



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

Shri Rawatpura Sarkar University, Raipur



Examination Scheme & Syllabus for B.Tech in Mechanical Engineering Semester-VIII

(Effective from the session: 2022-23)



**SHRI RAWATPURA SANKAR UNIVERSITY, RAIPUR, CHHATTISGARH
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**Four Years B.Tech. Programme
Scheme of Teaching and Examination
B.Tech. Eighth Semester Mechanical Engineering
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the session: 2022-23)**

S.N	Course Code	Course Title	Hours per week			Credit	Examination Scheme			Sem End Exam Duration (Hrs)
			L	T	P		Continuous Evaluation	Sem End Exam	Total	
1.	BENME801T	Robotics	3	1	-	4	30	70	100	3
2.	BENME801P	Robotics Lab	-	-	3	2	15	35	50	-
3.	BENME802T	Finite Element Methods	4	1	-	4	30	70	100	3
4.	BENME802P	Finite Element Methods Lab	-	-	3	2	15	35	50	-
5.	BENME803T	Industrial Engineering & Management	4	1	-	4	30	70	100	3
6.	BENME803P	Finite Element Methods Lab	-	-	3	2	15	35	50	-
7.	BENME804T	Professional Elective-III	4	1	-	4	30	70	100	3
8.	BENME805T	Open Elective- IV	4	1	-	4	30	70	100	3
9.	BENME806P	Major Project/seminar	4	1	4	6	100	50	150	-
		TOTAL				32			800	

L – LECTURE, T- TUTORIAL, P- PRACTICAL, EX-EXAM, IN- INTERNAL, TC- TOTAL CREDIT, Th- THOERY, Pr- PRACTICAL

List of Professional Electives-III

S.No.	Subject	Subject Code
I	Optimization Techniques	BENME804A
II	Environment Pollution & Control	BENME804B
III	Mechanical Handling System & Equipment's	BENME804C

Open Elective- IV

S.No.	Subject	Subject Code
I	Value Engineering	BENME805A
II	Non-Conventional Energy Sources	BENME805B



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Course Title	ROBOTICS				
Course Code	BENME801T				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Understanding of basic concept Mathematics, and other aspects of robotics, which includes designing, prototyping, analysis, coding algorithms etc.				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none">• To acquire the knowledge of basics of robotics and their importance.• Understand fundamental theory of robot design.• To acquire the knowledge on advanced algebraic tools for the description of motion.• To develop the ability to analyze and design the motion for articulated systems.• To acquire the knowledge of sensors, actuators and vision system used in robotics.				
Course Contents	<p>UNIT – I</p> <p>Introduction</p> <p>Fixed & flexible automation, evolution of robots and robotics, laws of robotics, progressive, advancement in robots, manipulator anatomy, arm configuration & work space, human arm characteristics, design and control issues, manipulation and control, actuators, sensors and vision, programming of robots, applications – material handling, processing applications, assembly applications, inspection applications etc, the future prospects, notations.</p> <p>UNIT – II</p> <p>Coordinate Frames, Mapping and Transforms</p> <p>Coordinate frames, description of objects in space, transformation of vectors, inverting a homogeneous transform, fundamental rotation matrices. mechanical structure and notations, description of links and joints, kinematic modeling of the manipulator, Denavit – Hartenberg notation, kinematic relationship between</p>				

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	<p>adjacent links, manipulator transformation matrix.</p> <p>UNIT – III</p> <p>Kinematic Modeling of Robots</p> <p>Position analysis - direct and inverse kinematic models of robotic manipulators, various examples. velocity analysis –Jacobian matrix, introduction to inverse kinematic model.</p> <p>UNIT – IV</p> <p>Robotic Sensors and Vision</p> <p>Introduction regarding sensing technologies, sensors in robotics, classification, characteristics, internal sensors – position, velocity, acceleration sensors, force sensors, external sensors – proximity, touch and slip sensors. robotic vision, process of imaging, architecture of robotic vision systems, image acquisition, components of vision system, image representation, image processing.</p> <p>UNIT – V</p> <p>Motion Planning and Control of Robot Manipulators</p> <p>Trajectory planning of robotic manipulator: joint space and Cartesian space techniques. open and close loop control, linear control schemes, examples of control models.</p> <p>Robot applications</p> <p>Industrial applications, material handling, processing applications, assembly applications, inspection application, principles for robot application and application planning, justification of robots, robot safety, non-industrial applications, robotic application for sustainable development.</p>
Course outcomes	<p>After the completion of course:</p> <ul style="list-style-type: none">• Apply knowledge of robotics for understanding, formulating and solving engineering problems.• Acquire knowledge and hands-on competence in applying the concepts in the design and development robots• Demonstrate creativeness in designing and development of robotics.• Identify, analyze and design of robots useful to the society.• Work effectively with multidisciplinary robots.
Text Books	<p>1. Robotics & Control – R.K. Mittal & I.J. Nagrath – TMH Publications.</p>

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	2. Introduction to Robotics Analysis, Systems Applications - Saced B. Niku, Pearson
Reference Books	<ol style="list-style-type: none">1. Principle of Robot Motion- Choset – PHI, Delhi2. Kinematics and Synthesis of linkages – Hartenberg and Denavit – McGraw Hill.3. Robotics Control Sensing - Vision and Intellgence – K.S. Fu, McGraw Hill.4. Robotic Engineering – An Integrated Approach - R.D. Klafter – PHI. Delhi.5. Introduction to Robotics - S.K. Saha – Mc Graw Hill.6. Introduction to Robotics – Mechanics and Control - John J. Craig

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Course Title	FINITE ELEMENT METHODS				
Course Code	BENME802T				
Course Credits	L	T	P	TC	
	4	1	-	4	
Prerequisites	Student should have good commanding on complex analysis, differential equations, numerical analysis courses, algorithms and computational complexity.				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none">• Understand the fundamental concepts of FEM.• Understanding the use and knowledge of fundamental stiffness matrix.• Know the behavior and usage of each type of elements covered in this course.• Be able to prepare a suitable FE model for structural mechanical analysis problems.• Can interpret and evaluate the quality of the results• Be aware of the limitations of the FEM.				
Course Contents	<p>Unit-I</p> <p>Formulation of Finite Element Equation starting from governing differential equation, Domain residual and minimization, Weighted residual method, Weak form of weighted residual method, solution of weak form using trial function, piecewise continuous trial function solution, formulation of one dimensional bar element using weak form of weighted residual element, Minimization of potential energy, Rayleigh-Ritz method, Piece-wise continuous trial function, finite element form of Rayleigh-Ritz method, finite element formulation derived from a functional, formulation of bar element and heat transfer element using Rayleigh-Ritz method</p> <p>Unit-II</p> <p>One dimensional finite element analysis, generic form of total potential for one dimensional case, determination of shape functions for linear bar finite element and quadratic bar finite element, stiffness matrix, one dimensional problems of structure mechanics and heat conduction</p>				

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	<p>Unit-III</p> <p>Stiffness matrix formulation for beam and frame element, Determination of shape functions and element matrices, Application problems</p> <p>Unit-IV</p> <p>Two dimensional finite element analysis, simple three node triangular elements, four node rectangular element, six node triangular element, natural coordinates, coordinate transformation, simple two dimensional problems, Gauss Quadrature Technique.</p> <p>Unit-V</p> <p>Finite element analysis for plane stress and plane strain problem, Strain displacement matrix for 2-D elements, two-dimensional integrals. Application problems, Scalar field problems including heat conduction and flow problems.</p>
Course outcomes	<p>After the completion of course:</p> <ul style="list-style-type: none">• Apply knowledge of finite element method for understanding, formulating and solving engineering problems.• Acquire knowledge and hands-on competence in applying the concepts finite element method in the analysis of structural and thermal systems.• Demonstrate creativeness in designing new systems components and processes in the field of engineering• Identify, analysis, and solve mechanical engineering problems useful to the society.• Work effectively with engineering and science teams as well as with multidisciplinary problems.
Text Books	<ol style="list-style-type: none">1. Textbook of Finite Element Analysis – Seshu P – Prentice Hall of India.2. Fundamentals of Finite Element Analysis - David Hutton – TMH, Delhi
Reference Books	<ol style="list-style-type: none">1. Finite Element Method: Basic concepts & Applications- Alavala – PHI, Delhi2. Finite Element in Engineering - T.R. Chandrupatla and Belegundu, Pearson, Singapore3. Concepts and Applications of Finite element analysis - Cook, Robert – John Wiley4. The Finite Element Method, A Practical Course - Liu and Quek. – McGraw Hill5. The Finite Element Method in Engineering - S.S. Rao.6. An Introduction to the Finite Element Method – J.N. Reddy – TMH, Delhi

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| | <ol style="list-style-type: none">7. Finite Element Method – Zienkiewicz. O C - TMH, Delhi8. Finite Element Analysis: Theory And Programming – Krishnamoorthy C.S.- TMH, Delhi9. Finite Element Procedure – K.J.Bathe – Prentice Hall of India10. A First Course in The Finite Element Method – Logan – Cengage Learning |
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Course Title	INDUSTRIAL ENGINEERING & MANAGEMENT				
Course Code	BENME803T				
Course Credits	L	T	P	TC	
	4	1	-	4	
Prerequisites	Understanding of basic concept of mathematics, physics, chemistry and other engineering subjects.				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none">• To impart capability of successfully planning, controlling, and implementing projects.• Understand and apply the principles of math's, science, technology and engineering, involving industry-relevant problems.• Contribute to the profitable growth of industrial economic sectors by using IE analytical tools, effective computational approaches, and systems thinking methodologies.• Maintain high standards of professional and ethical responsibility.• Flourish and work effectively in diverse, multicultural environments emphasizing the application of teamwork and communication skills.• Practice life-long learning to sustain technical currency and excellence throughout one's career.				
Course Contents	<p>Unit-I</p> <p>Introduction</p> <p>History & development, objective, place of Industrial Engineering in an organization, relation with other department, system approach.</p> <p>Plant Location</p> <p>Need for a suitable location, Plant location problems factors affecting location, quantitative method for evaluation of plant location.</p> <p>Plant Layout: Objective & Principles, factors affecting layout, types of layout.</p> <p>Unit-II</p>				

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	<p>Work Study: Purpose, objectives and applications of work study, Productivity and work study.</p> <p>Method Study</p> <p>Introduction, procedure, flow process charts, Multiple activity chart, motion economy principles, Therbligs, cycle graph and chronocyclegraph.</p> <p>Work Measurement</p> <p>Definition, types, Time Study- selection & timing the job, rating, allowances, Numerical on Normal and standard time calculation.</p> <p>Unit-III</p> <p>Job Evaluation and Merit Rating: Definition, objectives, methods.</p> <p>Wages and Incentives</p> <p>Terminology, characteristics, factors, types of incentives, wage incentive plan, Rowan plan, Taylor's differential piece rate system, Emerson's efficiency plan, Halsey's 50-50 plan, Bedaux plan, Group task & Bonus system.</p> <p>Unit-IV</p> <p>Basic concepts and Functions of management</p> <p>Nature, Purpose and Objectives of basic functions of management, Authority and Responsibility, social responsibility of manager, ethics and management.</p> <p>Human Resource Management</p> <p>Nature and Scope of Human Resource Planning, Recruitment and Selection, Training and Development, Career Growth, Grievances, Motivation – needs and types, Maslow hierarchy of needs theory, Herzberg two factor theory, Need-want-satisfaction chain, Quality of working life, job enrichment and job enlargement.</p> <p>Unit-V</p> <p>Marketing Management</p> <p>Marketing Environment, Marketing Mix, Advertising and Sales Promotion, Channels of Distribution.</p> <p>Financial Management</p> <p>Book keeping, financial statement Analysis, Financial Ratios, Capital Budgeting, Break-Even Analysis.</p>
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Course outcomes	<p>After the completion of course:</p> <ul style="list-style-type: none">• Ability to apply mathematics and science in Industrial engineering.• Ability to design and conduct experiments, as well as to analyze and interpret data.• Ability to identify, formulates, and solves engineering problems.• Ability to use the techniques, skills, and modern engineering tools necessary for industrial engineering practice.• Ability to design, develop, implement and improve integrated systems that include people, materials, information, equipment, and people.
Text Books	<ol style="list-style-type: none">1. Industrial Engineering and Production Management –MartandTelsang - S.Chand.2. Industrial Engineering & Management - S. Dalele& Mansoor Ali - Standard Publishers.
Reference Books	<ol style="list-style-type: none">1. Industrial Engineering &Management ,A new perspective- Philip E Hicks - Mcgraw Hill2. Company Essential of Management - H. Koonz and H. Weihrich – Mcgraw Hill3. Marketing Management- Kotler Philip- Prentice Hall of India4. Flexibility in Management - Sushil, Vikas publication - New Delhi5. Human Resource Management - Luthans Fred - McGraw Hill, Inc.6. Financial Management - M.Y. Khan and P.K. Jain - Tata Mc-Graw Hill7. Fundamentals of Business Organizations and Management -Y.K. Bhusan - S. Chand8. Industrial Management - K.K. Ahuja - Khanna Publishers9. Introduction of work study - ILO, Geneva - Universal Publishing Corporation, Bombay10. Motion and Time Study - Ralph M. Bannes - John Wiley & Sons11. Work Study and Ergonomics - H.S. Shan - Dhanpat Rai & Sons

Course Title	ROBOTICS LAB
Course Code	BENME801P

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Course Credits	L	T	P	TC	
	-	-	4	2	
Course Objectives	This course will enable students to: <ul style="list-style-type: none">• Students will learn the basics of robotics and their importance.• Understand fundamental theory of robot design.• To develop the ability to analyze and design the motion for articulated systems.• To acquire the knowledge of sensors, actuators and vision system used in robotics.				
Course Contents	List of Experiments: <ol style="list-style-type: none">1. Demonstration of Cartesian/ cylindrical/ spherical robot.2. Demonstration of Articulated/ SCARA robot.3. Virtual modeling for kinematics and dynamic verification any one robotic structure using suitable software.4. Design, modeling and analysis of two different types of grippers.5. Study of sensor integration.6. Two program for linear and non-linear path.7. Study of robotic system design.8. Programming for forward kinematics problems.9. Dynamic analysis of manipulators using software.10. Study and demonstration of actuators and vision system.11. Study of various robotic applications.12. 12. Setting robot for any one industrial application after industrial visit.				
Equipments/ Machines Required					
Course outcomes	After the completion of course: <ul style="list-style-type: none">• Demonstrate the basic functioning of a robot				

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	<ul style="list-style-type: none">• Identify various components of robots• Carryout kinematic analysis, workspace analysis, and trajectory planning for a robot• Identify suitable sensors/actuators for robot• Select an appropriate robot for given industrial inspection and material handling systems.• Illustrate various aspects of a robot as a humanoid
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Course Title	FINITE ELEMENTMETHODS LAB				
Course Code	BENME802P				
Course Credits	L	T	P	TC	
	-	-	4	2	
Course Objectives	This course will enable students to: <ul style="list-style-type: none">• The students learn the theory and characteristics of FEM that represent engineering structure.• To learn and apply fem solution to structural, thermal, dynamic problems to develop the knowledge and skill needed to effectively evaluate finite element analysis.				
Course Contents	Minimum eight assignments are to be completed on following area using appropriate Software. <ol style="list-style-type: none">1. Structural Analysis2. Thermal Analysis3. Fluid Flow Analysis4. Coupled Field Analysis5. Modal Analysis Minimum four problems shall be solved with Manual calculations in any of area specified above.				
Equipments/ Machines Required					
Course outcomes	After the completion of course: <ul style="list-style-type: none">• Solve differential equations using weighted residual methods• Develop the finite element equations to model engineering problems governed by second order differential equations• Apply the basic finite element formulation techniques to solve engineering problems by using one dimensional elements• Apply the basic finite element formulation techniques to solve engineering				

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	<p>problems by using two dimensional elements</p> <ul style="list-style-type: none">• Apply the basic finite element formulation techniques to find natural frequency of single degree of vibration system.• Use commercial FEA software, to solve problems related to mechanical engineering
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Course Title	INDUSTRIAL ENGINEERING & MANAGEMENT-LAB				
Course Code	BENME803P				
Course Credits	L	T	P	TC	
	-	-	4	2	
Course Objectives	This course will enable students to: <ul style="list-style-type: none">• An ability to identify, formulate and solve problems of integrated system of people, materials, information, equipment and energy.• An ability to design and conduct experiments as well as analyze and interpret data, for the development of efficient solutions for IEM problems.				
Course Contents	EXPERIMENTS TO BE PERFORMED (MINIMUM TEN EXPERIMENTS) <ol style="list-style-type: none">1. To prepare the charts & diagrams for a selected problem according to the existing method and an improved method -men type flow process chart.2. To prepare the charts & diagrams for a selected problem according to the existing method and an improved method -material type flow process chart3. To prepare the charts & diagrams for a selected problem according to the existing method and an improved method -machine type flow process chart4. 4. To prepare the charts & diagrams for a selected problem according to the existing method and an improved method – multiple activity chart.5. Study of principles of fundamentals of hand motion.6. Study & applications of principles of motion economy.7. Performance of micro motion study of a job.8. Problems in assignment of men & machines.9. Training for a performance rating using walking exercises / audio visual aids.10. Calculation of allowance for a job.11. Standard time calculation problems.12. Problems of wage incentive.13. Case study of an industrial/service organization using a method study				

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	techniques. 14. Stop watch time study of a job.
Equipments/ Machines Required	Study work only
Course outcomes	After the completion of course: <ul style="list-style-type: none">• Illustrate the need for optimization of resources and its significance• Develop ability in integrating knowledge of design along with other aspects of value addition in the conceptualization and manufacturing stage of various products.• Demonstrate the concept of value analysis and its relevance.• Manage and implement different concepts involved in method study and understanding of work content in different situations.• Describe different aspects of work system design and facilities design pertinent to manufacturing industries.• Illustrate concepts of Agile manufacturing, Lean manufacturing and Flexible manufacturing

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Professional Elective-III

Course Title	OPTIMIZATION TECHNIQUES				
Course Code	BENME804A				
Course Credits	L	T	P	TC	
	4	1	-	4	
Prerequisites	Understanding of basic concept of Mathematical formulation, linear programming, effective decisions–making; model formulation.				
Course Objectives	This course will enable students to: <ul style="list-style-type: none">• This course aims to introduce students to use advanced quantitative methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.				
Course Contents	UNIT – I Optimization Technique Classification of optimization, problems, single variable and multivariable optimization with equality constraints and Inequality constraints. Convex programming problem. UNIT – II Linear Programming - II Duality in Linear programming, dual simplex method, decomposition principle, sensitivity analysis, quadratic programming, changes in cost coefficient, golden section method. UNIT – III Non-Linear Programming – I Rate of convergence, Design variables, Random search methods, Chrivariate methods, Powell’s method, Newton’s method, Marquard Method, Test function. UNIT – IV Geometric Programming Unconstrained minimization problem, primal dual relationship, geometric programming with mixed Eriequality, application and complementary function. UNIT- V Dynamic Programming				

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	Multistage Decision processes. principles of optimality, continuous dynamic programming.
Course outcomes	After the completion of course: <ul style="list-style-type: none">• Ability to understand and analyze managerial problems in industry so that they are able to use resources (capitals, materials, staffing, and machines) more effectively.• Knowledge of formulating mathematical models for quantitative analysis of managerial problems in industry.• Skills in the use of Operations Research approaches and computer tools in solving real problems in industry.
Text Books	3. Optimization Techniques – C.S. Rao – Dhanpat Rai & Sons, New Delhi 4. Optimization methods for Engineering Design – R.L. Fox - Addison Wesley
Reference Books	7. Engineering Optimization Theory and Practice – S.S. Rao – New Age Publishers. 8. Introduction to optimum Design – J.S. Arora – Mc. Grawhill publishers 9. Optimization Methods for Engineering – Raju – PHI, Delhi 10. Foundation of Mathematical optimization – Pallaschke – Kluwer Academic Publishers 11. Optimization Methods in Operations Research and System Analysis–K V Mittal–Wiley, Delhi 12. Engineering Optimization: Theory And Practice - Singiresu S Rao – New Age 13. Optimization For Engineering Design- Deb, Kalyanmoy-Prentice Hall 14. Optimization Methods – Mohan & Deep- New Age, Delhi 15. An Introduction to Optimization- Chang, Edwin & Zak Stanislaw -John Wiley, New York 16. Optimization Concepts And Applications In Engineering – Belegundu & Chandrupatla-Pearson, Singapore

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Course Title	ENVIRONMENT POLLUTION & CONTROL				
Course Code	BENME804B				
Course Credits	L	T	P	TC	
	4	1	-	4	
Prerequisites	Understanding of basic concept Chemistry, Environment, mathematical calculation techniques.				
Course Objectives	This course will enable students to: <ul style="list-style-type: none">• To provide an introduction to Environmental Pollution.• To develop an understanding of the causes, chemistry and effects of pollution.• To build awareness of the strategies used to control and manage pollution.• To make aware of Environmental Laws & Acts				
Course Contents	UNIT-I Environmental Pollution – Introduction & Classification Sources and classification of air pollutants, aerosols, primary and secondary air pollutants, effect of air pollution on humanhealth, effect of SO ₂ , CO ₂ , NO ₂ H ₂ S and lead, economic effect of air pollution, mechanism of deterioration in pollutedatmosphere. Factors influencing atmospheric deterioration, effect of air pollution on building materials, paints, textiles,rubber, leather, paper and electronic industry. UNIT – II Environmental Pollution - Sources Air pollution due to automobiles, exhaust, Crankcase and evaporative emissions and their control,effect of various parameters of I.C. engines on air pollution, photochemical air pollution, air pollution from ferrousmetallurgical operations and thermal power plants. UNIT – III Chemistry of Pollution Definition of pollutant concentrations, mass concentration, volume concentration, mass-volumeconcentration and relationship between these concentrations, smoke and its control. Ningalmam smoke chart, smokeprevention and control of air pollution by process change, elementary ideas of control of gaseous contaminants forcombustion and absorption.				

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	<p>UNIT – IV</p> <p>Pollution Control</p> <p>Control of air pollution by equipment, objectives of using control equipment, objectives of using control equipment, settling chambers, inertial separators, cyclones, principle of electrostatic precipitators, descriptive study of the above equipment only, merits and demerits of the equipment, choice of equipment.</p> <p>UNIT – V</p> <p>Environmental Laws & Acts</p> <p>Air pollution indices, definition of air pollution index, type and use of air pollution indices, criteria for a standardized index, acid rain, causes of acid rain and its remedy, green house and its effect, air pollution legislation and regulations, constitution of the Board, functions of the central board and state boards, classification of pollution sources under Air Act 1981 and 1986.</p>
Course outcomes	<p>After the completion of course:</p> <ul style="list-style-type: none">• Understand contemporary pollution issues.• Have insight into specific examples of environmental pollution.• Understand the causes and effects of key types of environmental pollution.• Appreciate different pollution control strategies.• Awareness of Environmental Laws & Acts
Text Books	<ol style="list-style-type: none">1. Environmental Chemistry and Pollution Control - S S Dara – S Chand , New Delhi2. Air Pollution - M.N. Rao and H.V.N. Rao – TMH, New Delhi.
Reference Books	<ol style="list-style-type: none">1. Air Pollution Control Theory - Martin Crawford.- TMH, New Delhi2. Encyclopaedia of Environment Control Technology & Air Pollution Control – Cheremisinott P N – Gulf Publication, London3. Pollution Control Hand Book - Utility Publication, Securdarabad4. Environmental Pollution Conservation And Planning - Pashupatinath&Siddh Nath - Chugh Publications, Allahabad5. Environmental Air Pollution and Its Control - Chhatwal, Mehra&Katyal - Anmol Publications, New Delhi6. Environmental Pollution Control Engineering – Rao C S –Wiley, New Delhi7. Environmental Pollution Analysis – Khopkar S M- Wiley, New Delhi8. Air Pollution Control Technology - R.W. Bethewaven - Van Nostrans.9. Air Pollution & Control – KVSG Murali Krishnan – Kaushal & Company

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Course Title	MECHANICAL HANDLING SYSTEM & EQUIPMENTS				
Course Code	BENME804C				
Course Credits	L	T	P	TC	
	4	1	-	4	
Prerequisites	Understanding of basic concept material science, production technology and power plant engineering.				
Course Objectives	This course will enable students to: <ul style="list-style-type: none">• To introduce to the importance of proper material handling and storage techniques.• To introduce to selection of material handling equipment• To introduce to design considerations of mechanical handling equipment and load lifting attachments				
Course Contents	UNIT – I Elements of Material Handling System Importance, Terminology, objectives and benefits of better Material Handling, Principles and features of Material Handling System, Interrelationships between material handling and plant layout, physical facilities and other or organizational functions, Classification of Material Handling Equipment. UNIT – II Selection of Material Handling Equipment Factors affecting for selection, Material Handling Equation, Choices of Material Handling Equipment, General analysis Procedures, Basic Analytical techniques, the unit load concept Selection of suitable types of systems for applications, Activity cost data and economic analysis for design of components of Material Handling Systems, functions and parameters affecting service, packing and storage of materials. UNIT – III Design of Mechanical Handling Equipment Design of Hoists, Drives for hoisting, components, and hoisting mechanisms, rail traveling components and mechanisms, hoisting gear operation during transient motion, selecting the motor rating and determining breaking torque for hoisting mechanisms. Design of Cranes, Hand-propelled and electrically driven E.O.T				

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	<p>overheat traveling cranes, Traveling mechanisms of cantilever and monorail cranes, design considerations for structures of rotary and cranes with fixed radius, fixed post and overhead traveling cranes, Stability of stationary rotary and traveling rotary cranes.</p> <p>UNIT – IV</p> <p>Design of load lifting attachments</p> <p>Load chains and types of ropes used in Material Handling System, Forged, Standard and Ramshorn Hooks, Crane Grabs and Clamps, Grab Buckets, Electromagnetic Design consideration for conveyor belts, Application of attachments.</p> <p>UNIT – V</p> <p>Study of systems and Equipment used for Material Storage</p> <p>objectives of storage, Bulk material handling, Gravity flow of solid through slides and chutes, Storage in bins and hoppers, Belt conveyors, Bucket-elevators, Screw Conveyors, cabin vibratory Mobile racks etc.</p>
Course outcomes	<p>After the completion of course:</p> <ol style="list-style-type: none">1. The students will be able to identify material handling equipment requirements for a specific process and for various locations and working conditions.2. The students will be able to understand the benefit of an efficient material handling system3. The students will be able to recognize the importance of material storage equipments.
Text Books	<ol style="list-style-type: none">1. Material Handling Equipments - N. Rudenko - Peace Publishers, Moscow.2. Material handling System Design - James M. Apple, John-Wiley Publication, New York.
Reference Books	<ol style="list-style-type: none">1. Materials Handling Principles and Practice - Allegri T H - CBS Publication, New Delhi2. Material Handling - John R. Immer - McGraw Hill Co. Ltd., New York.3. Material Handling in Machine shops - Machinery Publication Co. Ltd., London.4. Material Handling Equipment - M. P. Nexandr - MIR Publication, Moscow.5. Bulk Solid Handling - C. R. Cock and J. Mason - Leonard Hill Publication Co. Ltd. U.S.A.6. Material Handling Hand Book - Kulwiar R. A - John Willy Publication, New York.

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Open Elective-IV

Course Title	VALUE ENGINEERING				
Course Code	BENME805A				
Course Credits	L	T	P	TC	
	4	1	-	4	
Prerequisites	<ul style="list-style-type: none">Understanding the objective of this course is to introduce students with the methodology of Value Engineering and its decision-making process.				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none">To familiarize students with procedures that provides standards for Value Engineering applications.To teach value engineering in a practical, project-based manner.During the course student will be engaged in decision-making using Value Engineering tools to ensure quality and value while reducing the cost of projects.Student will know about a number of case study applications of the Value Engineering to gain practical experience.				
Course Contents	<p>UNIT – I</p> <p>Basic Concepts</p> <p>Meaning of the term value, basic kind, reasons for poor value, value addition, origin and history. Benefits, relevance in Indian scenario.</p> <p>UNIT – II</p> <p>Techniques</p> <p>Different techniques, organizing value engineering study, value engineering and quality.</p> <p>UNIT – III</p> <p>Job Plan</p> <p>Different phases, General phase, Information phase, Functional Phase, Creation</p>				

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	<p>Phase, Evaluation Phase, Investigation Phase, Implementation Phase, Audit.</p> <p>UNIT – IV</p> <p>Selection of evaluation of VE Projects</p> <p>Project selection, method selection, value standard, application of methodology.</p> <p>UNIT – V</p> <p>Value Engineering Program</p> <p>VE operations in maintenance and repair activities, VE Cost, life cycle, cost model, training for VE, general value engineering, case studies.</p>
Course outcomes	<p>After the completion of course:</p> <ul style="list-style-type: none">• Understand the basics of Value Engineering (VE) to ensure that a standardized method is used for VE applications to projects• Learn to perform function analysis for projects.• Understand the appropriate time to apply VE for projects
Text Books	<ol style="list-style-type: none">1. Value Engineering a How to Manul– S.S. Iyer – New Age International Publishers, New Delhi2. Industrial Engineering & Management – O.P. Khanna – Dhanpat Rai & Sons
Reference Books	<ol style="list-style-type: none">1. Techniques of Value Analysis and Engineering – L.D. Miles – McGraw Hill, New York2. Value Engineering: A Systematic Approach – A.E. Mudge – McGraw Hill, New York3. Getting More at Less Cost: The Value Engineering Way - Jagannathan G - TMH, New Delhi4. Value Engineering a Practical Approach for Owners Designers & Constructions – Zimmerman LW & Gilen HD – CBS, New Delhi.5. Compendium on Value Engineering – H.G. Tufty – Indo-American Society.

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Course Title	NON CONVENTIONAL ENERGY SOURCES				
Course Code	BENME805B				
Course Credits	L	T	P	TC	
	4	1	-	4	
Prerequisites	<ul style="list-style-type: none">Understanding the objective of this course is to introduce students with the methodology of Value Engineering and its decision-making process.				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none">To provide a survey of the most important renewable energy resources and the technologies for harnessing these resources within the framework of a broad range of simple to state- of -the-art energy systems.				
Course Contents	<p>UNIT-I Need for Non-conventional energy sources, Types of Non-Conventional energy sources Fuel cells: Definition-Design and Principle of operation with special reference to H₂O₂- Solid oxide electrolyte cells-Advantages and Disadvantages of fuel cells-Applications of Fuel cells.</p> <p>UNIT-II Solar Energy: Solar radiation and its measurements-Solar energy collectors: Flat Plate and Concentrating Collectors- solar pond -Applications of Solar energy. Biomass Energy: Definition-Biomass conversion technologies.</p> <p>UNIT-III Wind Energy: Nature of wind-Basic components of Wind Energy Conversion System(WECS)-Wind energy collectors: Horizontal and vertical axis rotors- Advantages and Disadvantages of WECS - Applications of wind energy.</p> <p>UNIT-IV Ocean Energy: Ocean thermal electric conversion (OTEC) methods: Open cycle and Closed cycle Principles of tidal power generation-Advantages and limitations of tidal power generation.</p> <p>UNIT-V Geothermal Energy: Types of Geothermal resources- Applications of Geothermal Energy.</p>				

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Course outcomes	<ul style="list-style-type: none">• After completion of the course, students will be able to:• Demonstrate the generation of electricity from various Non-Conventional sources of energy, have a working knowledge on types of fuel cells.• Estimate the solar energy, Utilization of it, Principles involved in solar energy collection and conversion of it to electricity generation.• Explore the concepts involved in wind energy conversion system by studying its components, types and performance.• Illustrate ocean energy and explain the operational methods of their utilization.• Acquire the knowledge on Geothermal energy.
Text Books	<ol style="list-style-type: none">1. G.D. Rai, Non-Conventional Energy Sources ,Khanna Publishers, New Delhi, 2011.2. B H KHAN, Non-Conventional Energy Resources, McGraw Hill, 2nd Edition, 2009.3. Ashok Desai V, Non-Conventional Energy, Wiley Eastern Ltd, 1990.
Reference Books	<ol style="list-style-type: none">1. Mittal K.M, Non-Conventional Energy Systems, Wheeler Publishing Co. Ltd, 1997.2. Ramesh R, Kurnar K.U, Renewable Energy Technologies, Narosa Publishing House, New Delhi, 1997.

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