GURU KASHI UNIVERSITY

Bachelor of Technology in Mechanical Engineering

Session: 2023-24

Department of Mechanical Engineering

GRADUATE OUTCOME OF THE PROGRAMME

The program focuses to develop an ability to apply appropriate knowledge in Mechanical Engineering to identify, formulate, analyze, and solve complex engineering problems in order to develop sustainable computing solutions in broader economic, societal and environmental contexts.

PROGRAMME LEARNING OUTCOMES

After completing the programme, the learner will be able to:

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Identify, formulate and analysis complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
5. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
6. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
7. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
8. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Structure

Semester: I						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**
BME101	Basic Electrical Engineering	Core	3	0	0	3
BME110	Engineering Physics	Core	3	1	0	4
BME111	Engineering Mathematics–I	Core	3	1	0	4
BME104	Engineering Graphics & Drawing	Core	1	0	4	3
BME112	Engineering Physics Lab	Skill Based	0	0	4	2
BME106	Basic Electrical Engineering Lab	Skill Based	0	0	4	2
BME113	Fundamental of Computer and Information Technology	Value added	2	0	0	2
BME114	Constitution of India	Value added	2	0	0	NC
Total			14	2	12	20

Semester: II						
Course Code	**Course Name**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**
BME201	Engineering Chemistry	Core	3	0	0	3
BME214	Engineering Mathematics–II	Core	3	1	0	4
BME203	Programming for Problem Solving	Core	3	0	0	3
BME204	Communication Skills	Skill based	3	0	0	3
BME205	Manufacturing Practices	Skill based	1	0	4	3
BME206	Engineering Chemistry Lab	Skill based	0	0	2	1
BME207	Programming for Problem Solving Lab	Skill based	0	0	2	1
BME208	Communication Skills Lab	Skill based	0	0	2	1
Value Added Course (Any one) For other disciplines						
BME209	Entrepreneurship Development	VAC	2	0	0	2
BME210	Numerical Aptitude & Reasoning Ability					
BME211	Stress Management					
Total			15	1	10	21

Semester: III						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**
BME313	Engineering Physics-II	Core	3	1	0	4
BME314	Engineering Mathematics-III	Core	3	1	0	4
BME315	Environment Science	Value based	2	0	0	2
BME316	Basic Electronics Engineering	Core	3	1	0	4
BME317	Engineering Mechanics	Core	3	1	0	4
BME318	Applied Thermodynamics	Core	3	1	0	4
BME319	Engineering Physics-II	Skill based	0	0	2	1
BME320	Basic Electronics Engineering Lab	Skill based	0	0	2	1
BME399	xxx	MOOC	-	-	-	2
Total			17	5	4	26

Semester: IV						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**
BME411	Heat Transfer & Thermal Machines	Core	3	1	0	4
BME412	Fluid Mechanics & Hydraulic Machines	Core	3	1	0	4
BME413	Mechanics of Deformable Solids	Core	3	1	0	4
BME414	Engineering Materials & Applications	Core	3	1	0	4
BME415	Kinematics & Dynamics of Machines	Core	3	1	0	4
BME416	Mech. Engg. Lab-I(Thermal & Fluid)	Skill based	0	0	4	2
Total			15	5	4	22

Semester: V						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**
BME511	Machine Elements & System Design	Core	3	1	0	4
BME512	Mechatronics, Robotics & Control	Core	3	0	0	3
BME504	Manufacturing Processes	Core	3	1	0	4
BME513	Measurements & Metrology	Core	3	0	0	3
BME514	Mechatronics, Robotics & Control Lab	Skill based	0	0	2	1
BME515	Measurements & Metrology Lab	Skill based	0	0	2	1
BME516	Mech. Engg. Lab-II(Design) Lab	Skill based	0	0	4	2
BME517	Project Management	Skill based	3	0	0	3
BME599	xxx	MOOC	-	-	-	2
Total			15	2	8	23

Semester: VI						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**
BME611	Computer Aided Design & Analysis	Core	3	0	0	3
BME612	Manufacturing Automation	Core	3	0	0	3
BME613	Production & Operation Management	Core	3	1	0	4
BME614	Product Innovation & Entrepreneurship	Core	3	1	0	4
BME615	Mech. Engg. Lab-III (Manufacturing) Lab	Skill based	0	0	4	2
BME616	Computer Aided Design & Analysis Lab	Skill based	0	0	2	1
BME617	Manufacturing Automation Lab	Skill based	0	0	2	1
BME618	Operation Research	Skill based	3	0	0	3
BME619	Engineering Project-I(Literature Review)	Skill based	0	0	4	2
Total			15	2	12	23

Semester: VII						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**
XXX	Professional Elective-I	Discipline Elective-I	3	0	0	3
XXX	Professional Elective-II	Discipline Elective -II	3	0	0	3
XXX	XXX	Open Elective-I	3	0	0	3
XXX	XXX	Open Elective-II	3	0	0	3
BME713	Engineering Project-II (Design & Analysis)	Skill based	0	0	10	5
BME714	Seminar	Skill based	0	0	2	1
BME799	xxx	MOOC	-	-	-	2
Total			12	0	12	20
Open Elective Courses for other Departments						
BME715	Supply Chain Management	Open Elective-I	3	0	0	3
BME716	Six Sigma	Open Elective-II				

Semester: VIII						
Course Code Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	Credits
XXX	Professional Elective- III	Discipline Elective -III	3	0	0	3
XXX	XXX	Open Elective-III	3	0	0	3
BME802	Engineering Project-III (Prototype &	Skill based	0	0	16	8
Total			**6**	**0**	**16**	14
Grand Total			**108**	**17**	**78**	**166**
Open Elective Courses for other Departments						
BME803	Total Quality Management	Open Elective-III	3	0	0	3

Professional Elective Courses

Total **3** to be taken, at least one from each group – *Technology* and *Industry Sector*, based on Project topic and individual interest. Illustrative courses are listed here

Technology					
Course	**Course Title**	**L**	**T**	**P**	**Credits**
BME901	Finite Element Analysis	3	0	0	3
BME902	Computational Fluid Dynamics	3	0	0	3
BME903	Power Plant Engineering	3	0	0	3
BME904	Renewable Energy Engineering	3	0	0	3
BME905	Design for Manufacturing & Assembly	3	0	0	3
BME906	Eco-Friendly (Green) Design	3	0	0	3
BME907	Additive Manufacturing	3	0	0	3
BME908	Die, Mold and Tool Engineering	3	0	0	3
Industry Sector					
Course	**Course Title**	**L**	**T**	**P**	**Credits**
BME909	Automobile Engineering	3	0	0	3
BME910	Aerospace Engineering	3	0	0	3
BME911	Agricultural Engineering	3	0	0	3
BME912	Biomedical Engineering	3	0	0	3
BME913	Food Technology	3	0	0	3
BME914	Marine Engineering	3	0	0	3
BME915	Nuclear Engineering	3	0	0	3
BME916	Textile Engineering	3	0	0	3

Open Elective Courses

Student will select any **3** courses (from any department), based on individual interest andproject list provided by the dean academic office.

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 conduct a One-week workshop during the winter break after fifth semester on professional/ industry/ entrepreneurial orientation.
3. It is mandatory to organize at least one expert lecture per semester for each branch by inviting resource persons from domain specific industry.

Evaluation Criteria for Theory Courses

A. Continuous Assessment: [30 Marks]

CA-I Surprise Test (Two best out of three) - (10 Marks)

CA-II Assignment(s) (10 Marks)

CA-III Term paper/Quiz/Presentation (5 Marks)

B. Attendance (5 marks)

C. Mid Semester Test: [30 Marks]

D. End Semester Exams: [40 Marks]

Evaluation Criteria for Practical Courses

Performance of each practical-(10 Marks)

Report- (5 Marks)

Practical Viva – **(**5 Marks)

Total - (20 Marks) (Each Practical)

SEMESTER- I

Course Title: BASIC ELECTRICAL ENGINEERING
Course Code: BME101

L	T	P	Credits
3	0	0	3

TotalHours-45

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

1. Understand the DC and AC electrical circuit elements with RLC.
2. Analysis of simple circuits with dc excitation. Superposition, The venin and Norton Theorems.
3. Use Single Phase AC Circuits and representation of alternating quantities and determining the power in these circuits.
4. Classify the different types of Electrical machines.

Course Content

UNIT I **15 Hours**

DC Circuits

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

UNIT II **10 Hours**

AC Circuits

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three- phase balanced circuits, voltage and current relations in star and delta connections.

Transformers

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

UNIT III **10 Hours**

Electrical Machines

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

UNIT IV **10 Hours**

Power Converters

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Electrical Installations

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Transaction Mode

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

Suggested Readings

- *Kothari, D. P. and Nagrath, I. J. (2010). Basic Electrical Engineering. Tata McGraw Hill.*
- *Kulshreshtha, D. C. (2009). Basic Electrical Engineering. McGraw Hill.*
- *Bobrow, L. S. (2011). Fundamentals of Electrical Engineering. Oxford University Press.*
- *Hughes, E. (2010). Electrical and Electronics Technology. Pearson*

COURSE TITLE: ENGINEERING PHYSICS
COURSE CODE: BME110

L	T	P	Credits
3	1	0	4

Total Hours: 60

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

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 **15 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 **15 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 **15 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 **15 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 MATHEMATICS-I
COURSE CODE: BME111

L	T	P	Credits
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 GRAPHICS & DRAWING
COURSE CODE: BME104

L	T	P	Credits
1	0	4	3

Total Hours-45

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 **9 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 **12 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 **14 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 **10 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: ENGINEERING PHYSICS LAB
Course Code: BME112

L	T	P	Credits
0	0	4	2

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. Analyse 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 ELECTRICAL ENGINEERING LAB
Course Code: BME106

L	T	P	Credits
0	0	4	2

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 Content

List of Experiments:

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
3. Transformers: Observation of the no-load current waveform on an oscilloscope (non- sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
4. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
5. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
6. Torque Speed Characteristic of separately excited dc motor.
7. Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super- synchronous speed.
8. Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.
9. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

Course Title: Fundamental of Computer and Information Technology
Course Code: BME113

L	T	P	Credits
2	0	0	2

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

UNIT I **8 Hours**

Computer Hardware / Software- Definition, History, Generation, Characteristics, Types & Applications, Overview of a computer system:

Hardware/Software-Definition of Hardware**,** Input Unit: Keyboard, Mouse, Scanner etc**,** CPU: Arithmetic Logic Unit (ALU), Control Unit (CU), Memory Unit (MU)**,** Output Unit: Monitor, Printer etc**,** Storage Devices: Primary &Auxulary Memory (Floppy Disk, Hard Disk, Compact Disk, DVD, Flash Disk etc)**,** Others: Network Card, Modem, Sound Card etc.

Software: Definition & types of Software, Programming Language, Liveware, Firmware and Cache Memory

UNIT II **7 Hours**

Setting & Protection of Computer Room and Computer- Concept of **Computer related threats** (virus, worms, Trojan, phishing etc) remedies and protection

File Management basics: Physical structure of disk

UNIT III **7 Hours**

Concept of E-mail / Internet / Extranet, World Wide Web (WWW)- Familiarity with internet browsers (eg.Inernet Explorer, Firefox, Opera, Safari, Google Chrome etc.), Introduction of IP address, suBMEt mask and default gateway, Introduction to Network Media, topology and protocol, Setting up Microsoft Network, Dial-Up Networking

UNIT IV **8 Hours**

Number System: Introduction to binary, octal, decimal and hexadecimal number system Introduction to ASCII and Unicode standards

Transaction Mode

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

Suggested Readings

- *Rajaraman, V., & Adabala, N. (2014). Fundamentals of computers. PHI Learning Pvt. Ltd..*
- *Doja, M. N. (2005). Technology. Deep and Deep Publications.*
- *Bangia, R. (2008). Computer Fundamentals and Information Technology. Firewall Media.*

Course Title: Constitution of India
Course Code: BME114

L	T	P	Credits
2	0	0	NC

Total Hours-30

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

1. Knowledge and legal literacy and thereby to take up competitive examinations
2. Understand state and central policies, fundamental duties, Electoral Process, and special provisions
3. Analyze powers and functions of Municipalities, Panchayats and Co-operative Societies, and
4. Classify the engineering ethics and responsibilities of Engineer and an awareness about basic human rights in India

Course Content

Unit I **5 Hours**

Introduction to the Constitution of India, The Making of the Constitution and Salient features of the Constitution.

Preamble to the Indian Constitution Fundamental Rights & its limitations.

Unit II **10 Hours**

Directive Principles of State Policy & Relevance of Directive Principles State Policy Fundamental Duties.

Union Executives – President, Prime Minister Parliament Supreme Court of India.

State Executives – Governor Chief Minister, State Legislature High Court of State.

Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th &91st Amendments.

Unit III **10 Hours**

Special Provision for SC & ST Special Provision for Women, Children & Backward Classes Emergency Provisions. Human Rights –Meaning and Definitions, Legislation Specific Themes in Human Rights- Working of National Human Rights Commission in India

Powers and functions of Municipalities, Panchyats and Co – Operative Societies.

Unit IV **5 Hours**

Scope & Aims of Engineering Ethics, Responsibility of Engineers Impediments to Responsibility.

Risks, Safety and liability of Engineers, Honesty, Integrity & Reliability in Engineering.

Transaction Mode

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

Suggested Readings:

- *Singh Mahendra, P. (2000). VN Shukla's Constitution of India. Eastern Book Company, Lucknow.*
- *Agrawal, P. K., & Gupta, V. (2023). The Constitution of India Bare Act with Short Notes-Useful for Competitive Examinations: Bestseller Book by Dr. PK Agrawal; Virag Gupta: The Constitution of India Bare Act with Short Notes-Useful for Competitive Examinations. Prabhat Prakashan.*
- *Ghosh, P. K. (1966). Constitution of India (Prabhat Prakashan): How it Has Been Framed. Prabhat Prakashan.*

SEMESTER-II

L	T	P	Credits
3	0	0	3

Course Title: ENGINEERING CHEMISTRY
Course Code: BME201

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 MATHEMATICS –II
Course Code: BME214

L	T	P	Credits
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: PROGRAMMING FOR PROBLEM SOLVING
Course Code: BME203

L	T	P	Credits
3	0	0	3

Total Hours-45

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

1. Design the algorithms to write programs.
2. Illustrate arrays, pointers and structures to formulate algorithms and programs
3. Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration
4. Implement conditional branching, iteration and recursion.

Course Content

UNIT I **15 Hours**

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

UNIT II **15 Hours**

1. Arithmetic expressions and precedence
2. Conditional Branching and Loops
3. Writing and evaluation of conditionals and consequent branching
4. Iteration and loops
5. Arrays: Arrays (1-D, 2-D), Character arrays and Strings

UNIT III **8 Hours**

1. Basic Algorithms
   Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of Equations, notion of order of complexity through example programs (no formal definition required)
2. Function
   Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference.
3. Recursion
   Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT IV **7 Hours**

1. Structure

Structures, Defining structures and Array of Structures

2. Pointers
   Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)
   File handling (only if time is available, otherwise should be done as part of the lab)

Transaction Mode

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

Suggested Readings

- *Byron Gottfried, Schaum's (1995), Outline of Programming with C, McGraw-Hill*
- *E. Balaguru swamy (2005) Programming in ANSI C, Tata McGraw-Hill*

Course Title: COMMUNICATION SKILLS
Course Code: BME204

L	T	P	Credits
3	0	0	3

Total Hours-45

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 **16 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 **14 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
Course Code: BME205

L	T	P	Credits
1	0	4	3

Total Hours-45

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 **8 Hours**

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

UNIT II **6 Hours**

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

UNIT III **6 Hours**

1. Plastic moulding, glass cutting
2. Metal casting

UNIT IV **10 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: ENGINEERING CHEMISTRY LAB
Course Code: BME206

L	T	P	Credits
0	0	2	1

Total Hours-15

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: PROGRAMMING FOR PROBLEM SOLVING LAB
Course Code: BME207

L	T	P	Credits
0	0	2	1

Total Hours-15

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

1. Create read and write to and from simple text files.
2. Identify and correct logical errors encountered at run time
3. Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.
4. Represent data in arrays, strings and structures and manipulate them through a program

Course Content

List of Experiments:

Tutorial 1: Problem solving using computers
Lab1: Familiarization with programming Environment

Tutorial 2: Variable types and type conversions
Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions
Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops
Lab 4: Iterative problems e.g., sum of series

Tutorial 5: 1D Arrays: searching, sorting
Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings, memory structure
Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value
Lab 7: Simple functions

Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical integration)
Lab 8 and 9: Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls
Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation
Lab 11: Pointers and structures

Tutorial 12: File handling
Lab 12: File operations

Suggested Readings:

- *Byron Gottfried, Schaum's (1995), Outline of Programming with C, McGraw-Hill*
- *E. Balaguruswamy (2005) Programming in ANSI C, Tata McGraw-Hill.*

.

Course Title: COMMUNICATION SKILLS LAB
Course Code: BME208

L	T	P	Credits
0	0	2	1

Total Hours-15

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

1. Illustrate the importance of pronunciation and apply the same day to day conversation.
2. Apply verbal and non-verbal communication techniques in the Professional Environment.
3. Develop coherence, cohesion and competence in Oral discourse.
4. Evaluate the interview process confidently.

Course Content

Oral Communication

(This unit involves interactive practice sessions in Language Lab)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

Course Title: Entrepreneurship Development
Course Code: BME209

L	T	P	Credits
1	0	0	1

Total Hours: 15

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

1. Assess the commercial viability of new technologies, business opportunities and existin companies
2. Plan, organize, and execute a project or new venture with the goal of bringing new products and service to the market
3. Carry out scientific research in the field of entrepreneurship
4. Improved your interpersonal and collaborative skills

Course Content

UNIT I **10 Hours**

Introduction to Generic Skills: Importance of Generic Skill Development (GSD), Global and Local Scenario of GSD, Life Long Learning (LLL) and associated importance of GSD.

Managing Self: Knowing Self for Self Development- Self-concept, personality, traits, multiple intelligence such as language intelligence, numerical intelligence, psychological intelligence etc., Managing Self – Physical- Personal grooming, Health, Hygiene, Time Management, Managing Self – Intellectual development -Information Search: Sources of information, Reading: Purpose of reading, different styles of reading, techniques of systematic reading, Note Taking: Importance of note taking, techniques of note taking, Writing: Writing a rough draft, review and final draft. Managing Self – Psychological, Stress, Emotions, Anxiety-concepts and significance, Techniques to manage the above.

UNIT II **5 Hours**

Managing in Team: Team - definition, hierarchy, team dynamics, Team related skills- sympathy, empathy, co-operation, concern, lead and negotiate, work well with people from culturally diverse background, Communication in group - conversation and listening skills.

UNIT III **5 Hours**

Task Management: Task Initiation, Task Planning, Task execution, Task close out, Exercises/case studies on task planning towards development of skills for task management

Problem Solving: Prerequisites of problem solving- meaningful learning, ability to apply knowledge in problem solving, Different approaches for problem solving. Steps followed in problem solving. Exercises/case studies on problem solving.

UNIT IV **10 Hours**

Entrepreneurship: Introduction , Concept/Meaning and its need, Competencies/qualities of an entrepreneur, Entrepreneurial Support System e.g., District Industry Centres (DICs), Commercial Banks, State Financial Corporations, Small Industries Service Institute (SISIs), Small Industries Development Bank of India (SIDBI), National Bank of Agriculture and Rural Development (NABARD), National Small Industries Corporation (NSIC) and other relevant institutions/organizations at State/National level. Market Survey and Opportunity Identification (Business Planning)- How to start a small scale industry, Procedures for registration of small-scale industry, List of items reserved for exclusive manufacture in small-scale industry, Assessment of demand and supply in potential areas of growth,

Understanding business opportunity, Considerations in product selection, Data collection for setting up small ventures. Project Report Preparation- Preliminary Project Report, Techno-Economic Feasibility Report, Exercises regarding "Project Report Writing" for small projects.

Transaction Mode

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

Suggested Readings

- Khanka, S. S. (2006). *Entrepreneurial development*. S. Chand Publishing.
- Desai, V. (2009). Dynamics of entrepreneurial development and management (pp. 119-134). Himalaya Publishing House.
- Kennedy, A. (2015). *Business development for dummies*. John Wiley & Sons.

Course Title: NUMERICAL APTITUDE & REASONING ABILITY
Course Code: BME210

L	T	P	Cr.
1	0	0	1

Total Hours-15

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

1. Understand the basic concepts of quantitative ability and logical reasoning Skills
2. Learn the basic concepts of Acquire satisfactory competency in use of reasoning
3. Solve campus placements aptitude papers covering Quantitative Ability, Logical Reasoning
4. Create the ability to appear in exams like CAT, CMAT, GATE, GRE, GATE, UPSC, GPSC etc.

Course Content

UNIT I **4 Hours**

1. Quantitative Ability (Basic Mathematics)
1.1. Number Systems
1.2. LCM and HCF
1.3. Decimal Fractions
1.4. Simplification
1.5. Square Roots and Cube Roots
1.6. Average
1.7. Problems on Ages
1.8. Surds & Indices
1.9. Percentages
1.10 Problems on Numbers

UNIT II **4 Hours**

2. Quantitative Ability (Applied & Engineering Mathematics)
2.1. Logarithm
2.2. Permutation and Combinations
2.3 Probability
2.4 Profit and Loss
2.5 Simple and Compound Interest
2.6. Time, Speed and Distance
2.7. Time & Work
2.8. Ratio and Proportion
2.9. Area
2.10 Mixtures and Allegation

UNIT III **4 Hours**

3. Data Interpretation
3.1. Data Interpretation
3.2. Tables
3.3. Column Graphs
3.4. Bar Graphs
3.5. Line Charts
3.6. Pie Chart
3.7. Venn Diagrams

UNIT IV **3 Hours**

4. Logical Reasoning (Deductive Reasoning)
4.1. Analogy
4.2. Blood Relation
4.3 Directional Sense
4.4. Number and Letter Series
4.5. Coding – Decoding
4.6. Calendars
4.7. Clocks
4.8. Venn Diagrams
4.9. Seating Arrangement
4.10. Syllogism
4.11. Mathematical Operations

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 Modern Approach To Verbal & Non Verbal Reasoning By R S Agarwal, 2018.*
- *Analytical and Logical reasoning By Sijwali B S*
- *Quantitative aptitude for Competitive examination By R S Agarwal*
- *Analytical and Logical reasoning for CAT and other management entrance test By Sijwali B S*
- *Quantitative Aptitude by Competitive Examinations by AbhijitGuha 4th edition, 2016.*

Course Title: STRESS MANAGEMENT
Course Code: BME211

L	T	P	Cr.
1	0	0	1

Total Hours-15

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

1. Identify the nature and causes of stress in organizations
2. Knowledge of stress prevention mechanism
3. Classify the strategies that help cope with stress
4. Apply stress management principles in order to achieve high levels of performance and adopt effective strategies, plans and techniques to deal with stress

Course Content

UNIT I **3 Hours**

1. Understanding Stress
1.1 Stress – concept, features, types of stress
1.2 Relation between Stressors and Stress
1.3 Potential Sources of Stress – Environmental, Organizational and Individual
1.4 Consequences of Stress – Physiological, Psychological and Behavioural Symptoms
1.5 Stress at work place – Meaning, Reasons
1.6 Impact of Stress on Performance
1.7 Work Stress Model
1.8 Burnout – Concept
1.9 Stress v/s Burnout

UNIT II **4 Hours**

2. Managing Stress – I
2.1 Pre-requisites of Stress-free Life
2.2 Anxiety - Meaning, Mechanisms to cope up with anxiety
2.3 Relaxation - Concept and Techniques
2.4 Time Management - Meaning, Importance of Time Management
2.5 Approaches to Time Management
2.6 Stress Management - Concept, Benefits
2.7 Managing Stress at Individual level
2.8 Role of Organization in Managing Stress/ Stress Management Techniques
2.9 Approaches to Manage Stress - Action oriented, Emotion oriented, Acceptance oriented.

UNIT III **4 Hours**

3. Managing Stress – II
3.1 Models of Stress Management - Transactional Model, Health Realization/ Innate Health Model
3.2 General Adaption Syndrome (GAS) - Concept, Stages
3.3 Measurement of Stress Reaction - The Physiological Response,
3.4 The Cognitive Response, The Behavioural Response.
3.5 Stress prevention mechanism - Stress management through mind control and purification theory and practice of yoga education.
3.6 Stress management interventions: primary, secondary, tertiary.
3.7 Meditation – Meaning, Importance

UNIT IV **4 Hours**

4. Stress Management Leading to Success
4.1 Eustress – Concept, Factors affecting Eustress
4.2 Stress Management Therapy - Concept, Benefits
4.3 Stress Counselling - Concept
4.4 Value education for stress management
4.5 Stress and New Technology
4.6 Stress Audit Process
4.7 Assessment of Stress - Tools and Methods
4.8 Future of Stress Management

Transaction Mode

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

Suggested Readings:

- *Heena T. Bhagtani. (2018). Stress Management. Himalaya Publishing House.*
- *Dutta, P,K, (2010) Stress Management. Himalaya Publishing House.*
- *Roy,S (2012). Managing Stress. Sterling Publication.*

Semester-III

Course Title: ENGINEERING PHYSICS-II
Course Code: BME313

L	T	P	Cr.
3	1	0	4

Total Hours-60

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

1. Develop a solid foundation in physics principles, including mechanics, thermodynamics, and electromagnetism.
2. Understand the behaviour of light, interference, diffraction, and basic wave phenomena.
3. Gain insight into quantum theory, wave-particle duality, and fundamental atomic and molecular physics.
4. Explore relativity, nuclear physics, and particle physics concepts shaping the modern understanding of the universe.
5. Apply physics concepts to solve engineering problems, making informed design and analysis decisions.

Course Contents

Unit I **15 Hours**

Simple harmonic motion, damped and forced simple harmonic oscillator

Mechanical and electrical simple harmonic oscillators, complex number notation and phasor representation of simple harmonic motion, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, electrical and mechanical impedance, steady state motion of forced damped harmonic oscillator, power absorbed by oscillator.

Unit II **15 Hours**

Non-dispersive transverse and longitudinal waves in one dimension and introduction to dispersion

Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their Eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves and speed of sound, standing sound waves. Waves with dispersion, water waves, superposition of waves and Fourier method, wave groups and group velocity.

Unit III **13 Hours**

The propagation of light and geometric optics

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them, transfer formula and the matrix method.

Unit IV **17 Hours**

Wave optics

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach-Zehnder interferometer.

Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power.

Lasers

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

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 (Oscillations, Waves & Optics) with Lab ManualISBN: 978-93-91505-13-4*
- *Bhattacharya & Nag, Engineering Physics, 2021.*
- *Ian G. Main, Oscillations and waves in physics, 1932.*
- *H.J. Pain, The physics of vibrations and waves, 1968.*
- *E. Hecht, Optics, 2016.*
- *A. Ghatak, Optics, 1977.*
- *O. Svelto, Principles of Lasers, 1976.*

Course Title: **ENGINEERING MATHEMATICS-III**
Course Code: **BME314**

L	T	P	Cr.
3	1	0	4

Total Hours-60

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

1. Ability to solve various types of partial differential equations using specialized techniques.
2. Analyse random variables, calculate moments, and perform hypothesis tests.
3. Apply differential equations in different coordinate systems for real-world problem-solving.
4. Understand the Proficiency in bivariate distributions analysis and curve fitting using least squares method.
5. Understand and apply probability theory, conditional probability, and independence of events.

Course Contents

UNIT I **13 Hours**

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'A lembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation.

UNIT II **17 Hours**

Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables. Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables;

UNIT III **15 Hours**

Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions,

UNIT IV **15 Hours**

Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves.

Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean,difference of means, and difference of standard deviations. Test for ratio of variances - Chi- square test for goodness of fit and independence of attributes

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 Prescribed Textbook: Mathematics – II (Probability and Statistics), ISBN: 978-93-91505-41-7*
- *Reena Garg, Engineering Mathematics, Khanna Book Publishing Company, 2022.*
- *Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2021.*
- *Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.*
- *N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint,2010.*

Course Title: ENVIRONMENT SCIENCE
Course Code: BME315

L	T	P	Credits
2	0	0	NC

Total Hours-30

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

1. Measure environmental variables and interpret results
2. Evaluate local, regional and global environmental topics related to resource usage and management
3. Propose solutions to environmental problems related to resource usage and management
4. Interpret the results of scientific studies of environmental problems
5. Describe threats to global biodiversity, their implications and potential solutions

Course Content

UNIT I **6 Hours**

Introduction: Definition and scope and importance of multidisciplinary nature of environment. Need for public awareness.

Natural Resources: Natural Resources and associated problems, use and over exploitation, case studies of forest resources and water resources.

Ecosystems: Concept of Ecosystem, Structure, interrelationship, producers, consumers and decomposers, ecological pyramids-biodiversity and importance. Hot spots of biodiversity.

UNIT II **10 Hours**

Environmental Pollution: Definition, Causes, effects and control measures of air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measure of urban and industrial wastes. Role of an individual in prevention of pollution, Pollution case studies.

UNIT III **8 Hours**

Disaster Management: Floods, earthquake, cyclone and landslides.

Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.

Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of pollution) Act. Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation Public awareness.

UNIT IV **6 Hours**

Human Population and the Environment: Population growth, variation among nations. Population explosion – Family Welfare Program. Environment and human health, Human Rights, Value Education, HIV/AIDS. Women and child Welfare. Role of Information Technology in Environment and human health. 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:

- *Agarwal, K. C.(1987). Environment Biology. Nidi Publ. Ltd.Bikaner.*
- *Jadhav, H, &Bhosale, V.M.(1995).Environment Protection and Laws. Himalaya Pub House,Delhi*
- *Rao, M. N. &Datta, A.K.(2008).Waste Water Treatment. Oxford & IBH Publ. Co. Pvt.Ltd*

Course Title: BASIC ELECTRONIC ENGINEERING
Course Code: BME316

L	T	P	Cr.
3	1	0	4

Total Hours-60

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

- Understand P-N junction diodes, rectifiers, Zener diodes, and their applications in electronic circuits.
- Analysis of operational amplifier configurations and their applications in amplification, integration, and more.
- Learn about timing circuits using RC elements and oscillator concepts with IC 555.
- Acquire the knowledge about digital logic principles, including gates, flip-flops, counters, and microprocessor basics.
- Explore communication system elements, modulation techniques, and mobile communication basics.

Course Contents

UNIT I **13 HOURS**

Introduction to P-N Junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.

UNIT II **17 Hours**

Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator. RC-timing circuits, IC 555 and its applications as a stable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.

UNIT III **15 Hours**

Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, de-multiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

UNIT IV **15 Hours**

The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.

Transaction Mode

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

Suggested Readings:

- *Floyd, Electronic Devices‖ Pearson Education 9th edition, 2012.*
- *R.P. Jain, —Modern Digital Electronics‖, Tata Mc Graw Hill, 3rd Edition, 2007.*
- *A.K. Maini & Nakul Maini - All-in-One Electronics Simplified, Khanna Book Publishing, 2021.*
- *Frenzel, —Communication Electronics: Principles and Applications‖, Tata Mc Graw Hill, 3rd Edition,2001*
- *Mittel, Basic Electrical Engineering, Tata McGraw Hill*

Course Title: **ENGINEERING MECHANICS**
Course Code: **BME317**

L	T	P	Cr.
3	1	0	4

Total Hours-60

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 **15 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 **14 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 coordinate system 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 **13 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**
Course Code: **BME318**

L	T	P	Cr.
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**

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

UNIT II **14 Hours**

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

UNIT III **16 Hours**

Properties of dry and wet air, use of pschyrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point. Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, super saturation-compressible flow in diffusers, efficiency of nozzle and diffuser.

UNIT IV **14 Hours**

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors. Analysis of steam turbines, velocity and pressure compounding of steam turbines

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 ofThermodynamics, 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 of Engineering Thermodynamics, JohnWiley and Sons.*
- *Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd*

Course Title: **ENGINEERING PHYSICS-II LAB**
Course Code: **BME319**

L	T	P	Cr.
0	0	2	1

Total Hours-15

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

1. Illustrate the working laser pointer.
2. Analyse 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 Contents

Suggested list of experiments from the following:

Diffraction and interference experiments (from ordinary light or laser pointers); measurementof speed of light on a table top using modulation; minimum deviation from a prism.

Course Title: **BASIC ELECTRONICS ENGINEERING LAB**
Course Code: **BME320**

L	T	P	Cr.
0	0	2	1

Total Hours-15

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

1. Verification of ohms and Kirchhoff's Laws.
2. Three Phase Power Measurement
3. Load test on DC Shunt Motor.
4. Load test on Self Excited DC Generator
5. Load test on Single phase Transformer
6. Load Test on Induction Motor
7. Characteristics of PN and Zener Diodes
8. Characteristics of BJT, SCR and MOSFET
9. Design and analysis of Half wave and Full Wave rectifiers
10. Measurement of displacement of LVDT

Semester: IV

Course Title: HEAT TRANSFER & THERMAL MACHINES
Course Code: BME411

L	T	P	Cr.
3	1	0	4

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 oremploy 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 **14 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 **18 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 **15 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 **13 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: **FLUID MECHANICS & HYDRAULIC MACHINES**

Course Code: **BME412**

L	T	P	Cr.
3	1	0	4

Total Hours-60

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

1. Understand the concept of Comprehend the fundamental properties and behaviour of fluids, including viscosity, pressure, and buoyancy.
2. Analysis the Master fluid flow principles, equations of motion, and Bernoulli's theorem for analysing fluid behaviour 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 **15 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 **15 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. (4)

UNIT III **15 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 and minor losses (Darcy's and Chezy's equation); Flow through siphon pipes; Branching pipes and equivalent pipe.

UNIT IV **15 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: **MECHANICS OF DEFORMABLE SOLIDS**
Course Code: **BME413**

L	T	P	Cr.
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 andunderstand 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 developedwithin 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: **ENGINEERING MATERIALS AND APPLICATIONS**

Course Code: **BME414**

L	T	P	Cr.
3	1	0	4

Total Hours-60

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

1. Select the range of engineering materials, their mechanical properties and applications
2. Understand the various methods to measure the mechanical properties of materials
3. 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 **15 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 **15 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.*
- *U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.*

Course Title: **KINEMATICS AND DYNAMICS OF MACHINES**

Course Code: **BME415**

L	T	P	Cr.
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: **MECHANICAL ENGG. LAB-1 (THERMAL & FLUID)**

Course Code: **BME416**

L	T	P	Cr.
0	0	4	2

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/thermal 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
7. Determination of the thermal conductivity and specific heat of given objects
8. Determination of the calorific value of a given fuel and its flash & fire points
9. Determination of the p-V diagram and the performance of a 4-stroke diesel engine
10. Determination of the convective heat transfer coefficient for flow over a heated plate
11. Determination of the emissivity of a given sample
12. Determination of the performance characteristics of a vapour compression system

*****

Semester: V

Course Title: MACHINE ELEMENT & SYSTEM DESIGN
Course Code: BME511

L	T	P	Cr.
3	1	0	4

Total Hours-60

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 **15 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 **13 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 **17 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 **15 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: **MECHATRONICS, ROBOTICS AND CONTROL**

Course Code: **BME512**

L	T	P	Cr.
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: **MANUFACTURING PROCESSES**
Course Code: **BME504**

L	T	P	Cr.
3	1	0	4

Total Hours-60

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 sheet metal 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 **16 Hours**

Additive, subtractive and shaping processes; Relative advantages and limitations; Inter-dependency of geometry, material and process; Effect on product quality and cost; Part design for manufacturability; Process selection criteria. Metal casting (sand, die and investment casting), Bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending); Thermoplastic and thermoset plastic processes (ex. injection and blow molding); Powder metallurgy; Metal injection molding; Glass and composite processes (layup).

UNIT II **16 Hours**

Turning, Drilling, Milling, Grinding and other finishing processes; Single and multi-point cutting tools; Cutting tool materials; Cutting fluids; Material removal rates, surface finish, accuracy, integrity and machinability Abrasive Jet Machining, Water Jet Machining; Ultrasonic Machining; Electrical Discharge Machining, Wire EDM; Electro- Chemical Machining; Laser Beam Machining, Plasma Arc Machining and Electron Beam Machining; Micro and nano manufacturing.

UNIT III **14 Hours**

Extrusion; vat polymerization, powder bed fusion; material jetting, binder jetting; direct energy deposition and lamination processes. Arc welding, gas welding, shielded metal arc welding; GMAW (MIG) and GTAW (TIG); Brazing and soldering; Solid state joining; Adhesive bonding.

UNIT IV **14 Hours**

Casting – metal flow, solidification and cooling; application to design of gating and feeding systems for quality and yield optimization; OR *Forming* – Plastic deformation and yield criteria; load estimation; OR *Machining* – Orthogonal cutting, various force components; Chip formation, Tool wear and tool life.

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: **MEASUREMENTS AND METROLOGY**
Course Code: **BME513**

L	T	P	Cr.
3	0	0	3

Total Hours-45

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

1. Basic knowledge about measurement systems and their components
2. Various instruments used for measurement of mechanical and electrical parameters
3. Integrate measurement systems for process monitoring and control
4. Design of limits, fits and tolerances for given applications

Course Contents

UNIT I **10 Hours**

Parameters – geometry (straightness, flatness, roundness, etc.), displacement, force, speed, torque, flow, level, pressure, temperature, acceleration, etc.; Definitions: Accuracy, precision, range, resolution, uncertainly and error sources; Regression analysis. Structure and examples of measurement systems; Calibration principles; Linear and angular measurements; Comparators; Gauge design; Interferometry.

UNIT II **15 Hours**

Definitions; Tolerance zone and grades, Hole and shaft system, Geometric tolerances, Tylor's principle of gauging, Design of tolerances for various applications; Tolerance analysis in manufacturing and assembly; Role of metrology in Design of Manufacturing. *Dimensional metrology* – Vernier, micrometers, LVDT; *Form metrology* – form tester, surface profiler, CMM, 3D scanning; *Surface metrology* – optical microscopes, Laser scanning microscopes, electron microscopy (SEM/TEM), x-ray microscopy, Raman spectroscopy; Tool wear, workpiece quality and process metrology.

UNIT III **12 Hours**

Measurement of temperature, thermal conductivity and diffusivity; Flow obstruction methods; Magnetic flow meters.Signal generators and analysis; Wave analyzer; Spectrum analyzer; *Frequency counters* – measurement errors, extending the frequency range; *Transducers* – types, strain gages, displacement transducers; *Digital data acquisition system* - interfacing transducers to electronics control and measuring system; Instrumentation amplifier; Isolation amplifier; Computer-controlled test systems.

UNIT IV **8 Hours**

DOE techniques; Taguchi orthogonal arrays; Data acquisition, signal processing and conditioning; Error of a system of ideal elements; Error probability density function of a system of non-ideal elements; Error reduction techniques; Quality control and assurance in industry.

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: **MECHATRONICS, ROBOTICS AND CONTROL LAB**

Course Code: **BME514**

L	T	P	Cr.
0	0	2	1

Total Hours-15

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: **MEASUREMENTS & METROLOGY LAB**
Course Code: **BME515**

L	T	P	Cr.
0	0	2	1

Total Hours-15

Course Contents

List of Experiments

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

Course Title: **MECHANICAL ENGINEERING LAB-II (DESIGN)**

Course Code: **BME516**

L	T	P	Cr.
0	0	4	2

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 behaviour 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 oscillatingcylinder mechanisms
10. Cam & follower and motion studies
11. Single degree of freedom Spring-mass-damper system, determination of natural frequency anddamping coefficient
12. Determination of torsional natural frequency of single and double rotor systems- undamped anddamped natural frequencies

Course Title: **PROJECT MANAGEMENT**
Course Code: **BME517**

L	T	P	Cr.
3	0	0	3

Total Hours-45

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

1. Differentiate between project, program, and sub-project by identifying contrasting and related characteristics of each utilizing examples from engineering specific industries.
2. Employ an integrated real-world engineering project to create deliverables, such as a work breakdown structure and a project charter, scope statement, project network diagrams and time-driven schedule.
3. Identify each of the following tools, techniques or outputs using an automated project management tool: Critical path; Schedule compression; Crashing; Slack/float; Fast tracking; and Resource leveling
4. Apply project scheduling concepts, geared toward typical Mechanical engineering Concepts, such as Activity Gantt Chart, resource gram/ histogram; resource spreadsheet; and resource-driven schedule through multimedia presentation showing step-by-step procedure.

Course Contents

UNIT I **13 Hours**

Project Management Concepts, Project Planning, Resource Scheduling, Critical Chain Scheduling, Project Quality Management.

UNIT II **10 Hours**

Project performance Measurement and Control, Project Closure/ Termination.

UNIT III **12 Hours**

Managing Project Teams, IT in Projects, International Projects: Issues in managing international projects.

UNIT IV **10 Hours**

Selection and training of employees, cross cultural considerations.

Transaction Mode

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

Suggested Readings:

- *Clifford F Gray, Erik W Larson, "Project Management-The Managerial Process", Tata Mcgraw-Hill Publishing Co Ltd, 2017.*
- *Jack Meredith, Samuel J. Mantel Jr. "Project Management- A Managerial Approach", John Wiley and Sons, 1999.*
- *John M Nicholas "Project Management For Business And Technology" Prentice Hall of India Pvt Ltd*
- *James P Lewis "Project Planning, Scheduling And Control" Tata Mcgraw-Hill Publishing Co Ltd.*

SEMESTER: VI

Course Title: COMPUTER AIDED DESIGN & ANALYSIS
Course Code: BME611

L	T	P	Credits
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 **14 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: MANUFACTURING AUTOMATION
Course Code: BME612

L	T	P	Credits
3	0	0	3

Total Hours-45

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

1. Understand the importance of automation in manufacturing value chain
2. Get the knowledge of various elements of automation tools and techniques
3. Understand the emerging digital manufacturing trends
4. Analysis of Manufacturing Automation case studies

Course Content

UNIT I **10 Hours**

Introduction: Definition; Reasons for automating; Strategies; Types of automation; Numerical control (NC, CNC, DNC); Introduction to CNC programming and computer-aided process planning.

Machine and Process Automation: CNC machines, Automated flow lines (types, selection); Work part transport and transfer mechanisms; Feedback systems and control; Modular and reconfigurable machines, adaptive machine controls.

UNIT II **11 Hours**

Automated Assembly Systems: Historical developments; Choice of assembly methods; Design for automated assembly; Transfer systems; Vibratory and non-vibratory feeders; Feed tracks, part orienting and placing mechanisms.

Factory Automation: Lean manufacturing, Automation scalability (fixed, programmable, flexible and reconfigurable); Design and analysis of automated flow lines; Average production time, production rate, line efficiency; Analysis of transfer lines without storage; Partial and full automation.

UNIT III **14 Hours**

Automation Tools and Techniques: Mechanical, electro-mechanical, pneumatic and hydraulic systems; Sensors integration; Process monitoring, data analysis and control using actuators; Robots (pick, place, assembly, welding, painting, etc.); Automatic Guided Vehicles; Automated inspection and measurement (CMM and 3D Scanning); Machine vision, AI and machine learning; Human- machine interfaces; Examples and case studies.

Advanced Automation Trends: Digital, inclusive, smart and distributed manufacturing; Industry 4.0; Digital transformations in shop-floors (CIM to Smart factory; Intelligent machines to Smart Machines; Factory automation to Distributed automation; Human sense to system sensed).

UNIT IV **10 Hours**

Examples and Case Studies: Pick and place robots, testing and sorting based systems, etc; Orientation of parts: in-bowl and out-of-bowl toolings; Manufacturing equipment embedded with digital data and driven by adoptive controls; Manufacturing automation with autonomous decisions taken by computers based on the realistic process/machines (production conditions) data acquired from the resources.

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. P. Groover, Automation, Production Systems and Computer-integrated Manufacturing,Prentice Hall, 2018.*
- *S. Kalpakjian and S. R. Schmid, Manufacturing – Engineering and Technology, Pearson.*
- *Yoram Koren, Computer Control of Manufacturing Systems, McGraw Hill, 2005.*
- *CAD/CAM Principles and Applications, P.N. Rao, Tata McGraw Hill, 2010.*

Course Title: PRODUCTION & OPERATION MANAGEMENT
Course Code: BME613

L	T	P	Credits
3	1	0	4

Total Hours-60

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

1. Provide knowledge on production management techniques that develop and establish relationship between market demand and production capability.
2. Understand the operation management: Resource planning and their utility
3. Understand the scientific approach and tools and techniques that assure marketcompetitiveness by ensuring the quality, cost and time,
4. Analysis the minimal spanning tree and maximum flow model.

Course Content

UNIT I **18 Hours**

Introduction: Scope of production management. Production system and resources (machines, tooling, etc.); Types of production (batch, flow and unit), Roles of line supervisors and production managers.

Project Management: Project life cycle: concept phase (RFQ, Quotations, Proposals), Project initiations, DPR preparation (project value, business case development and feasibility study); Projectplanning (obtaining resources, acquiring financing and procuring required materials); Project team, producing quality outputs, handling risk, acceptance criteria; Project execution (allocation of resources, scheduling, building deliverables); Project Monitoring and control: Project networks, progress review (physical and financial), CPM and PERT, critical path, re-scheduling; Project closure: acceptance of project deliverable; Analytics: Performance, capability aggregation, cost benefit analysis, variability analysis, Output-outcome analysis, project documentation, best practices, and depository.

UNIT II **12 Hours**

Production Planning and Control: Production planning, Process planning, Resource planning, demand-utility mapping (production capability index, forecasting models, aggregate production planning, materials requirement planning); Inventory Management: Economic order Quantity, discount models, stochastic inventory models, practical inventory control models, JIT; Supply chain and management.

UNIT III **15 Hours**

Factory Management: Factory layout: line balancing, material flow and handling, Lean and green manufacturing, Human resource management, Training need analysis, Advantage and opportunitiesfor Digitalization, Advanced factory systems: TQM; Important acts, regularities and safety norms, Reliability assessment of processes, Block chain, Energy management, Efficiency & throughput, Overall equipment effectiveness. Process capability, lean manufacturing.

UNIT IV **15 Hours**

Operation Management: Linear programming, objective function and constraints, graphical method, Simplex and duplex algorithms, transportation assignment; Simple queuing theory models; Traveling Salesman problem; Network models:

shortest route, minimal spanning tree, maximum flow model.

Transaction Mode

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

Suggested Readings

- *L.J. Krajewski and L.P Ritzmen, Operations Management: Strategy and Analysis, Pearson,2010.*
- *R.B. Chase, F.R. Jacobs and N.J. Aquilano, Operations Management for CompetitiveAdvantage, Tata McGraw Hill, 2011.*
- *W. J. Hopp and M. L. Spearman, Factory Physics: Foundations of ManufacturingManagement, McGraw Hill International Edition, 2008.*
- *Mahadevan. B., Operations Management: Theory and Practice, Pearson, 2015.*
- *Taha H. A., Operations Research, 6th Edition, PHI India, 2003.*
- *M.P. Poonia, Total Quality Management, Khanna Publishing House, 2022.*

Course Title: PRODUCT INNOVATION & ENTREPRENEURSHIP
Course Code: BME614

L	T	P	Credits
3	1	0	4

Total Hours-60

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

1. Understand the importance of entrepreneurship and innovation to creating value
2. Analyze marketing theory and frameworks in formulating entrepreneurship and innovation
3. Construct a marketing plan for new business ventures
4. Evaluate market entry and product/service innovation development

Course Content

UNIT I **15 Hours**

Entrepreneurship: Role of entrepreneurship in economic development; Entrepreneurial mindset, motivation and competencies; Market pull and technology push factors; New product development lifecycle; Technology readiness levels; Product-market fit validation; Commercialization pathways;Business vision & leadership; Team composition & management.

UNIT II **15 Hours**

Product Innovation: Opportunity scanning, market survey, need identification and problem definition; Creative design thinking for concept generation; Detailed design & prototyping; Functionality & manufacturability; Bill of materials & components supply chain; Manufacturing & assembly plan; Product testing & quality assurance; Intellectual property rights management.

UNIT III **15 Hours**

Marketing & Finance: Market segmentation & market sizing; Customer persona & value proposition; Marketing (Go-to-market) strategy; Distribution channels and sales network; Funding requirement (based on stage); Source of funding for startup ventures; Financial projections and accounting; Startup to scale up financing.

UNIT IV **15 Hours**

Venture Creation: Sustainable business options & pathways; Business model & business canvas; Startup team & business partners; Startup ecosystem and stakeholders; Technology business incubators & parks; Proposal pitching & agreements; Startup company incorporation; Social impact& responsibility.

Course Project: Need identification, innovative solution, business plan, go-to-market strategy.

Transaction Mode

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

Suggested Readings

- *Bill Aulet, "Technology Entrepreneurship", 4th ed., Tata McGraw Hill, 2014.*
- *Peter F. Drucker, "Innovation and Entrepreneurship", 1st ed., Harper Business, 2006.*
- *Chelat Bhuvanachandran, Innovision, Khanna Book Publishing, 2022.*

- *Byers, Dorf, and Nelson, Technology Ventures: From Ideas to Enterprise, McGraw Hill, 2010*
- *Steve Blank, "The Startup Owner's Manual"*
- *T.V. Rao, "Entrepreneurship - A South Asian Perspective"*

Course Title: MECHANICAL ENGG. LAB-III (MANUFACTURING)
Course Code: BME615

L	T	P	Credits
0	0	4	2

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
2. Contour milling using vertical milling machine
3. Spur gear cutting in milling machine
4. Measurement of cutting forces in Milling/ Turning process
5. CNC part programming
6. Drilling of a small hole using wire EDM
7. Microprocessor controlled pick & place robot
8. Use of Tool Maker's Microscope
9. Comparator and sine bar
10. Surface finish measurement equipment
11. Bore diameter measurement using micrometer and telescopic gauge
12. Use of Autocollimator

Course Title: COMPUTER AIDED DESIGN & ANALYSIS LAB
Course Code: BME616

L	T	P	Credits
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: MANUFACTURING AUTOMATION LAB
Course Code: BME617

L	T	P	Credits
0	0	2	1

Total Hours-15

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

1. Develop microcontroller programs to monitor and control the manufacturing systems.
2. Design and develop an automated system for a given industrial application.
3. Select and integrate various components of automation like sensors, actuators, PLC and robots for a given application

Course Content

1. Draw the circuit diagram to operate single acting pneumatic cylinder using 3/2 push button direction control valve.
2. Draw the circuit diagram to operate double acting pneumatic cylinder using 5/2 direction control valve using push button momentary switch/push button latch.
3. Draw the circuit diagram to operate single acting pneumatic cylinder using 5/2 air spring valve & PLC.
4. Draw the circuit diagram to operate double acting pneumatic cylinder using 5/2 air spring valve & PLC.
5. Draw the circuit diagram to operate double acting hydraulic cylinder using 4/2 direction control valve (solenoid control) using push button switch/latch switch.
6. Draw the circuit diagram to operate double acting hydraulic cylinder using 4/2 direction.
7. Draw the circuit diagram to operate double acting hydraulic cylinder using 4/2 direction control valve (solenoid control) using PLC.
8. Draw the circuit diagram to operate double acting hydraulic cylinder using 4/3 direction control valve (solenoid control) using PLC.

Course Title: OPERATION RESEARCH
Course Code: BME618

L	T	P	Credits
3	0	0	3

Total Hours-45

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 **11 Hours**

Introduction: Origin of Operation Research, Historical Standpoint, Methodology, Different Phases, Characteristics, Scope and Application of Operations Research:

Linear Programming Problem: Introduction, Requirement of LP, Basic Assumptions, Formulation of LP, General Statement of LP, Solution techniques of LP: Graphical Methods, Analytical Methods: Simplex, Big M and Two Phase, Special Case of LP Problem, Graphical Sensitivity Analysis.

UNIT II **10 Hours**

Transportation and Assignment: Transportation Problems definition, Linear form, Solution methods: North west corner method, least cost method, Vogel's approximation method. Degeneracy in transportation, Modified Distribution method, Unbalanced problems and profit maximization problems. Transshipment Problems. Assignment Problems and Travelling sales man Problem

UNIT III **12 Hours**

Dynamic Programming:

Introduction to deterministic and probabilistic dynamic programming. Solution of simple problems. Advantages of dynamic

Queuing theory:

Types of queuing situation: Queuing models with Poisson's input and exponential service, their application to simple situations.

UNIT IV **12 Hours**

Replacement Models:

Replacement of items that deteriorate, Replacement of items whose maintenance and repair costs increase with time, replacement of items that fail suddenly; replacement of items whose maintenance costs increase with time and value of money also changes, individual replacement policy, group replacement policy.

Network models:

PERT & CPM introduction, analysis of time bound project situations, construction of networks, identification of critical path, slack and floats, crashing of network for cost reduction, resource leveling and smoothening.

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 Operations Research. San Francisco: Holden-Day.*

Course Title: ENGINEERING PROJECT-1 (LITERATURE REVIEW)
Course Code: BME619

L	T	P	Credits
0	0	4	2

Total Hours-30

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.

Semester: VII

Course Title: ENGINEERING PROJECT-II (DESIGN & ANALYSIS)
Course Code: BME713

L	T	P	Credits
0	0	10	5

Total Hours-75

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.

Semester: VIII

Course Title: ENGINEERING PROJECT-III (PROTOTYPE & TESTING)

Course Code: BME802

L	T	P	Credits
0	0	16	8

Total Hours-100

Course Content

It is intended to start the project work early in the seventh semester and carry out both design and fabrication of a mechanical device whose working can be demonstrated. The design is expected to becompleted in the seventh semester and the fabrication and demonstration will be carried out in the eighth semester.

Profession Elective Course
Group: Technology

Course Title: FINITE ELEMENT ANALYSIS
Course Code: BME901

L	T	P	Credits
3	0	0	3

Total Hours-45

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

1. Describe the procedure involved to solve a problem using Finite Element Methods.
2. Examine the element stiffness matrices using different approach.
3. Understand a 2D problem using line, triangular, axisymmetric and quadrilateral element.
4. Examine the theory and characteristics of finite elements that represent engineering structures.

Course Content

UNIT I **12 Hours**

Introduction:
Finite element methods, history and range of applications.

Finite Elements:
Definition and properties, assembly rules and general assembly procedure, features of assembled matrix, boundary conditions.

UNIT II **10 Hours**

Continuum Problems:
Classification of differential equations, variational formulation approach, Ritz method, element equations from variations. Galerkin's weighted residual approach, energy balance methods.

UNIT III **13 Hours**

Element Shapes and Interpolation Functions:
Basic element shapes, generalized coordinates, polynomials, natural coordinates in one-, two- and three-dimensions, Lagrange and Hermite polynomials, two-D and three-D elements for C^o and C^1 problems, Coordinate transformation, iso-parametric elements and numerical integration.

UNIT IV **10 Hours**

Applications & Case Studies:
Application of finite element methods to elasticity and structural, heat transfer, fluid-flow, lubrication and general field 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

1. Huebner, K.H. (1975). *The Finite Element Method for Engineers*. John Wiley. New York.
2. Jeffery, M.S. (1989). *Applied Finite Element Modeling*. Marcel Dekker. New York.
3. Zienkiewicz, O.C. (2003). *The Finite Element Method*. Tata McGraw Hill. New Delhi.
4. Desai, C.S. (2005). *Introduction to the FEM*. (CBS)-affiliated to East West Press. New Delhi.

5. Buchanan, G. R. (1995). *Finite Element Analysis*. Schaum MGH, New York.

Course Title: COMPUTATIONAL FLUID DYNAMIC
Course Code: BME902

L	T	P	Credits
3	0	0	3

Total Hours-45

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 **10 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 **10 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 **12 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 **13 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: POWER PLANT ENGINEERING
Course Code: BME903

L	T	P	Credits
3	0	0	3

Total Hours-45

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

1. Understand the principles of operation fordifferent power plants and their economics.
2. Design of chimney in thermal power plants, knowledge of cooling tower operation, numerical on surface condenser design.
3. Discussing environmental and safety aspects of power plant operation.
4. Basic knowledge of Different types of nuclear power plants including Pressurized water reactor, Boiling water reactor, gas cooled reactor, liquid metal fast breeder reactor

Course Content

UNIT I **12 Hours**

Introduction: Power plants – types and classification based on energy sources.

Coal based Thermal Power Plants: Basic Rankine cycle and its modifications; Layout of modern coal power plant; Super critical boilers, FBC boilers; Turbines, condensers, steam and heating rates; Subsystems of thermal power plants; Fuel and ash handling; Draught system; Feed water treatment; Binary cycles and cogeneration systems.

UNIT II **10 Hours**

Gas Turbine and Combined Cycle Power Plants: Brayton cycle analysis and optimization; Components of gas turbine power plants; Combined cycle power plants; Integrated Gasifier based Combined Cycle (IGCC) systems.

UNIT III **13 Hours**

Nuclear Power Plants: Basics of nuclear energy conversion; Layout and subsystems of nuclear power plants; Boiling Water Reactor (BWR); Pressurized Water Reactor (PWR); CANDU Reactor; Pressurized Heavy Water Reactor (PHWR); Fast Breeder Reactors (FBR); Gas cooled and liquid metal cooled reactors; Safety measures for nuclear power plants.

Hydroelectric Power Plants: Classification; Typical layout and components.

UNIT IV **10 Hours**

Renewable Power Systems: Principles of wind, tidal, solar photo-voltaic, solar thermal, geothermal, biogas and fuel cell power systems.

Energy Economics and Environment: Economic and environmental issues; Power tariffs; Load distribution parameters; Load curve; Capital and operating cost of different power plants; Pollution control technologies including waste disposal options for coal and nuclear plants.

Transaction Mode

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

Suggested Readings:

- *Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.*
- *El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.*
- *Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.*

Course Title: RENEWABLE ENERGY ENGINEERING
Course Code: BME904

L	T	P	Credits
3	0	0	3

Total Hours-45

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 **10 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 **15 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 **10 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 **10 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
Course Code: BME905

L	T	P	Credits
3	0	0	3

Total Hours-45

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 **10 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 **13 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 **12 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 **10 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
Course Code: BME907

L	T	P	Credits
3	0	0	3

Total Hours-45

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 **10 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 **10 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 **12 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 nonequilibrium 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: DIE, MOLD AND TOOL ENGINEERING
Course Code: BME908

L	T	P	Credits
3	0	0	3

Total Hours-45

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 **12 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 **11 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 **12 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 **10 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.*

Profession Elective Course
Group: Industry Sector

Course Title: AUTOMOBILE ENGINEERING
Course Code: BME909

L	T	P	Credits
3	0	0	3

Total Hours-45

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

1. Understand the functioning of automobiles, maintenance and their manufacturing.
2. Examine the servicing of automobiles or trading/ manufacturing of auto components this helps to make skillful.
3. Illustrate the types of air compressors, working principle of two stroke and four stroke engines.
4. Differentiate the operating characteristics of common internal combustion engines.

Course Contents

UNIT I **10 Hours**

Vehicle Structure and Engines

Types of Automobiles - Vehicle Construction – Chassis – Frame and Body – Aerodynamic forces. Engine components, Materials and functions - Cooling and Lubrication systems in engines – Turbo Chargers – Engine Emission Control by three way Catalytic converter – Electronic Engine Management System.

UNIT II **10 Hours**

Engine Auxiliary Systems

Carburetor–working principle - Electronic fuel injection system – Mono-point and Multi - Point Injection Systems – Construction, Operation and Maintenance of Lead Acid Battery - Electrical systems – Battery generator – Starting Motor and Drives – Lighting and Ignition (Battery, Magneto Coil and Electronic Type) - Regulators-cut outs.

UNIT III **10 Hours**

Transmission Systems

Clutch – Types and Construction – Gear Boxes, Manual and Automatic – Floor Mounted Shift Mechanism – Over Drives – Fluid flywheel - Torque converters– Propeller shaft – Slip Joint – Universal Joints – Differential and Rear Axle – Hotchkiss Drive and Torque Tube Drive – Introduction to rear wheel drive.

UNIT IV **15 Hours 1.**

Steering, Brakesand Suspension

Wheels and Tyres – Wheel Alignment Parameters - Steering Geometry and Types of steering gear box– Power Steering – Types of Front Axle – Suspension systems – Braking Systems – Types and Construction – Diagonal Braking System – Antilock Braking System.

2. Alternative Energy Sources

Use of Natural Gas, LPG, Biodiesel, Alcohol and Hydrogen in Automobiles - Electric and Hybrid Vehicles, Fuel Cells – Introduction to off road vehicles.

Transaction Mode

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

Suggested Readings:

- *Crouse, W.H. (1965). Automotive Mechanics.Tata McGraw Hill.*
- *Singh, K.(2009).Automobile Engineering(Vol. I & II).Standard Publishers.*
- *Newton, K., Steeds, W. & Garrett, T.K. (1996). The Motor Vehicle. Butterworth International.*
- *Heitner, J.(2004).Automotive Mechanics. EastWest Press.*
- *Gupta, R.B.(2016).Automobile Engineering. Satya Prakashan publications.*

Course Title: AEROSPACE ENGINEERING
Course Code: BME910

L	T	P	Credits
3	0	0	3

Total Hours-45

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

1. Apply a deep working knowledge of technical fundamentals to solve engineering problems and address society's needs in aerospace and related areas for the nation and the world.
2. Understand technical, business, societal, and other contexts; demonstrate a commitment to ethical action; and continue to strengthen technical, professional, and personal skills.
3. Communicate and collaborate effectively as members of multidisciplinary teams.
4. Design, implementation, and operation of innovative technologies, products, processes, and systems in aerospace and related areas for the nation and the world.

Course Contents

UNIT I **8 Hours**

History of flights; Anatomy of flight vehicles.

UNIT II **13 Hours**

Engine Auxiliary Systems

Classification of aircraft and spacecraft; Atmosphere and flying weather; Airfoil and wing aerodynamics; Aerodynamic forces, lift and drag, high lift devices.

UNIT III **12 Hours**

Aircraft performance–takeoff and landing, cruising, climbing, gliding and turning flights, range and endurance, ceiling, flight envelope; Principles of stability and control.

UNIT IV **12 Hours**

Aerospace propulsion systems; Elements of structures and materials; Airplanes of the future; Hypersonic vehicles; Basics of space flight; Indian aerospace scenario.

Transaction Mode

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

Suggested Readings:

- *J. D. Anderson, Jr., Introduction to Flight, McGraw Hill, 2000.*
- *R. A. Shevell, Fundamentals of Flight, Pearson Education, 1989.*
- *C. Kermode, Mechanics of Flight, Longman, 1996.*
- *L. J. Clancy, Aerodynamics, Himalayan Books, 1996.*
- *S. K. Ojha, Flight Performance of Aircraft, AIAA Series, 1997.*
- *J. J. Sellers, Understanding Space: An Introduction to Astronautics, McGraw Hill, 2005.*

Course Title: AGRICULTURE ENGINEERING
Course Code: BME911

L	T	P	Credits
3	0	0	3

Total Hours-45

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

1. Differentiate primary and secondary tillage; identify tillage implements associated with either the primary or secondary tillage category.
2. Understand why a producer might do conservation vs. conventional tillage.
3. Describe strip tillage, ridge tillage, no-tillage, mulch tillage, and vertical tillage.
4. Perform all pre-inspection and operations of at least two different types of farm machinery

Course Contents

UNIT I **10 Hours**

Status of Farm Power in India, Sources of Farm Power , I.C. engines, working principles of I C engines, comparison of two stroke and four stroke cycle engines , Study of different components of I.C. engine,
I.C. engine terminology and solved problems.

UNIT II **13 Hours**

Engine Auxiliary Systems

Familiarization with different systems of I.C. engines: Air cleaning, cooling, lubrication ,fuel supply and hydraulic control system of a tractor,
Familiarization with Power transmission system : clutch, gear box, differential and final drive of a tractor.

UNIT III **11 Hours** Tractor types, Cost analysis of tractor power and attached implement, Familiarization with Primary and Secondary Tillage implement, Implement for hill agriculture, implement for Intercultural operations.

UNIT IV **11 Hours**

Familiarization with sowing and planting equipment, calibration of a seed drill and solved examples, Familiarization with Plant Protection equipment, Familiarization with harvesting and threshing equipment.

Transaction Mode

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

Suggested Readings:

- *Jagadishwar Sahay - Elements of Agricultural Engineering,2006.*
- *Surendra Singh. Farm Machinery - Principles and Applications. ICAR Publication.*
- *S. C. Jain and C. R. Rai. Farm Tractor – Maintenance and Repair. StandardPublishers, 1705-B, Nai Sarak, Delhi – 110006.*
- *Ojha, T. P. and Michael, A.M. Principles of Agricultural Engineering. Vol. I, JainBrothers, 16/893, East Park Road, Karol Bagh, New Delhi – 110005.*

Course Title: **BIOMEDICAL ENGINEERING**
Course Code: **BME306**

L	T	P	Cr.
3	0	0	3

Total Hours-45

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

1. Gain expertise in designing and developing medical devices and instruments for diagnosis, monitoring, and treatment.
2. Understand the mechanics of biological systems, studying movement and forces in the context of human physiology.
3. Explore the selection and development of materials for implants and medical devices compatible with living tissues.
4. Learn about medical imaging technologies like MRI, CT, and ultrasound, used for visualization and diagnosis.

Course Contents

UNIT I **10 Hours**

Introduction to Medical Instruments and Devices, Principles and Applications. Fundamentals of Anatomy and Physiology in Biomedical Engineering. Biomaterials and their Classification for Medical Applications. Medical Imaging Techniques: X-ray, MRI, CT, Ultrasound, and their Principles. Basic Principles of Biomechanics in Biomedical Engineering.

UNIT II **10 Hours**

Biomechanics: Kinematics and Dynamics of Human Movement. Medical Electronics: Sensors, Signal Processing, and Instrumentation. Diagnostic Techniques: Electrocardiography (ECG), Electroencephalography (EEG), and Electromyography (EMG). Principles of Medical Imaging and Image Processing. Design and Evaluation of Medical Devices: Safety and Regulatory Considerations.

UNIT III **10 Hours**

Medical Signal Processing: Analysis and Interpretation of Physiological Signals. Biomedical Instrumentation: Measurement Techniques and Transducers. Introduction to Biomedical Sensors and Biosensors. Medical Data Acquisition and Processing. Patient Monitoring Systems and Telemedicine Applications.

UNIT IV **15 Hours**

Biomedical Image Analysis: Image Enhancement, Segmentation, and Feature Extraction. Digital Image Processing in Medical Imaging: Applications and Techniques. Medical Imaging Modalities: Ultrasound, MRI, PET, SPECT, and CT. Medical Image Reconstruction Techniques: Tomography and 3D Imaging. Emerging Trends in Biomedical Engineering: Wearable Health Technologies and Point-of-Care Devices.

Transaction Mode

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

Suggested Readings:

- *"Introduction to Biomedical Engineering" by John Enderle, Susan M. Blanchard, Joseph D. Bronzino, 2005.*
- *"Biomechanics: Concepts and Computation" by Cees Oomens, Marcel Brekelmans, Frank Baaijens, 2018.*
- *"Medical Instrumentation: Application and Design" by John G. Webster, 2009.*
- *"Medical Imaging Signals and Systems" by Jerry L. Prince, Jonathan Links, 2006.*
- *"Biomedical Signal Processing: Principles and Techniques" by Rangaraj M. Rangayyan, 2002.*
- *"Digital Image Processing" by Rafael C. Gonzalez, Richard E. Woods, 2008.*

Course Title: **FOOD TECHNOLOGY**
Course Code: **BME913**

L	T	P	Cr.
3	0	0	3

Total Hours-45

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

1. Apply scientific principles to analyze and understand the composition, quality, and safety of food products.
2. Evaluate and implement food preservation methods to extend shelf life and maintain product quality.
3. Demonstrate knowledge of food regulations, labeling requirements, and ethical considerations in the food industry.
4. Design and innovate food products, considering consumer preferences, sustainability, and technological advancements.

Course Contents

UNIT I **12 Hours**

Food Chemistry: Macronutrients and Micronutrients, Chemical Reactions in Food Processing, Enzymes in Food Systems. Food Microbiology: Microbial Spoilage, Pathogens, Microbial Growth Factors. Food Preservation Techniques: Heat Processing, Refrigeration, Freezing, Drying, Fermentation.

UNIT II **12 Hours**

Food Engineering Principles: Heat and Mass Transfer in Food Processing, Fluid Flow, Unit Operations in Food Industry. Food Processing Technologies: Thermal Processing, Mixing, Separation, Size Reduction, Extrusion. Food Packaging: Types of Packaging Materials, Packaging Design, Shelf-Life Extension

UNIT III **10 Hours**

Food Quality and Safety: Quality Parameters, Sensory Evaluation, Quality Control Methods. Food Additives: Types, Functions, Regulations. Food Analysis Techniques: Proximate Analysis, Instrumental Methods for Food Analysis, Chromatography. Food Laws and Regulations: International and National Food Standards and Regulations.

UNIT IV **11 Hours**

Food Product Development: Formulation, Sensory Analysis, Nutritional Labeling. Food Biotechnology: Applications in Food Processing, Genetic Modification. Food Supply Chain Management: Procurement, Storage, Distribution, Logistics. Emerging Trends in Food Technology: Functional Foods, Sustainable Food Processing.

Transaction Mode

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

Suggested Readings:

- *"Food Processing Technology: Principles and Practice" by P.J. Fellows, 2009.*
- *"Food Science" by Norman N. Potter and Joseph H. Hotchkiss, 1999.*
- *"Introduction to Food Engineering" by R. Paul Singh and Dennis R. Heldman, 1984.*
- *"Food Microbiology: An Introduction" by Thomas J. Montville, Karl R. Matthews, and Yvonne Schäfer, 2020.*
- *"Food Packaging: Principles and Practice" by Gordon L. Robertson, 2016.*

Course Title: **MARINE ENGINEERING**
Course Code: **BME914**

L	T	P	Cr.
3	0	0	3

Total Hours-45

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

1. Acquire a solid understanding of various marine propulsion systems, including engines and propellers, enabling the analysis and optimization of ship propulsion performance.
2. Expertise in international maritime regulations and safety standards, allowing the implementation of safety measures, adherence to regulations, and effective management of shipboard safety.
3. Develop the skills to comprehend, operate, and maintain marine auxiliary systems such as steering gear, bow thrusters, pumps, and electrical systems, ensuring the efficient operation of shipboard equipment

Course Contents

UNIT I **10 Hours**

Marine Propulsion Systems: Types and Characteristics of Marine Engines, Propeller Types and Performance, Engine Performance Analysis. Marine Power Generation: Shipboard Power Plants, Diesel Generator Operation, Power Distribution.

UNIT II **15 Hours**

Marine Heat Transfer: Heat Exchangers, Cooling Systems, Thermal Efficiency Enhancement. Ship Stability: Centre of Gravity, Centre of Buoyancy, Stability Criteria. Ship Construction: Shipbuilding Materials, Structural Components, Welding Techniques.

UNIT III **10 Hours**

Marine Auxiliary Systems: Steering Gear, Bow Thrusters, Marine Pumps, Compressed Air Systems. Ship Hydrodynamics: Resistance and Propulsion, Hydrodynamic Performance Analysis. Marine Electrical Systems: Power Generation and Distribution, Electrical Machinery.

UNIT IV **10 Hours**

Marine Safety and Regulations: International Maritime Organization (IMO) Regulations, SOLAS Convention, Shipboard Safety. Marine Automation and Control: Engine Control Systems, Alarm and Monitoring Systems. Marine Pollution Prevention: Environmental Regulations, Ballast Water Management.

Transaction Mode

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

Suggested Readings:

- *"Marine Engineering: Principles and Practice" by Anthony F. Molland, 2011.*
- *"Introduction to Marine Engineering" by D.A. Taylor, 2014.*
- *"Reeds Vol 12 Motor Engineering Knowledge for Marine Engineers" by Paul Anthony Russell, 2012.*
- *"Marine Diesel Engines: Maintenance and Repair Manual" by Jean-Luc Pallas, 2006.*
- *"Ship Construction" by David J. Eyres, 2006.*

*****

Course Title: **NUCLEAR ENGINEERING**
Course Code: **BME915**

L	T	P	Cr.
3	0	0	3

Total Hours-45

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

1. Acquire a solid understanding of various marine propulsion systems, including engines and propellers, enabling the analysis and optimization of ship propulsion performance.
2. Gain expertise in international maritime regulations and safety standards, allowing the implementation of safety measures, adherence to regulations, and effective management of shipboard safety.
3. Develop the skills to comprehend, operate, and maintain marine auxiliary systems such as steering gear, bow thrusters, pumps, and electrical systems, ensuring the efficient operation of shipboard equipment

Course Contents

UNIT I **10 Hours**

Nuclear Physics Fundamentals - Particle structure, nuclear forces, and radioactive decay. Nuclear Reactions and Interactions - Cross sections, reaction mechanisms, and neutron interactions with matter. Nuclear Energy - Fission and fusion processes, energy release, and fuel cycles. Radiation Detection and Measurement - Principles of radiation detection, detectors, and dosimetry. Nuclear Reactor Types - Overview of reactor types, their operation, and safety considerations

UNIT II **15 Hours**

Nuclear Reactor Kinetics - Reactor dynamics, reactivity, and control mechanisms. Neutron Transport Theory - Neutron diffusion equation, boundary conditions, and solutions. Neutron Moderation and Absorption - Moderating materials, resonance absorption, and thermalization. Reactor Safety Analysis - Safety systems, accident scenarios, and containment strategies. Reactor Shielding - Radiation shielding materials, calculations, and design considerations.

UNIT III **10 Hours**

Nuclear Fuel Cycle - Uranium enrichment, fuel fabrication, and spent fuel management. Radioactive Waste Management - Classification of waste, disposal methods, and environmental impact. Nuclear Instrumentation and Control - Control systems, instrumentation, and reactor operation. Nuclear

Thermal Hydraulics - Heat transfer, coolant flow, and safety analysis in reactor systems. Radiation Protection and Shielding - Design of shielding, radiation exposure limits, and occupational safety.

UNIT IV **10 Hours**

Nuclear Power Economics - Cost analysis, economics of nuclear power plants, and public perception. Nuclear Regulations and Licensing - Regulatory framework, licensing procedures, and safety regulations. Emerging Nuclear Technologies - Advanced reactor designs, fast reactors, and thorium-based reactors. Nuclear Non-Proliferation - Treaty obligations, safeguards, and preventing nuclear weapons proliferation. Fusion Energy - Basic principles of fusion, research reactors, and potential for commercial fusion energy production.

Transaction Mode

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

Suggested Readings:

- *"Introduction to Nuclear Engineering" by John R. Lamarsh and Anthony J. Baratta, 2001.*
- *"Nuclear Reactor Physics, Second Edition" by Weston M. Stacey, 2007.*
- *"The Physics of Nuclear Reactors" by Serge Marguet, 2011.*
- *"Introduction to Nuclear Engineering, Third Edition" by John R. Lamarsh and Anthony J. Baratta, 2001.*
- *"Fundamentals of Nuclear Reactor Physics" by Elmer E. Lewis, 2008.*