory exercise for 3-D modelling.
3. Exercise for advanced 3-D modelling.
4. Exercise for 3-D editing options.
5. Exercise for Assembly modelling.
6. Exercise for surface modelling.
7. Introductory exercise for finite element analysis.

Course Title: Computational Fluid Dynamic	L	T	P	Cr.
Course Code: BME6356	4	0	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Develop the governing equations for fluid flow
2. Apply finite difference, finite volume and finite element methods to solve the flow problems
3. Examine the stability and conduct a grid-convergence assessment
4. Evaluate turbulence models to engineering fluid flow problems

Course Content

UNIT I **15 Hours**

Equations of fluid dynamics

Basic concepts Eulerarian and Lagrangian methods of describing fluid flow motion, acceleration and deformation of fluid particle, vorticity. Laws governing fluid motion, continuity, Navier – stokes & energy equations. Boundary layer equation, Euler equations, potential flow equations, Bernoulli's equation and vorticity transport equation. Initial and boundary conditions. Classification of equation of motions – hyperbolic, parabolic, elliptic.

UNIT II **15 Hours**

Mathematical Preliminaries

Numerical integration. Review of linear algebra, solution of simultaneous linear algebraic equations – matrix inversion, solvers – direct methods, elimination methods, ill conditioned systems; Gauss- Sidel method, successive over relaxation method.

UNIT III **18 Hours**

Grid Generation

Transformation of coordinates. General principles of grid generation – structured grids in two and three dimensions, algebraic grid generation, differential equations-based grid generation; Elliptic grid generation, algorithm, Grid clustering, Grid refinement, Adaptive grids, Moving grids. Algorithms, CAD interfaces to grid generation. Techniques for complex and large problems: Multi block methods.

Finite difference discretization

Elementary finite difference coefficients, basic aspects of finite difference equations, consistency, explicit and implicit methods, errors and stability analysis. Stability of elliptic and hyperbolic equations. Fundamentals of

fluid flow modeling- conservative property, upwind scheme, transporting property, higher order up winding. Finite difference applications in heat transfer – conduction, convection.

UNIT IV **12 Hours**

Finite Volume Method

Introduction, Application of FVM in diffusion and convection problems, NS equations – staggered grid, collocated grid, SIMPLE algorithm. Solution of discretized equations using TDMA. Finite volume methods for unsteady problems– explicit schemes, implicit schemes. Finite Element Method: Introduction. Weighted residual and vibrational formulations. Interpolation in one-dimensional and two-dimensional cases. Application of FEM to ID and 2D problems in fluid flow and heat transfer

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Ferziger J. H.& Peric, M. (1999). Computational Methods for fluid Dynamics. Springer-Verlag.*
- *Anderson J. (1995). Computational fluid Dynamics. McGraw Hill Inc.*
- *Patankar, S. P. (1980). Numerical Heat Transfer & Fluid flow. CRC Press.*
- *Sunderarajan& Muralidhar, K.(2009). Computational Fluid Flow and Heat Transfer. Narosa Publishing*

Course Title: Non Traditional Machining Methods	L	T	P	Cr.
Course Code: BME6357	4	0	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Develop the governing equations for fluid flow
2. Apply finite difference, finite volume and finite element methods to solve the flow problems
3. Examine the stability and conduct a grid-convergence assessment
4. Evaluate turbulence models to engineering fluid flow problems

Course Content

UNIT I **15 Hours**

Introduction: Objective, scope and outcome of the course. Introduction and classification of advanced machining process, consideration in process selection, difference between traditional and non-traditional process, Hybrid process. Abrasive finishing processes: AFM, MAF (for Plain and cylindrical surfaces).

UNIT II **14 Hours**

Mechanical advanced machining process: Introduction, Mechanics of metal removal, process principle, Advantages, disadvantages and applications of AJM, USM, WJC.

UNIT III **14 Hours**

Thermo electric advanced machining process: Introduction, Principle, process parameters, advantages, disadvantages and applications about EDM, EDG, LBM, PAM, EBM.

UNIT IV **17 Hours**

Electrochemical and chemical advanced machining process: ECM, ECG, ESD, Chemical machining, 6 Anode shape prediction and tool design for ECM process. Tool (cathode) design for ECM Process. Introduction to Micro and nanomachining,

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Advanced machining processes/ VK Jain/ Allied publishers.*
- *Production technology by R.K.Jain/Khanna publishers.*
- *Modern Machining Process / Pandey P.C. and Shah H.S. / TMH.*
- *New Technology / Bhattacharya A/ The Institution of Engineers, India 1984.*
- *Modern Production / Operations Management / Baffa & Rakesh Sarin*

Course Title: Computer Integrated Manufacturing	L	T	P	Cr.
Course Code: BME6358	4	0	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Apply manufacturing concepts and management principles.
2. Classify and compare different manufacturing processes and systems.
3. Develop part program for manufacturing of different machine components.
4. Analyze the behavior of manufacturing system using simulation.

Course Content

UNIT I **14 Hours**

Introduction: Objective, scope and outcome of the course. Introduction to CIM: Overview of Production Systems, the product cycle, Automation in Production Systems, computer's role in manufacturing, sources and types of data used in manufacturing. The Beginning of CAM: Historical Background, Numerical Control (NC): Basic components of an NC system, coordinate system and motions control systems. Computer Numerical Control (CNC): features of CNC, machine control unit, CNC software. Direct Numerical Control and Distributed Numerical Control. Applications, advantages and disadvantages of NC. Adaptive control of machining system.

UNIT II **15 Hours**

NC Part programming: Manual and computer assisted part programming, Part programming with APT. NC part programming using CAD/CAM software. NC cutter path verification. Computer Aided Process Planning: Traditional Process Planning, Retrieval process planning system, Generative Process Planning, Machinability data systems, computer generated time standards. Group Technology: Introduction, part families, part classification and coding, coding system and machining cells.

UNIT III **16 Hours**

Computer Aided Production Management Systems: Introduction to computer aided PPC, Introduction to computer aided inventory management, manufacturing resource planning (MRPII), computer process monitoring and shop floor control, computer process control. Computer Aided Quality Control; Computer in quality control, contact inspection methods, Non contact inspection methods, optical and non optical computer aided testing.

UNIT IV **15 Hours**

Computer Aided Material Handling; Computer control on material handling, conveying, picking. Ware house control, computerized material handling for automated inspection and assembly. Computer Integrated Manufacturing Systems: Introduction, types special manufacturing systems, flexible manufacturing systems (FMS). Collaborative Engineering; Introduction, Faster Design throughput, Web based design, Changing design approaches,

extended enterprises, concurrent engineering, Agile and lean manufacturing.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.*
- *Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.*
- *Gideon Halevi and Roland Weill, "Principles of Process Planning – A Logical Approach" Chapman & Hall, London, 1995.*
- *Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India.*
- *Rao. P, N Tewari &T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000.*

Course Title: Die, Mold And Tool Engineering	L	T	P	Cr.
Course Code: BME6359	4	0	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand of fixturing and work holding during machining processes.
2. Provide an understanding of the metallurgy, processing, and types of tool steels, including heat treatment.
3. Acquire knowledge an introduction to dies and molds for forming processes in both the liquid and solid states.
4. Basic understanding of the economics of tooling: break even analysis, number of mold or die cavities, comparison of production processes based on production run.

Course Content

UNIT I **14 Hours**

Cutting Tool Design

Fundamentals of Cutting tools design, cutting tools and their principal elements, Tool geometry, system of nomenclatures and their interrelations, setting for the grinding of various basic cutting tool (turning, drilling, milling).

Analyses and Design of Jigs and Fixture

Principles of jig and fixture design, Dual cylinder location, diamond pin analysis, V-block analysis, design principles of centralizers, various mechanisms and design of equalizers, analysis for optimum number of clamping forces required and calculation of their magnitudes, concept of modular fixtures, design of fixtures for NC/CNC machines, computer Applications in fixture design and analysis

UNIT II **15 Hours**

Design of press tools:

Components of die design, design of die blocks, punches and strippers, methods of holding punches, sketches of stock stops, Design procedure for progressive dies, compound dies and combination dies for press tool operation forging die design for drop and machine forging parts. Computer applications in press tool design.

UNIT III **16 Hours**

Design of forging dies:

Grain flow considerations, parting line selection, draft, design problems involving ribs, bosses and fillets. Flash and flash control, determination of number of impressions required and their sequence, design steps and analysis of forging dies, detail calculations, shrinkage, cavity shapes, heat transfer considerations, cooling and ejection systems, automation in forging operations, computer aided design and analysis.

UNIT IV **15 Hours**

Design of injection molds

Principles of melt processing, product considerations, determination of economical number of cavities, temperature control of injection molds, calculation of mold opening force and ejection force. Detail design of cooling system, ejection system and gating system. Moldability features, mold flow analysis

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Cole: "Tool Design" , 1970.*
- *Donaldson: "Tool Design", Tata McGraw Hill, 2012.*
- *ASTEM: "Fundamentals of Tool Design", 2010.*
- *P.C.Sharma: "A Textbook of Production Engineering"., S.Chand Publication, N.Delhi, 1999.*
- *Ivana Suchy, "Handbook of Die Design", 2nd edition McGraw Hill, 2006.*
- *Ventatraman, "Design of Jigs, Fixtures and Press Tools", Ascent Series Tata McGraw Hill.*
- *Deshpande D. L., "Basic Tools", 2nd edition University Press.*

Semester-VII

Course Title: Operation Research	L	T	P	Cr.
Course Code: BME7400	3	1	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Apply various types of deterministic models like linear programming, transportation model etc.
2. Analysis various types of stochastic models like waiting line model, project line model, simulation etc.
3. Develop the relationship between a linear program and its dual and perform sensitivity analysis.
4. Understand the decision making environment and apply decision making process in the real world situations.

Course Content

UNIT I **15 Hours**

Introduction: Meaning of optimization, operations research (OR), historical development, characteristics and application of operations research, scope of operations research, Classification of optimization techniques in brief:

Linear Programming Problem: Introduction, formulation of linear programming problem (LPP), graphical representation and solution to LP problems, solution of LPP using simplex method, Big-M method and two phase method, degeneracy in LPP, duality in linear programming.

UNIT II **14 Hours**

Transportation Model: Definition, mathematical formulation, balanced and unbalanced problem, different methods of obtaining initial basic solution, Vogel's approximation, optimal solution of transportation model using MODI method, optimality test, optimal solution of minimization and maximization problems.

UNIT III **16 Hours**

Assignment Model: Introduction, mathematical formulation, difference between transportation and assignment model, unbalanced (m x n matrix) assignment problem, minimization and maximization assignment problem, optimal solution of assignment model using Hungarian method, sequencing and traveling salesman problems.

Queuing theory: Introduction, elements/structure of queues, operating characteristics, classification of queuing model, Kendall's notation for representing Queuing Model, Case studies on (M/M/I) Model.

UNIT IV **15 Hours**

Network models (PERT & CPM): Introduction, evolution and application of PERT & CPM technique, concept of activities and events, drawing of network diagram, Fulkerson's rule, float and slack times, time estimates, critical path, estimation of project completion time, crashing and updating problems

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Wagner, H.M.(1980). Principles of Operations Research. Prentice Hall.*
- *Gupta, P.K.& Hira, D.S.(1976).Operations Research. S. Chand &Co.*
- *Taha, H.(1999). Introduction to Operation Research. Pearson.*
- *Hillier, F. S. & Lieberman, G. J. (1967). Introduction to O.R.. San Francisco: Holden-Day.*

Course Title: Product Design & Development	L	T	P	Cr.
Course Code: BME7401	4	0	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understanding the principle and theories of Product Design and Development.
2. Apply the concept of creative methods for generation and development of product.
3. Analyze the engineering characteristics and quality function deployment for gathering the information to develop new product.
4. Design the product architecture and configuration of new product.

Course Content

UNIT I **15 Hours**

INTRODUCTION: Modern Product Development and Design Theories: Understanding the opportunity, Development and Implementation of a concept, Reverse engineering and redesign methodologies.

UNIT II **14 Hours**

PRODUCT DESIGN PROCESS: Need, Identification, Kano diagram, Establishing Engineering Characteristics, Quality Function Deployment (QFD), Product Design Specification (PDS), Information Gathering.

UNIT III **16 Hours**

CONCEPT GENERATION: Creative methods for design, Functional decomposition and synthesis, Morphological methods, Theory of Inventive Problem solving, Axiomatic Design. CONCEPT EVALUATION AND DECISION MAKING: Concept evaluation and decision making: Decision Theory, Evaluation methods, Pugh's concept, weighted decision Matrix

UNIT IV **15 Hours**

EMBODIMENT DESIGN: Product Architecture, Configuration and Parametric Design Concepts, Ergonomics and Design for Environment and detailed design. ETHICAL ISSUE AND TEAM MANAGEMENT: Ethical issues considered during Engineering design process, Product liability, Tort law, functioning, discharge, Team Dynamics and problem solving tools in design, Case studies.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Wagner, H.M.(1980). Principles of Operations Research. Prentice Hall.*
- *Gupta, P.K.& Hira, D.S.(1976).Operations Research. S. Chand &Co.*

- *Taha, H.(1999). Introduction to Operation Research. Pearson.*
- *Hillier, F. S. & Lieberman, G. J. (1967). Introduction to O.R.. San Francisco: Holden-Day.*

Course Title: Total Quality Management	L	T	P	Cr.
Course Code: BME7402	4	0	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the basic terminologies and metrics that are used to govern quality management
2. Get a better perspective on quality standards like ISO and quality awards
3. Be able to identify the various metrics that govern quality
4. Elucidate the role and importance of six sigma as a quality measurement tool
5. Identify the various means and techniques for establishing quality in manufacturing, services and IT sector.

Course Contents

UNIT I **14 Hours**

Evolution of Quality: Historical Perspective, Basic Concepts of Quality, Vision, Mission and Objectives of an Organization, Corporate Structure in an Organization and Role of Quality.

Philosophy of TQM: Gurus of TQM- Quality Management Philosophy of Deming and Juran, Deming's Fourteen Points of Quality Management, Ten steps of quality Management of Juran, Crosby's "Absolutes of Quality" and his Fourteen Steps of Quality Management, Integration of Deming, Juran and Crosby's Quality Management Philosophies to TQM, Taguchi's Philosophy of Quality Engineering.

UNIT II **15 Hours**

Components of TQM: Internal Components: Leadership Quality Policy and Statements Organizational Structure Role of HR in TQM, External Components: Customers' Satisfaction Impact on/of- Suppliers, Investors and Society, Contextual application of TQM.

UNIT III **15 Hours**

Analysis & Improve the Quality: Seven QC Tools – Stratification, Check Sheets, Control Chart, Histogram, Pareto Chart, Cause- and-effect diagram & Scatter diagram. New Management and planning tools – 5 Why Analysis, Affinity Diagram, Interrelationship Digraph & Tree Diagram, Matrix Diagram, Matrix Data Analysis, Process Decision Program Chart and Arrow Diagram, Continuous Process Improvements – Benchmarking, PDCA Cycle, 6S, Kaizen, Lean and Six- Sigma principles.

UNIT IV **16 Hours**

Introduction to techniques used in TQM: Six Sigma, Kaizen, 7 Habits of Highly Effective People

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Dale H. Besterfield, Carol Besterfield Michna, Glen Besterfield, Mary Besterfield Sacre, Hemant Urdhwareshe & Rashmi Urdhwareshe "Total Quality Management", Pearson.*
- *Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.*
- *Janakiraman. B and Gopal.R.K., "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.*

Course Title: Mechatronics, Robotics & Control	L	T	P	Cr.
Course Code: BME7403	3	0	0	3

Total Hours-45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Ability to recognize and analyze electro-mechanical systems in daily lives.
2. Understand the role of sensors, actuators, and controls in mechatronic systems.
3. Familiarity with control theory and controller design.
4. Understand the measurement of various quantities using instruments, their accuracy & range and the techniques for controlling devices automatically.

Course Contents

UNIT I **10 Hours**

Electro-mechanical systems; Typical applications; Examples – automobiles, home appliances, medical instruments, etc. Transduction principles; Sensitivity, accuracy, range, resolution, noise sources; Sensors for common engineering measurements – proximity, force, velocity, temperature, etc.; Signal processing and conditioning; Selection of sensors.

UNIT II **15 Hours**

Pneumatic and hydraulic actuators; Electric motors including DC, AC, BLDC, servo and stepper motors; Solenoids and relays; Active materials – piezoelectric and shape memory alloys. Microprocessors and their architecture; Memory and peripheral interfacing; Programming; Microcontrollers; Programmable Logic Controllers; PLC principle and operation; Analog and digital input/output modules; Memory module; Timers, internal relays, counters and data handling; Industrial automation systems; Basic PLC programming; Industry kits (Arduino, Raspberry Pi, etc.).

UNIT III **10 Hours**

Robot configurations: serial and parallel; Denavit–Hartenberg parameters; Manipulators kinematics; Rotation matrix, Homogenous transformation matrix; Direct and inverse Kinematics for robot position and orientation; Workspace estimation and path planning; Robot vision; Motion tracking; Robot programming and control; Industrial robots - Pick and place robots, sorting, assembly, welding, inspection, etc.

UNIT IV **10 Hours**

Basic control concepts; Feedback; Open and closed loop control; Concept of block diagrams; P, PI and PID controllers; Tuning the gain of controllers; System models, transfer functions, system response,

frequency response; Root Locus method and Bode plots. Demonstration and projects using simulation software (e.g., MATLAB, Scilab, ROBODK) for control systems and robotics.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *W. Bolton, "Mechatronics," Addison Wesley Longman, 2010.*
- *J. J. Craig, Introduction to Robotics Mechanics and Control, Addison Wesley, 1999.*
- *G.K. McMillan, "Process/Industrial Instruments and Controls Handbook," McGraw-Hill,1999.*
- *S. Mukherjee, "Essentials of Robotics Process Automation", Khanna Book Publishing, 2021.*

Course Title: Mechatronics, Robotics And Control Lab	L	T	P	Cr.
Course Code: BME7404	0	0	2	1

Total Hours-30

Course Contents

List of Experiments

1. Design and assembly of hydraulic / pneumatic circuit.
2. Study of power steering mechanism using cut piece model
3. Study of reciprocating movement of double acting cylinder using pneumatic direction control valves
4. Use of direction control valve and pressure control valves clamping devices for jig and fixture
5. Study of robotic arm and its configuration
6. Study the robotic end effectors
7. Study of different types of hydraulic and pneumatic valves

Course Title: Engineering Project	L	T	P	Cr.
Course Code: BME7405	0	0	8	4

Total Hours-120

Course Content

This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

Course Title: SUPPLY CHAIN MANAGEMENT	L	T	P	Cr.
Course Code: BME7406	4	0	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Knowledge gain about supply chain management concept.
2. Conduct performance measurements of any supply chain.
3. Capable to apply the SCM philosophy in the industry.
4. Conduct of inventory management at inbound & outbound supply chain level
5. Understand the framework and scope of supply chain networks and functions.

Course Contents

UNIT I **15 Hours**

Perspective of Supply Chain Logistics Management. Logistics concept, role and scope; Logistics Environment- Integrating Logistics of Supply, Logistics of Production and Logistics of Distribution. Internal and external factors for logistics strategy, Operational Resources of logistics (personnel, warehouse means of transport, warehouse transport aids, organizational aids, material stocks, and area/ spare).

UNIT II **14 Hours**

Effective supply chain management, customer networking and manufacturing, Risk Pooling, Postponement, cross docking in supply chain, CPFR, IT-enabled supply chains value of Information, Coordination in SCM.

UNIT III **16 Hours**

Logistics Activity Mix. JIT and Logistics, Synchronized manufacturing. Purchasing and Materials Management. Distributional logistical systems and facilities-single stage or multistage, warehouse(s), their number, location and allocation, Automated Warehousing, Materials Handling and Packaging. Simulation aided planning of conveyor and warehousing systems.

UNIT IV **15 Hours**

Supply Chain Logistics Mix Management. Logistical Connectivity: Transportation modes, rate structure, legal aspects; maintenance, spares and repairs; test and support equipment, Routing of freight flows.

Management and Organization of the Logistics Systems; Organization, Information and cost control; Logistical information Systems, Computer aided logistics management. Case Studies.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Sunil Chopra, Peter Meindi and Kalra, "Supply Chain Management , Strategy, Planning, and operation" Pearson Education, 2010*
- *Arvind Jayant, "Industrial Engineering & Operation Management", Studium Press 2019, New Delhi*
- *Srinivasan G.S; "Quantitative models in Operations and Supply Chain Management", PHI, 2010.*
- *James B. Ayers , "Handbook of Supply chain management", St.Lucle press, 2000.*

Course Title: Process Planning & Cost Estimation	L	T	P	Cr.
Course Code: BME7407	4	0	0	4

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the various processes planning.
2. Learn to estimate cost Learn to estimate various cost elements
3. Learn to estimate production cost Learn to fix foundry cost
4. Learn the find machining time estimation

Course Contents

UNIT I **12 Hours**

PROCESS PLANNING Types of production, standardization, simplification, production design and selection - Process Planning, selection and analysis – Steps involved in manual and experienced based planning and computer aided process planning – Retrieval, Generative – Selection of process analysis – Break even analysis.)

UNIT II **15 Hours**

ESTIMATION AND COSTING Aim and objective of cost estimation – Functions of estimation – Costing – Importance and aims of costing – Difference between costing and estimation. Importance of realistic estimates – Estimation procedure.

UNIT III **15 Hours**

COST ELEMENTS Material cost – Determination of material cost, Labour cost - Determination of labour cost, Expenses — Analysis of overhead expenses – Factory expenses, Administrative expenses – Selling and Distributing expenses – Allocation of overhead expenses. Cost of product – Illustrative examples Depreciation: Depreciation – Causes of Depreciation – Methods of Depreciation.

UNIT IV **18 Hours**

ESTIMATION OF PRODUCTION COST Estimation in forging shop – Losses in forging – forging cost – Illustrative examples. Estimation in welding shop – Gas cutting – Electric welding - Illustrative examples. Estimation in foundry shop – Estimation of pattern cost and casting cost - Illustrative examples. MACHINING TIME ESTIMATION of Machining Time for Lathe operations – Estimation of Machining Time for Drilling, Boring, Shaping, Planning, Milling and Grinding operations - Illustrative examples.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *M.Adithian and B.S. Pabla, Estimation and Costing, Konark publishers Pvt. Ltd., 1989.*
- *A.K.Chitale and R.C.Gupta, Product Design and Manufacturing, Prentice Hall Pvt. Ltd.., 2005*
- *Namua Singh, System Approach to computer integrated Design and Manufacturing, John Wiley & Sons,Inc.,1996.*
- *Joseph G Monks, Operation Management, Theory & Problems, McGraw Hill Book Company, 1987.*
- *T.R.Banga and S.C.Sharma, Estimations and Costing, Khanna Publishers,1988.*
- *G.B.S.Narang and V.Kumar, Production and Costing, Khanna Publishers, 1995.*
- *https://books.google.com/books?id=A9-ZXblNrPoC.*

Semester: VIII

Course Title: Internship	**L**	**T**	**P**	**Cr.**
Course Code: BME8450	**0**	**0**	**0**	**20**

Learning Outcomes: After completion of this course, the learner will be able to:

1. Identify the problem, define objectives and scope of the project work
2. Carryout Team work
3. Prepare and present a comprehensive report of the project work
4. Apply the principles of Engineering to solve problems
5. Solve Engineering problems using the concept of design and manufacturing

Course Contents