A Documentary Support

for

Matric No. – 1.1.1

Programme Outcomes & Course Outcomes

under the

Criteria – I

(Curriculum Design and Development)

Key Indicator - 1.1

in

Matric No. – 1.1.1

B.E. MECHANICAL ENGINEERING

1998

Registrar
Dr. B.R.A. University, Agra

Mapping:

Local Need *Regional* *National* *Global Need*

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

POs List

Program outcomes suggested by the NBA for engineering programs

Program Outcomes (POs), are attributes acquired by the student at the time of graduation. The POs given in the Table below, ensure that the POs are aligned to the Graduate Attributes (GAs) specified by National Board of Accreditation (NBA). These attributes are measured at the time of Graduation, and hence computed every year for the outgoing Batch. The POs are addressed and attained through the Course Outcomes (COs) of various courses of the curriculum.

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** 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. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** 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.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge 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.
12. **Life-long learning:** 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.

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

Registrar
Dr. B.R.A. University, Agra

Mathematics III (BSC-301)

III SEMESTER (ECE, CSE, EE, ME, CE)

L T P C
3 1 0 4

Prerequisite: Basic knowledge of elementary Mathematics.
Course Outcomes (COs):
After completing this course, a student will be able to:
1. Solve the Fourier Transform of function.

2. Compute poles & zeros.

3. Evaluate the real & complex integrals with the help of Cauchy's Residue Theorem.

4. Utilize curve fitting techniques for data representations and computation in engineering analysis.

5. Employee the principle of linear regression and correlation, translate real word problems into probability models, Use Binomial, Poisson & Normal Distribution to solve statistical problems.

Strength of Materials (BME-301)

L T P C
3 1 0 4

Prerequisite: Students must have knowledge of engineering mechanics basic engineering applications.
Course Outcomes (COs):
After completing this course, a student will be able to:
1. Compute the fundamentals of stress and strain concepts in compound loading condition and demonstrate an understanding of the applied mechanics theory.

2. Calculate the stresses and strains associated with thin and thick cylinder.

3. Analyzing the problems of springs subjected to various actions and Evaluating stresses in columns.

4. Calculate stresses and deformations in beams subjected to different loading and estimate the effect of torsion in shafts.

5. Demonstrate stress and deflection in unsymmetrical bending and Curved Beams, determination of shear centre.

Materials Science (BME-302)

L T P C
3 0 2 4

Prerequisite: Fundamental knowledge of Intermediate level physics and chemistry.
Course Outcomes (COs):
After completing this course, a student will be able to:
1. Analyze the Structure of materials at different levels, basic concepts of crystalline materials like unit cell, FCC, BCC, HCP, APF (Atomic Packing Factor), Co-ordination Number etc.

2. Understand concept of mechanical behavior of materials and calculations of same using appropriate equations.

3. Explain the concept of phase & phase diagram & understand the basic terminologies associated with metallurgy. Construction and identification of phase diagrams and reactions.

4. Understand and suggest the heat treatment process & types. Significance of properties Vs microstructure. Surface hardening & its types. Introduce the concept of hardenability & demonstrate the test used to find hardenability of steels.

5. Explain features, classification, applications of newer class materials like smart materials, piezoelectric materials, biomaterials, composite materials etc.

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By: Registrar

Registrar
Dr. B.R.A. University, Agra

Materials Science Lab (BME-352)

Course Outcomes (COs):

After completing this course, a student will be able to:

1. Prepare formal laboratory reports describing the results of experiments;
2. Operate basic instruments in materials science and engineering;
3. Interpret the data from the experiments.
4. Relate properties to microstructure.
5. Understand various crystal structures and relationship to properties
6. Select metals and alloys for industrial applications
7. Understanding metals and their use in industries
8. Understanding heat treatment procedures and the change of properties
9. Improving material properties by different heat treatment processes.

Engineering Thermodynamics (BME-303)

L T P C
3 1 0 4

Prerequisite: Physics of Class XII

Course Outcomes (COs):

After completing this course, a student will be able to:

1. Understand the role of the internal energy, enthalpy, entropy, temperature, pressure and specific volume thermodynamic properties and illustrate laws of thermodynamics state and apply the first law of thermodynamics for closed and open systems.
2. Understand second law of thermodynamics and concepts of entropy and apply the concept to solve entropy problems.
3. Distinguish between ideal gas and pure substance and calculate thermodynamics properties using tables of thermodynamics properties and ability to solve problems based on Rankine and Brayton cycle.
4. Understand concept of irreversibility and second law efficiency and establish thermodynamic relation among various equation.
5. Estimate Stoichiometric air required for combustion and exhaust gas analysis.

Machine Drawing (BME-304)

L T P C
2 0 4 4

Prerequisite: Basic knowledge of Engineering Graphics and Design.

Course Outcomes (COs):

After completing this course, a student will be able to:

1. Understand principles of orthographic projections for machine drawing.
2. To draw the projections of machine elements including keys, couplings, cotters, riveted, bolted and welded joints.
3. To draw the assembled view using drawings of machine components and Engines.
4. To free hand sketches of machine elements.

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

Registrar
Dr. B.R.A. University, Agra

5. Understand detailed Assembly drawings of Ball bearing, shaft, crane hook, Plummer block, tailstock, engine block assembly. Remembering the concepts Computer aided drawing of machine components.

Machine Drawing Lab (BME-354)

Course Outcomes (COs):
After completing this course, a student will be able to:
1. Prepare different types of line and dimensioning.

2. Understand of orthogonal projection and isometric projection.

3. Analyze the concept of different types of fasteners.

4. Understand and draw different types of machine elements.

5. Analyze the different types of Assembly.

Environment and Ecology (MC-301/MC-401)

L T P C
2 0 0 0

Prerequisite: Basic knowledge College Geography.
Course Outcomes (COs):
After completing this course, a student will be able to:
1. Understanding of the importance of ecosystem and biodiversity and natural resources for maintaining ecological balance.

2. Analyze human impacts on various aspects of the environment and social issue related to sustainable development.

3. Identifying sources and effects of environmental pollution. Develop the methods for control of environmental pollution and hazards due to engineering/technological activities.

4. Aware of important acts and laws in respect of environment and EIA process.

Measurement and Metrology (BME-401)

L T P C
3 0 2 4

Prerequisite: Basic knowledge of Engineering physics, Fundamental Concept of Workshop Practice, Engineering thermodynamics etc.
Course Outcomes (COs):
After completing this course, a student will be able to:
1. Ability to understand the basic concepts of measurement by learning about different measuring systems, different sensor and transducers and different signal transmission and processing devices.

2. Ability to understand the working principle of different measuring devices for time, pressure, force and temperature measurement.

3. Ability to understand the concept of limit, fit and tolerance for applying it for solving the numerical problems, and understand the concept of comparators.

4. Ability to understand the concept of geometric forms and use of different tools for measurement of geometric forms, measurement related to thread and surface texture.

5. Ability to understand the concept of control system and study of different types of controllers.

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

Registrar
Dr. B.R.A. University, Agra

Measurement and Metrology Lab (BME-451)

Course Outcomes (COs):

After completing this course, a student will be able to:

1. Understand the concept of vernier caliper and use it for measurement of gear tooth and learn to measure taper of a shaft.

2. Understand the concept of limit gauge and slip gauge and learn the use of micrometer.

3. Perform the test of roundness, concentricity and understand the concept and use of dial gauge.

4. Understand the concept of autocollimator and to perform test of thermocouple and stroboscope.

Engineering Fluid Mechanics (BME-402)

L T P C
3 1 2 5

Prerequisite: Basic knowledge of engineering physics.

Course Outcomes (COs):

After completing this course, a student will be able to:

1. Understand property of fluid, measurement of pressure and broad principles of fluid statics.

2. Inculcate knowledge on description of fluid motion, stream and velocity potential, their properties and applications.

3. Understand the dynamics of fluid flow -energy equation and its applications and gain knowledge about dimensional and model analysis

4. Analyse the Flow through Pipes, Laminar and turbulent flows, major and minor losses in pipes.

5. Understand and solve the boundary layer problems and evaluate friction over surface.

Engineering Fluid Mechanics Lab (BME-452)

Course Outcomes (COs):

After completing this course, a student will be able to:

1. Verify the Bernoulli's Theorem.
2. Determine the friction factor for the pipes.

3. Determine the coefficient of discharge of Venturimeter and Orifice meter.

4. Determine the minor losses due to sudden enlargement, sudden contraction and bends.

5. Determine the coefficient of discharge of Notch (V and Rectangular types).

Manufacturing Science I (BME-403)

L T P C
3 0 2 4

Prerequisite: Course on Workshop Technology

Course Outcomes (COs):

After completing this course, a student will be able to:

1. Define the term manufacturing and its importance towards technological and social economic development.

2. Classify the basic principles of casting processes and discuss its type's defects and remedies.

3. Design of gating/riser system needed for casting

4. Describe the various forming process like (rolling, forging, extrusion, drawing, sheet metal operation) and Implement a suitable forming process for a given component.

5. Compare the various types of joining processes and select the appropriate one according to the application.

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

Registrar
Dr. B.R.A. University, Agra

Manufacturing Science I Lab (BME-453)

Course Outcomes (COs):

After completing this course, a student will be able to:

1. Design the gating and riser system needed for casting and requirements to achieve defect free casting.
2. Understand the basic geometry of pattern making and their application.
3. To gain the knowledge of Forging technique and application in industrial domain.
4. Design the jigs and fixtures required for various mechanical works.
5. Understand the working of press working operation like blanking and piercing.

Theory of Machines I (BME-404)

L T P C
3 1 0 4

Prerequisite: A course on Engineering Thermodynamics and Engineering Drawing.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Define various components of mechanisms, Develop mechanisms to provide specific motion.
2. Draw velocity and acceleration diagrams of various mechanisms.
3. Basic ideas of kinematic synthesis
4. Understand the importance of Cams, Gain the basic ideas of kinematics of Cams,
5. Understand the basic ideas of gears and also Analyze speed and number of teeth in various gears, Select appropriate power transmission for specific application.

Applied Thermodynamics (BME-405)

L T P C
3 1 2 5

Prerequisite: A course on Engineering Thermodynamics and Engineering Drawing.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Analyze the cycle of internal combustion engine in order to perform heat, work and efficiency calculation.
2. Understand the vapour cycle in order to carry out the calculation on system performance.
3. Understand boilers and their performance, understand condenser and their performance.
4. Construct steam engine velocity diagram in order to determine the stage calculation mathematically and graphically.
5. Analyze the various gas turbine plant system arrangement in order to perform heat, work, efficiency calculation.

Applied Thermodynamics Lab (BME-455)

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand the working principles & knowledge of parts of boilers.
2. Understand the working principles & pats of two stroke I C Engines.
3. Understand the working principles & parts of four stroke I C Engines.

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By: Registrar

Registrar
Dr. B.R.A. University, Agra

4. Demonstrate the performance of internal combustion engine.

5. Understand the working Principles & parts of steam & gas turbine.

Human Value and Professional Ethics (MC402/MC-302)

L T P C
2 0 0 0

Prerequisite:
Course Outcomes (COs):
After completing this course a student will be able to:
1. Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society

2. Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.

3. Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society

4. Distinguish between ethical and unethical practices, and start working over the strategy to actualize a harmonious environment wherever they work.

Internal Combustion Engines (BME-501)

L T P C
3 1 2 5

Prerequisite:
Course Outcomes (COs):
1. Understand various types of I.C. engines and cycles of operation.

2. Understand the normal and abnormal combustion phenomenon in SI and CI engines.

3. Identify fuel metering and fuel supply systems for different types of engines

4. Interpret different alternative fuels and its emissions, then the method to control these emissions and their effect on environment.

5. Understand supercharging and its effect on performance of SI and CI engine.

Internal Combustion Engines Lab (BME-551)

Course outcome (COs):
1. Identify the various types of I.C. Engines and cycles of operation.

2. Express the effect of various operating variables on engine performance.

3. Demonstration of fuel metering and fuel supply systems for different types of engines.

Theory of Machines II (BME-502)

L T P C
3 1 2 5

Prerequisite: A course on Engineering Mechanics and Thermodynamics.
Course Outcomes (COs):
After completing this course a student will be able to:
1. Understand of force analysis of linkages and Demonstrate functioning of single slider crank mechanism and its inversions based systems.

2. To analyze the different types of governors and flywheels.

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

Registrar
Dr. B.R.A. University, Agra

3. Understand the concept of gyroscopic couple for ships, aero planes and road vehicles.

4. To balancing of the reciprocation and rotatory systems.

5. Demonstrate functioning clutches and brakes.

Theory of Machines II Lab (BME-552)

Course Outcomes (COs):
After completing this course a student will be able to:
1. Understand the profiles of cams and its effect on follower intermittent motion.

2. Understand the concept of gyroscopic couple for ships, aero planes and road vehicles.

3. To analyze the different types of governors.

4. Examine the balancing of rotating masses in dynamic balancing.

5. Demonstrate functioning of gears.

Departmental Elective I

Manufacturing Science II (DE-ME-501)

L T P C
3 1 0 4

Prerequisite: Course on Workshop Technology.
Course Outcomes (COs):
1. Detailed knowledge of cutting tool & their geometry, nomenclature, tool materials, their properties.

2. Identify the different machines on the basis of their operations- Lathe, shaper, slotter, planer, milling, drilling and boring.

3. Understand the use of Grinding machines.

4. Understanding the concept of limits, fits, tolerances and surface finish and their utility in the industrial context

5. Identify different non-conventional machining processes and the applications of non-conventional welding.

Rapid Prototyping and Rapid Tools (DE-ME-502)

L T P C
3 1 0 4

Prerequisite: Course on Computer aided Design and Manufacturing and Basic course on manufacturing, numerical control and robotics
Course Outcomes (COs):
After completing this course a student will be able to:
1. Understand basics of rapid prototyping and modeling and steps of preparing prototypes.

2. Understand liquid, solid and powder based prototyping systems.

3. Understand practical applications of rapid prototyping and tooling in modern industries.

4. Become familiar with recent advances in rapid prototyping and tooling.

5. Apply the Process of Rapid Prototyping in Advanced techniques.

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

Registrar
Dr. B.R.A. University, Agra

Rapid Prototyping and Rapid Tools (DE-ME-502)

L T P C
3 1 0 4

Prerequisite: Course on Computer aided Design and Manufacturing and Basic course on manufacturing, numerical control and robotics

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand basics of rapid prototyping and modeling and steps of preparing prototypes.
2. Understand liquid, solid and powder based prototyping systems.
3. Understand practical applications of rapid prototyping and tooling in modern industries.
4. Become familiar with recent advances in rapid prototyping and tooling.
5. Apply the Process of Rapid Prototyping in Advanced techniques.

Open Elective I

Industrial Engineering and Automation (OE-ME-501)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of Workshop Practice.

Course Outcomes (COs):

After completing this course a student will be able to:

1. Analyze and explain productivity concepts and measurements.
2. Explain various Industrial Layout and time study.
3. Exhibit skills towards program evaluation and review technique.
4. Analyze and perform Break even analysis.
5. Understand of High Volume Production Systems, Transfer Devices and Feeder.

Total Quality Management (OE-ME-502)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of Industrial Engineering

Course Outcomes (COs):

After completing this course a student will be able to:

1. Describe the dimensional barrier regarding Quality.
2. Summarize the Total quality principles.
3. Demonstrate the tools utilization for quality improvement. Analyze the various types of techniques are used to measure quality
4. Discover the new decision of principle in real time projects.
5. Apply the various quality systems in implementation of Total quality management.

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

Registrar
Dr. B.R.A. University, Agra

Production Planning and Control (OE-ME-503)

L T P C
3 0 0 3

Prerequisite:
Course Outcomes (COs):
After completion of this course student will be able to:
1. Understand the role Production Planning and control activities in Manufacturing and Services.

2. Understand and perform various Forecasting techniques and problems.

3. Understand and perform various Inventory Management techniques and apply in real manufacturing scenario/How to use MRP/ERP.

4. Demonstrate various Scheduling procedures/Balancing concepts.

5. Understand and Evaluate Dispatching procedures.

Value Engineering (OE-ME-504)

L T P C
3 0 0 3

Prerequisite:
Course Outcomes (COs):
After completing this course a student will be able to:
1. Understand concepts of value engineering and value analysis.

2. Understand the evaluation techniques of function and problem setting and solving systems.

3. Describe various phases involved in value engineering job plan and techniques of value engineering.

4. Understand the applications of value Analysis of management practice in different organizations.

5. Demonstrate their ability to apply value analysis in various fields.

Occupational Health and Safety (BMC-501)

L T P C
3 0 0 0

Prerequisite:
Course Outcomes (COs):
After learning the course the students should be able to:
1. Identify the diseases associated with occupation.

2. Manage safety in industries by suggesting safety measures.

3. Identify the accidental causes & apply the preventions.

4. Identify Fire Explosion & apply PPE.

5. Identify & apply Hazards & Risk identification, Assessment and control techniques.

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By: Registrar

Registrar
Dr. B.R.A. University, Agra

Industrial Management (BHSM-501)

L T P C
3 0 0 3

Prerequisite:
Course Outcomes (COs):
1. Understand the basic concepts of management and explain the various principles of management

2. Understand the various functions of personal management and solves workers related problem

3. Recall the concept of marketing and examine various marketing strategies.

4. Explain the importance of financial management, relate it with break-even analysis and budget.

5. Understand the various principles of plant management & classify different type of material handling equipment's.

Design of Machine Elements (BME-601)

L T P C
3 1 0 4

Prerequisite: Basic knowledge of Engineering Drawing and Machine Drawing.
Course Outcomes (COs):
After completing this course a student will be able to:
1. Understanding of Design requirements, Design procedure, Design for Static Load by using Theory of failure.

2. Be able to apply knowledge of the stress and strain for analyze and Design for Fluctuating Loads. Develop Logical and Analytical ability to apply Knowledge to Design of Riveted Joints.

3. Apply the knowledge of stress & strain in combined loading condition to design Shaft, Keys and Couplings.

4. Understand the standard geometry, application, failures of Spur and Helical Gear and Design and Developed effectively Spur and Helical Gears for different loading conditions.

5. Understand the standard geometry, applications, failures of Sliding contact bearings and Design and Developed effectively sliding contact bearings for different loading conditions as per manufacturer catalog.

Heat and Mass Transfer (BME-602)

L T P C
3 1 2 5

Prerequisite: Basic Knowledge of Thermodynamics and Fluid Mechanics.
Course Outcomes (COs):
After completing this course a student will be able to:
1. Explain the laws of heat transfer, modes of heat transfer and fundamentals Conduction.

2. Mathematically model and analyze the consequence of heat and transfer in thermal analyses of engineering systems and fins concepts.

3. Apply empirical correlations for forced, free convection and phase change process.

4. Formulate, evaluate and develop solution for radiation heat transfer problems in different situations.

5. Understand the consequence of heat transfer in thermal analyses of engineering systems like heat exchanger. Analyze different phenomenon occurring in engineering systems involving mass transfer in steady state.

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

Registrar
Dr. B.R.A. University, Agra

Heat and Mass Transfer Lab (BME-652)

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand laws of heat transfer, modes of heat transfer and fundamentals of heat exchangers.

2. Mathematically model and analyze the consequence of heat and transfer in thermal analyses of engineering systems.

3. Formulate, evaluate and develop solution for conduction, convection and radiation heat transfer problems in different situations.

3. Apply empirical correlations for forced, free convection and phase change process.

4. Understand, apply principles and analyze mass transfer phenomenon in different processes /systems.

Automobile Engineering (BME-603)

L T P C
3 0 2 4

Prerequisite: Basic Knowledge of I C Engines

Course Outcomes (COs):

After completing this course a student will be able to:

1. Understand the basic requirements from automobile and technology used in them.

2. Demonstrate understanding of different functional systems of automobile such as brakes, suspension system, steering mechanism, gear box and transmission system.

3. Analyze different functional systems of automobiles and the advancements in them.

4. Carry out calculations pertaining to vehicle dynamics.

5. Understand and analyze impact of automobile on environment, different measures and regulations for its control.

Automobile Engineering Lab (BME-653)

Course Outcomes (COs):

After completing this course a student will be able to:

1. Explain the various types of chassis, frame and functions of I C Engine parts.

2. Distinguish between the manual transmissions with automatic transmission systems.

3. Demonstrate how the steering, brakes and the suspension system operate.

4. Justify the importance of alternative fuels.

Unconventional Manufacturing (DE-ME-601)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of Manufacturing Science

Course Outcomes (COs):

After completion of the course a student will be able to:

1. Understand the process capability of unconventional manufacturing process.

2. Understand various non-conventional manufacturing processes.

3. Develop competency to selecting various un-conventional manufacturing processes.

4. Explain the working principles of thermal energy based processes.

5. Understand the Diffusion and Photo- Lithography process for electronic-device.

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

Registrar
Dr. B.R.A. University, Agra

Experimental Stress Analysis (DE-ME-602)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of Engineering Mechanics and Mechanics of Solids.
Course Outcomes (COs):
After completing this course a student will be able to:
1. Analyse the 3-D state of stress in components with application of plane stress and plane strain conditions.

2. Analyse 3D state of strain in the components.

3. Understand various practical methods of analyzing strain in the components.

4. Understand the parameters, and practical applications of strain gauges.

5. Understanding various aspects of photo elasticity and its application for stress analysis.

Reliability and Maintenance Engineering (DE-ME-603)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of Power Plant Engineering.
Course Outcomes (COs):
After completion of this course student will be able to:
1. Explain maintenance objectives and functions, need for maintenance plan and organization, and cost of maintenance, equipment and production delays.

2. Understand equipment wear records and standards and various kinds of NDT methods for predictive maintenance.

3. Explain maintenance of mechanical drives such as belt drive, chain drive and gears

4. Understand the maintenance of pumps, compressors and control valves.

5. Explain the principles and techniques applicable in life testing and reliability improvements.

Additive Manufacturing (DE-ME-604)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of Computer Aided Design.
Course Outcomes (COs):
After completion of this course student will be able to:
1. Describe various CAD issues for 3D printing and rapid prototyping and related operations for STL model manipulation.

2. Formulate and solve typical problems on reverse engineering for surface reconstruction from physical prototype models through digitizing and spline based surface fitting.

3. Formulate and solve typical problems on reverse engineering for surface reconstruction from digitized mesh models through topological modelling and subdivision surface fitting.

4. Explain and summarize the principles and key characteristics of additive manufacturing technologies and commonly used 3D printing and additive manufacturing systems.

5. Explain and summarize typical rapid tooling processes for quick batch production of plastic and metal parts

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

Registrar
Dr. B.R.A. University, Agra

Open Elective Course II

Composite Materials (OE-ME-601)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of Materials Science.
Course Outcomes (COs):
1. Knowledge of the different types of engineering materials.
2. Knowledge of the types of reinforcements and fibers.
3. Understand the various types of composites used in engineering and their properties.
4. Describe the processing of composite materials and manufacturing techniques.
5. Understand and analyze the various methods of testing the composites.

Entrepreneurship (OE-ME-602)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of industrial management.
Course Outcomes (COs):
1. Understand entrepreneurship and its related theory and government policies
2. Understand various Business Enterprises and Ownership Structure
3. Prepare project report and able to understand project evaluation method.
4. Understand various strategies and policies in management and enterprises.
5. Understand Institutional support towards the development of entrepreneurship.

Mechanical System Design (OE-ME-603)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of Industrial Engineering.
Course Outcomes (COs):
After completing this course a student will be able to:
1. Understand the attributes characterizing a system and case study.
2. Explain the system modelling and case study compound bar system.
3. Differentiate and understand the graph modelling, graph analysis and materials handling systems.
4. Understand the method for optimization model with single system.
5. Justify the inventory control in production plant.

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

Registrar
Dr. B.R.A. University, Agra

Product Design and Development (OE-ME-604)

L T P C
3 0 0 3

Prerequisite:
Course Outcomes (COs):
After completing this course a student will be able to:
1. Understand how to create new product based on mechanical design engineering.

2. Understand all mechanical aspects of product design by incorporating concept, creativity, structural, manufacturing, esthetic etc.

3. Solve open-ended problem belongs to design engineering that meet the requirements.

4. Understand various product designing methods.

5. Understand human factors and cost evaluation in industrial design concepts.

Economics for Industry (BHSM-601)

L T P C
3 0 0 3

Prerequisite: Basic knowledge of economics.
Course outcomes (COs):
At the end of the course, the students will be able to:
1. Define the main concepts and describe the models and methods in economic analysis.

2. Explain economic events in individual markets and the aggregate economy using basic theory and tools.

3. Apply supply and demand analysis to relevant economic issues.

4. Explain how individual decisions and actions as a member of society affect the economy locally, nationally and internationally.

5. Distinguish between perfect competition and imperfect competition and explain the welfare loss in non-competitive markets.

Mechanical Vibration (BME-701)

L T P C
3 0 2 4

Prerequisite: Basic Knowledge of Engineering Mathematics.
Course Outcomes (COs):
After completing this course a student will be able to:
1. Understand the basic concepts of vibrations.

2. Develop analyze the one degree to multi-degree of freedom vibration problems.

3. Understand the vibration control mechanisms and systems.

4. Practice the numerical techniques used for solving the vibrational models of mechanical systems.

5. Analysis of different method such as Rayleigh's, Dunkerley's, and Critical Speed of shaft with one disc with and without damping.

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

Registrar
Dr. B.R.A. University, Agra

Mechanical Vibration Lab (BME-751)

Course Outcomes (COs):
After completing this course a student will be able to:
1. Understand the basic concept of pendulum.

2. Explain analyze the one degree vibration problems.

3. Understand the forced vibration of spring mass system.

4. Solving the vibrational models of mechanical systems.

5. Analysis of Torsional Vibration.

Advanced Welding Technology (BME-702)

L T P C
2 0 0 2

Prerequisite: Basic Knowledge of Workshop Technology and Manufacturing Science.
Course Outcomes (COs):
After completing this course a student will be able to:
1. Understand the theoretical and practical aspects of welding and it's phenomena.

2. Understand the various welding process.

3. Describe the basic metallurgy of the melted and heat affected zone of a metal or alloy and heat transfer involved in different welding process.

4. Understand the various process involved in repair and maintenance of welding and the weldability of different metal.

5. Demonstrate their ability to check the weldment quality using various inspection and testing methods.

Departmental Elective-III

Refrigeration and Air Conditioning (DE-ME-701)

L T P C
3 0 2 4

Prerequisite: Basic Knowledge of Engineering Thermodynamics.
Course Outcomes (COs):
After completing this course a student will be able to:
1. Illustrate the fundamental principles and applications of refrigeration and air conditioning system.

2. Analyse performance of vapor compression refrigeration system.

3. Study the working principles of vapor absorption system and different refrigerants used.

4. Analyse the air conditioning processes using principles of Psychrometry.

5. Study the different refrigeration equipment's and its application in cold storage ,ice plant.

Refrigeration and Air Conditioning Lab (DE-ME-751)

Course Outcomes (COs):
After completing this course a student will be able to:
1. Understand the concept of refrigeration test rig and its applications.

2. Understand the concept of different types of expansion devices and its application.

3. Remembering concept of evaporators in refrigeration systems.

4. Learn and use of condensers.

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

Registrar
Dr. B.R.A. University, Agra

5. Analyze the basic components of air conditioning system.

6. To study basic components of air-conditioning system.

7. Evaluate the various performance parameters use in refrigeration test rig.

8. Understand the concept of air washer and window air conditioner

Design and Analysis of Heat Exchangers (DE-ME-702)

L T P C
3 0 2 4

Prerequisite: Basic Knowledge of Heat and Mass Transfer.
Course Outcomes (COs):
After completing this course a student will be able to:
1. Understand LMTD method and NTU method of analysis of common types of heat exchangers.

2. Understand the method to design of heat exchangers subject to fouling.

3. Understand the design procedure of double pipe heat exchangers and Shell & tube heat exchangers.

4. Understand the designing aspects of compact heat exchangers and thermal design of shell & tube condensers.

5. Describe the thermal analysis of evaporator and understand performance evaluation of Heat transfer Enhancement technique.

Design and Analysis of Heat Exchangers Lab (DE-ME-752)

Course Outcomes (COs):
After completing this course a student will be able to:
1. Understand the concept of LMTD method and Applications.

2. Understand the concept effectiveness-NTU method and Applications.

3. Understand the concept and analysis of double pipe heat exchanger with parallel and counter flow arrangement.

4. Understand the design and analysis of shell and tube type heat exchangers.

5. Understand the concept of plate type heat exchanger.

Open Elective Course III

Non-Conventional Energy Resources (OE-ME-701)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of Power Plant Engineering.
Couse Outcomes (COs):
1. Illustrate the generation of electricity from various Non-Conventional sources of energy, have a working knowledge on types of fuel cells.

2. Study the solar energy, Utilization of it, Principles involved in solar energy collection and conversion of it to electricity generation.

3. Study the working principle of geothermal energy, Magneto-hydrodynamics (MHD) and fuel cell technology for energy generation.

4. Explore the concepts involved in wind energy conversion system by studying its components, types and performance.

5. Study the working principle of bio mass, wave and tidal wave and OTEC.

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

Registrar
Dr. B.R.A. University, Agra

Nanotechnology (OE-ME-702)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of Materials Science.
Course Outcomes (COs):
After completion of this course student will be able to:
1. Explain the fundamental principles of nanotechnology and their application to engineering.

2. Apply engineering and physics concepts to the Nano-scale and non-continuum domain.

3. Study the properties of individual Nano particles, metal Nano clusters and semi conducting nanomaterial.

4. Discuss and evaluate state-of-the-art characterization methods for nanomaterial, and determine nanomaterial safety and handling methods required during characterization.

5. Explain methods of fabricating nanostructures of carbon Buckey Ball, Carbon nano-tubes

Non-Destructive Evaluation (OE-ME-703)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of Material Science and Engineering.
Course Outcomes (COs):
After completion of this course student will be able to:
1. Obtain the fundamental knowledge about different NDT methods and visual inspection.

2. Explain the principles and testing knowledge of DPT(liquid penetrate inspection) and MPT for product testing.

3. Explain the principles and techniques in Radiography Testing.

4. Describe the knowledge about Ultrasonic Testing for products.

5. Understand the materials and testing procedure for Eddy Current Inspection& Thermography Testing.

Introduction to Mechanical Micro Machining (OE-ME-704)

L T P C
3 0 0 3

Prerequisite: Basic Knowledge of Conventional machining processes..
Course Outcomes (COs):
1. Understand of process of Ultra Sonic Micro Machining, Abrasive Jet Micro Machining, Water Jet Micro Machining etc.

2. Explain the Beam Energy based micro machining, Electron Beam Micro Machining, Laser Beam Micro Machining, Electric Discharge Micro Machining etc.

3. To understand the Magneto Rheological abrasive flow finishing, Magnetic Float polishing, Elastic Emission Machining etc.

4. Understand of Micro bending with LASER, LASER micro welding, Electron beam for micro welding.

5. Understand the Metrology for micro machined components and Machining of Micro gear, micro nozzle, micro pins, Applications.

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

Registrar
Dr. B.R.A. University, Agra

Computer Aided Design and Manufacturing (BME-801)

L T P C
3 0 2 4

Prerequisite: Basic Knowledge of Computer.
Course Outcomes (COs):
1. Acquire the knowledge of geometric modelling and Execute the steps required in CAD software for developing 2D and 3D models and perform transformations.
2. Develop mathematical models to represent curves and surfaces.
3. Develop programs for NC and CNC to manufacture industrial components.
4. Illustrate group technology, CAPP and CIM concepts.
5. Understand the concept of FMS and Robotics.

Computer Aided Design and Manufacturing (BME-851)

Course Outcomes (COs):
1. Modeling of simple machine parts and assemblies from the part drawings using standard CAD packages.

2. Generate CNC Turning and Milling codes for different operations using standard CAM packages. Write manual part programming using ISO codes for turning and milling operations.

Thermal Turbo Machines (BME-802)

L T P C
3 0 0 3

Prerequisite: Course on Applied Thermodynamics.
Course Outcomes (COs):
After completion of this course student will be able to:
1. Understand the principles of operation of thermal turbo machines.

2. Design different work absorbing turbo machines like compressors and pumps.

3. Design different work producing turbo machines like gas and steam turbines.

4. Understand the functional parameters and components in different turbo machines.

Departmental Elective IV
Reverse Engineering (DE-ME-801)

L T P C
3 0 0 3

Prerequisite: Basic knowledge of Additive manufacturing.
Course Outcomes (COs):
1. Acquire basic knowledge about the main opportunities provided by Reverse Engineering and Rapid Prototyping tools.

2. Represents an opportunity to learn how to conduct detailed product design by benefitting from cutting-edge technologies.

Computational Fluid Dynamics (DE-ME-802)

L T P C
3 0 0 3

Prerequisite: Basic knowledge Engineering Fluid Mechanics.
Course Outcomes (COs):
After completion of this course student will be able to:
1. Apply the physical principles to derive the governing equations which govern fluid flow and heat transfer.

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By: Registrar

Registrar
Dr. B.R.A. University, Agra

2. Solve the diffusion problems using finite difference methods.

3. Solve the diffusion problems using finite volume methods.

4. Understand the various concepts of Finite Volume Method for Convection Diffusion.

5. Apply various algorithms to analyze the flow field and understand the turbulence models for the given problem.

Open Elective IV

Power Plant Engineering (OE-ME-801)

L T P C
3 1 0 4

Prerequisite: Basic Knowledge of Thermodynamics and I C Engines.
Course outcomes (COs):
1. Understand the basics of power plants.

2. Analyze the working and layout of the of steam power plant.

3. Define the working principles of Diesel power plant, its layout, safety principles and compare it with other types of plants.

4. Discuss the working principle and basic components of the nuclear power plants and Hydro-electric power plants and safety precautions involved with it.

5. Discuss and analyze the mathematical and working principle of different electrical equipment involved in the generation of the power.

Optimization Method in Engineering (OE-ME-802)

L T P C
3 1 0 4

Prerequisite: Course on calculus, matrix
Course Outcomes (COs):
After completion of the course a student will be able:
1. Learn one dimensional optimization methods.

2. Learn constrained optimization of multi-variable function.

3. Apply integer programming methods.

4. Dynamic programming and operation research problems

5. Learn soft computing based optimization.

Fracture Mechanics (OE-ME-802)

L T P C
3 1 0 4

Prerequisite: Basic Knowledge of Mechanics of Solids and Theory of Elasticity.
Course Outcomes (COs):
1. Basic Understanding of Crack in a Structure, Fracture Toughness, Types of Fracture.

2. Analyze elastic and elastic-plastic stress fields at the crack-tip in a solid material..

3. Estimate crack growth based on energy balance.

4. Demonstrate standard fracture mechanics tests for finding J-Integral and Crack Opening Displacement.

5. Inspect a solid material for the presence of crack.

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

Registrar
Dr. B.R.A. University, Agra

Machine Tool Design (OE-ME-804)

L T P C
3 1 0 4

Prerequisite: Basic Knowledge of Workshop Technology.

Course Outcomes (COs):

After successful completion of this course students will be able to

1. Understand classification of machine tools with their nomenclature, specification and uses.
2. Explain working of various drives mounted in machine tools.
3. Analyze the speed and feed box with the regulation of speed and feed rates.
4. Design components like structural bed, column, power screws etc.
5. Apply knowledge to study dynamics of machine tool and its control.

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

Registrar
Dr. B.R.A. University, Agra