7th Semester

Department of Mechanical Engineering
Subject Offered During Academic Year 2021-22

Basaveshwar Engineering College (Autonomous), Department of Mechanical Engineering
Scheme Autonomous Syllabus (175 credits) 2020-21 (Regular) and 2021-22(Lateral) Batch
VII Sem. B. E (Mechanical Engineering)

Sl No	Code	Subject	Credits	Hours/Week			Examination Marks		
				Lecturer	Tutorial	Practical	CIE	SEE	Total
01	UME 704 C	Finite Elements Methods	3	2	2	-	50	50	100
03	UME 709 O	*On line course	1	-	-	-	-	-	-
04	UME 7XX E	Dept Elective – 2	3	3	-	-	50	50	100
05	UME 7XX E	Dept Elective – 3	3	3	-	-	50	50	100
06	UME 7XX E	Dept Elective – 4	3	3	-	-	50	50	100
07	UME 705 L	CAE Lab	1	-	-	2	50	50	100
08	UME 706 L	CNC Lab	1	-	-	2	50	50	100
09	UME 7XX N	**Open Elective- 2	3	-	-	-	-	-	-
10	UME 711 P	Project Phase –I + Internship	5+2	-	-	10	50	50	100
11	UXX XXX N	**Open Elective	2	2	-	-	50	50	100

***Online course should be of minimum 04 weeks duration to earn 01 credit.**

****Open elective - I is offered by other department to Mechanical Engineering Students**

Electives offered by the Department:

The Students have register for any three-elective selecting maximum one from each group

Group – I	Group – II	Group – III	Group - IV
UME 713 E: Non-Destructive Testing UME 721 E: Advance Manufacturing Technology UME 712 E: Composite Materials	UME 727 E: Control Engineering UME 728 E: Tool Design	UME 720 E: Power Plant Engineering UME 729 E: Refrigeration & Air conditioning	UME 730 E: Operation Management UME 731 E: Six Sigma

*** For awarding B.E. (Mechanical Engineering) degree, each student is required to complete minimum of 04 weeks or (02 weeks + 02 weeks) of Internship between 3rd and 6th semester to earn 02 credits which will be awarded during 7th Semester.**

B. E. MECHANICAL ENGINEERING SEMESTER -VII			
Finite Element Methods			
Course Code	**UME 704C**	CIE Marks	50
Teaching Hours/Week (L:T:P)	2:2:0	SEE Marks	100
Credits	3	SEE Exam Hours	03

UNIT – I

10 hours

Introduction: Equilibrium equations in elasticity subjected to body force, traction forces, stress strain relations for plane stress and plane strain, Boundary conditions, Initial conditions, Euler's Lagrange's equations of bar, beams, Principle of a minimum potential energy, principle of virtual work, Rayleigh-Ritz method Galerkins method and Matrix techniques .

Basic Procedure: General description of Finite Element Method, , Discretization process; types of elements 1D, 2D and 3D elements, size of the elements, location of nodes, node numbering scheme, half Bandwidth, Stiffness matrix of bar element by direct method, Properties of stiffness matrix, Preprocessing, post processing. Engineering applications of finite element method. Advantages & Disadvantages of FEM.

UNIT – II

10 hours

Interpolation Models: Polynomial form of interpolation functions- linear, quadratic and cubic, Simplex, Complex, Multiplex elements, Selection of the order of the interpolation polynomial, Convergence requirements, , static condensation. penalty approach and elimination method.

one dimensional bar element: Recall of 1D linear bar element. Lagrangian interpolation, Higher order one dimensional elements- quadratic, Cubic element and their shape functions, properties of shape functions, Effect of temperature on 1D elements and stress calculation.

UNIT – III

10hours

TWO dimensional elements: Shape functions and stiffness matrix of 2D elements four-Node quadrilateral, Nine-Node quadrilateral Eight-Node quadrilateral, serendipity and lagrange comparison with 2D pascals triangle. CST and LST shape functions ,jacobian matrix , stiffness matix, force terms, stress calculation and Numerical integration. Introduction to 3-D elements shape function of tetrahedron element

UNIT – IV

10hours

TRUSSES AND BEAM ELEMENTS: Analysis of trusses and beam elements its shape functions, stiffnesmatrix and stress calculation

Heat Transfer Problems: Steady state heat transfer, 1D heat conduction governing equation, boundary conditions, One dimensional element, Functional approach for heat conduction, Galerkin approach for heat conduction, heat flux boundary condition, 1D heat transfer in thin fins.

Assignment: (Mention the contents of the Assignment to be submitted)

Course Outcomes: At the end of the course, the student will be able to:

CO1 Understand the fundamental theory of the FEM method
- Generate the governing FE equations for systems governed by partial differential equations

CO2 Understand the role and significance of shape functions in finite element formulations and use linear, quadratic, and cubic shape functions for interpolation
- Apply the FEM method to solve Bars subject static load and thermal load.

CO3 Understand the formulation of two-dimensional elements (triangle and quadrilateral elements)
- Apply the concept of Lagrange interpolation for 3D elements.

CO4 Understand the formulation of truss, beams and Heat transfer concept.
- Apply the FEM method to solve truss and beams.

Question paper pattern:

- Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
- Each question carries 20 marks and should not have more than 4 sub divisions.
- Any five full questions are to be answered choosing at least one from each unit.

Sl No	Title of the Book	NameoftheAuthor/s	Name of the Publishers	Edition and Year
Textbook/s				
1	Finite Elements in enginring	ChandrupatlaT.R	Pearson Edition.	3rd edition, 2015.
2	Finite Element Analysis	C.S.Krishnamurthy	Tata McGraw Hill Publishing Co. Ltd, New Delhi,	2nd edition, 1995
3	Fundamental Finite Element Analysis and Application	Asghar Bhatt	PageTurner	3rd edition, 2013.
4	Advanced Topics in Finite Element Analysis of Structures with Mathematica and MATLAB Computations	Asghar Bhatt	PageTurner	3rd edition, 2013.
Reference Books				
1	The FEM its basics and fundamentals	O.C.Zienkiewicz	Elsevier	6th edition, 2013
2	Finite Element Method	J.N.Reddy	McGraw –Hill	International Edition
3	Finite Element Methods	Daryl. L. Logon	Thomson Learning	3rd edition, 2001.
4	Finite Element Analysis	H.V. Lakshminarayana	universities press	2004

B. E. MECHANICAL ENGINEERING SEMESTER -VII			
NON-DESTRUCTIVE TESTING			
Course Code	**UME 713C**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3-0-0	SEE Marks	100
Credits	03	SEE Exam Hours	03

UNIT-I

Introduction to ND Testing: **09 Hours**

Information gathered from NDT, Defects in manufacturing Advantages and disadvantages of NDT, Comparison of destructive & Non-destructive tests, Methods of NDT, Common application of NDT, Flaw detection & evaluation, leak detection & evaluation, Non-Destructive Evaluation, visual inspection Replication microscopy technique for

Non-Destructive Evaluation: Specimen preparation, replication techniques, and micro structural analysis

UNIT-II

09 Hours

Liquid Penetrant Inspection: Principles, penetrant methods, procedure, materials used, equipment, parameters and applications

Magnetic Particle Inspection: Principle, general procedure, advantages & limitations, applications, magnetic field generation, types of magnetic particles and suspension liquids,

Direction of the Magnetic Field, Importance of Magnetic Field Direction

UNIT-III

09 Hours

Radiography Inspection: principle, X-ray radiography, equipment, Gamma-ray radiography, real time radiography & film radiography, radiation safety, advantages, disadvantages, and applications of **radiography Computed tomography:** Principles, capabilities, comparison to other NDE methods, CT equipment's, industrial computed tomography applications

UNIT-IV

12 Hours

Ultrasonic inspection: Basic equipment, advantages & limitations, inspection methods pulse echo A, B, C scans transmission transducers & couplants Thermal Inspection: Principles, equipment, inspection methods applications

Eddy Current Inspection: Principles of operation, procedure, advantages & limitations, operating variables, inspection coils, eddy current instruments, application examples

Assignment: (Mention the contents of the Assignment to be submitted)

Course Outcomes: At the end of the course, the student will be able to:

CO1	To have a basic knowledge of surface N D E techniques which enable to carry out various inspection in accordance with the established procedures.
CO2	Differentiate various defect types and select the appropriate N D T methods for better evaluation
CO3	Documentation of the testing and evaluation of the results for further analysis
CO4	Students will be able to understand significance and suitability of various nondestructive testing methods in industrial application.

Question paper pattern:

- Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
- Each question carries 20 marks and should not have more than 4 sub divisions.
- Any five full questions are to be answered choosing at least one from each unit.

Sl No	Title of the Book	Name of the Author/s	Name of the Publishers	Edition and Year
Textbook/s				
1	Non-Destructive –Garden and Reach	Mc Gonnagle Jj	NEWYORK	
REFERENCE BOOKS				
1	Non Destructive Evaluation and Quality Control	Metals Hand Book	American Society of Metals	9TH, EDITION 2001

B. E. MECHANICAL ENGINEERING SEMESTER -VII			
ADVANCED MANUFACTURING TECHN0LOGY			
Course Code	**UME721E**	CIE Marks	50
Teaching Hours/Week (L: T:P)	3-0-0	SEE Marks	100
Credits	03	SEE Exam Hours	03

UNIT-1

05 Hours

Introduction: Introduction to CAD/CAM, product system facilities: Low, medium, and high. Manufacturing support systems, Automation in production systems. Automated manufacturing systems. Computerized manufacturing systems. Reasons for automating, Automation principles and strategies. Discussions.

Fundamentals of Automated Production Lines: **05 Hours**

Introduction, System configurations, Work part transfer mechanisms, Storage buffers, Control of the production line.

UNIT-2

Analysis of Transfer Lines: **05 Hours**

Analysis of Transfer Lines with no internal storage: Basic terminology and Performance measures, Workstation breakdown analysis: Upper bound approach, Lower bound approach, and Analysis of Transfer Lines with storage buffers. Numerical examples.

Automated Assembly System: **05 Hours**

Introduction, System configurations, Parts delivery at workstations, Applications. Quantitative analysis: Parts delivery system, Multi-station and single station assembly machines. Partial automation.

UNIT-3

NC Part Programming: **05 Hours**

Basic components of an NC system, EIA and ISO coding standards, NC part programming exercises.

Computer Assisted Part Programming: **05 Hours**

Defining part geometry**,** Specifying tool path and operation sequence, Computer task in computer-assisted part programming, Part programming with APT exercises.

UNIT-4

Product life cycle management: **05 Hours**

Introduction, Product information, PLM framework, Benefits, Implementation, Enabling technologies, Example of business problem. Product data management: Evolution of PDM systems, Scope, Benefits, Implementation, Software capabilities, software functions

Advances in Automated Factory: **05 Hours**

Industry 4.0**:** functions, applications and benefits, Components of Industry 4.0, Internet of things (IoT), IoT applications in manufacturing, Big-Data and cloud computing for IoT, IoT for smart manufacturing.

Course Outcomes: At the end of the course, the student will be able to:

CO1 will be able to
- read and demonstrate good comprehension of study of two aspects of production systems and how they are sometimes automated and /or computerized in modern industrial practice.

CO2 will demonstrate the ability to
- Apply basic methods of examination of the technology of automated production lines and develop several mathematical models that can be used to analyze their operation.
- Use of mechanized and automated devices to perform the various assembly tasks in an assembly line or cell.

CO3 will demonstrate the ability to
- Evaluate, integrate, and apply programmable automation in which the mechanical actions of the machine tool or other equipment are controlled by a program containing coded alphanumeric data.

CO4 will be able to
- Properly understand PLM; why it is crucial for companies to implement, what a PLM system offers, what PDM is and its relationship to PLM.
- Study the functions and components, applications and benefits of Industry 4.0, Concept of IoT.

Question Paper Pattern for Semester End Examination (SEE):

- Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
- Each question carries 20 marks and should not have more than 4 subdivisions.
- Any five full questions are to be answered choosing at least one from each unit.

Sl No	Title of the Book	Name of the Author/s	Name of the Publishers	Edition and Year
Textbook/s				
1	Automation, Production Systems and CIM	Groover M. P	Prentice Hall of India	2006
2	Mastering CAD/CAM	Ibrahim Zeid	Tata McGraw Hill	2008
3	CAD/CAM Principles and Applications	P. N. Rao	Tata McGraw Hill	2nd Edition
4	Computer Integrated Manufacturing	Bharat Vijamuri	Sunstar Publisher	4th Edition, 2018.
Reference Books				
1	Industry 4.0	Google Search on the content		

B.E. MECHANICAL ENGINEERING SEMESTER – VII			
COMPOSITE MATERIALS			
Course Code	UME712E	CIE Marks	50
Teaching Hours/ Week (L.T.P)	3.0.0	SEE Marks	100
Credits	3	SEE Exam Hours	03

UNIT - I

Introduction to composite materials **10 Hours**

Definition and classification of composites based on matrix and reinforcement, Characteristics of composite materials, Fibrous composites, Laminate composites and particulate composites. Factors which determine the properties of composites, Benefits of composites, properties and types of reinforcements and matrices, Reinforcement-matrix interface.

UNIT - II

Polymer matrix composites **10 Hours**

Introduction, Polymer matrices, Processing methods like Lay-up and curing, open and closed mold process- hand layup techniques, laminate bag molding, production procedures for bag molding, filament winding, pultrusion, polyforming, thermo-forming, molding methods, properties of PMCs and applications, Some commercial PMCs.

UNIT - III

Metal matrix composites **10 Hours**

Introduction, Metallic matrices, Classification of MMCs, need for production of MMCs, Interface reactions, processing methods like Powder metallurgy, diffusion bonding, Melt stirring, Compo/Rheo casting, Squeeze casting, Liquid melt infiltration, Spray deposition and In situ Processes, Properties of metal matrix composites, Applications, Some commercial MMCs.

UNIT - IV

Mechanics of composite materials **9 Hours**

Continuous fibres, Iso-stress condition, Iso-strain condition, critical volume fraction of fibre and minimum volume fraction of fibre, Numerical on modulus of rigidity, and mechanics of discontinuous fibres, stress Vs strain curves for PMCs, MMCs, and CMCs. Cutting and machining of composites: Reciprocating knife cutting, cutting of cured composite, Joining of composites: Mechanical fastening, Adhesive bonding.

Assignment: Quiz of 25 questions and MCQ Type

Course Outcomes: At the end of the course, the student will be able to:

- **CO1** Define the composites, matrix and reinforcement, the types, benefits and properties of composites.
- **CO2** Explain polymer matrix composites, their production methods, applications
- **CO3** Define and explain metal matrix composites, their production methods, applications
- **CO4** Understand the mechanics of composite materials, solve the numerical on modulus of rigidity, cutting and joining of composite materials

Question paper pattern:

- Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
- Each question carries 20 marks and should not have more than 4 subdivisions.
- Any five full questions are to be answered choosing at least one from each unit.

Sl No	Title of the Book	Name of the Author/s	Name of the Publishers	Edition and Year
Textbook/s				
1	Composite Science and Engineering	K. K. Chawla	Springer Verlag	1998
2	Introduction to composite materials	Hull and Clyne	Cambridge University Press	2nd Edition, 1990
3	Composite Materials: Engineering and Science	F. L. Mathew and R. D. Rawlings	Woodhead Publishing Limited	1999
Reference Books				
1	Composite materials handbook	Meing Schwaitz	McGraw Hill Book Company	1984
2	Mechanics of Composite Materials	Robert M. Jones	McGraw Hill Kogakusha Ltd	1998
3	Composite materials	S. C. Sharma	Narosa Publishing House	2000
4	Mechanics of composites	Artar Kaw	CEC Press	2002

B. E. MECHANICAL ENGINEERING SEMESTER -VII			
CONTROL ENGINEERING			
Course Code	**UME 712E**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3	SEE Marks	100
Credits	3	SEE Exam Hours	03

UNIT – I

INTRODUCTION5 Hours

Concept of automatic controls, open and closed loop systems, concepts of feedback, requirement of an ideal control system. Types of controllers – Proportional, Integral, Proportional Integral, Proportional Integral Differential controllers.

MATHEMATICAL MODELS: 5 Hours

Transfer function models, Models of Mechanical systems, Hydraulic systems.

UNIT- II

BLOCK DIAGRAMS AND SIGNAL FLOW GRAPHS: 5 Hours

Transfer Functions definition, function, blocks representation of system elements, reduction of block diagrams, signal flow graphs: Mason's gain formula.

TRANSIENT AND STEADY STATE RESPONSE ANALYSIS: 5 Hours

Introduction, first order and second order system response to step, ramp and impulse inputs, concepts of time constant and its importance in speed of response. System stability: Routh's –Hurwitz Criterion.

UNIT - III

FREQUENCY RESPONSE ANALYSIS: 10 Hours

Polar plots: Stability Analysis, Relative stability concepts, phase and gain margin, Bode Plots: stability analysis using Bode plots, Simplified Bode Diagrams.

UNIT - IV

ROOT LOCUS PLOTS: 6 Hours

Definition of root loci, general rules for constructing root loci, Analysis using root locus

CONTROL ACTION AND SYSTEM COMPENSATION: 4 Hours

Series and feedback compensation, Physical devices for system compensation.

Assignment: Quiz of 25 questions and MCQ Type

Course Outcomes: At the end of the course, the student will be able to:

- **CO1** Study the fundamental concepts of Control systems and mathematical modeling of the system.
- **CO2** To study the concepts of block diagrams & signal flow graph and the basic concepts of proportional, integral, and derivative (PID) control.
- **CO3** To study the characteristics of closed-loop control systems, including steady-state and transient response, parametric sensitivity, disturbances, error, and stability.
- **CO4** To learn the basics of stability analysis of the system

Question paper pattern:

- Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
- Each question carries 20 marks and should not have more than 4 sub divisions.
- Any five full questions are to be answered choosing at least one from each unit.

Sl No	Title of the Book	Name of the Author/s	Name of the Publishers	Edition and Year
Textbook/s				
1	Modern Control Engineering	Katsuhiko Ogata	University of Minnesota. Prentice Hall, New Jersey	5th edition, 2010.
2	Control systems Engineering	I.J. Nagrath and M. Gopal	New Age International Publisher	6th edition, 2018
Reference Books				
1	Control systems Engineering	U.A. Bakshi and V.U.Bakshi	Technical Publications Pune	3rd edition 2011
2	Control Systems	Joseph Distefano and Allen Stubberud	Schaum's Outline Series	3rd edition 2017

B. E. MECHANICAL ENGINEERING SEMESTER – VII			
TOOL DESIGN			
Course Code	UME7XXE/8XXE	CIE MARKS	: 50
Teaching Hours/Week (L:T:P)	3:0:0	SEE MARKS	: 100
Credits	3	SEE Exam Hours	: 3 Hrs

UNIT –I

Tool Design Methods: **05hours**

Introduction, the design procedure, drafting, and design techniques in tooling drawing.

Design of Cutting Tools: **06 Hours**

Introduction, the metal cutting process, revision of metal cutting tools-single point cutting tools, milling cutters, drills and drilling, reamers, taps, selection of carbide tools, determining the insert thickness for carbide tools.

UNIT – II

Locating and Clamping Methods: **05 Hours**

Introduction, basic principle of location, locating methods and devices, basic principle of clamping.

Design of Drill Jigs: **06Hours**

Introduction, types of drill jigs, general considerations in the design of drill jigs, drill bushings, methods of construction.

UNIT – III

Design of Fixtures: **05 Hours**

Introduction, types of fixtures, fixtures and economic.

Design of Press-working Tools: **05 Hours**

Power presses, cutting operations, types of die – cutting operations and their design, evolution of blanking and progressive blanking.

UNIT – IV

Design of Sheet Metal Bending, Forming and Drawing Dies: **06 Hours**

Introduction, bending dies, forming dies, drawing dies, evolution of a draw die, progressive dies and selection of progressive dies. Strip development for progressive dies, evolution of progressive dies, examples of progressive dies. Extrusion dies, drop forging dies and auxiliary tools, problems.

Plastics as Tooling Materials: **04 Hours**

Introduction, plastics commonly used as tooling materials, application of epoxy plastic tools, construction methods, metal forming operations with Urethane dies, calculating forces for Urethane pressure pads, problems.

Assignment : Twenty five Multi Choice Questions covering the entire syllabus (Quiz)

Course Outcomes: At the end of the course, the student will be able to:

CO1 ***Explain*** the design procedure and design of cutting tools.
CO2 ***Analyze*** the locating and clamping methods and design of jigs
CO3 ***Design*** of fixtures, press working tools, press tool operations and their economy
CO4 ***Design*** of sheet metal bending, forming and drawing dies
CO5 ***Analyze*** the commonly used polymer tooling materials and design aspects like pressu forces etc.,

Question paper pattern

- A total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
- Each question carries 20 Marks and should not have more than 4 subdivisions.
- Any five full questions are to answer choosing at least one from each unit.

S.No.	Title of the book	Name of the Author/s	Name of the publishers	Edition/Year of Publication
Reference Books				
1	Tool Design	Cyril Donaldson, George H Lecain and V C Goold	Tata McGraw Hill Publishing Company Ltd	35th reprint Edition/ 2005
2	ASTME, Fundamentals of Tool Design	ASTME	PHI (P), Ltd, New Delhi	1983
3	Machine Tool Design and Numerical Control	N. K. Mehta	Tata McGraw Hill Publisher (P) Ltd, New Delhi	2006
4	Fundamentals of tool design	Wilson F. W.	ASME PHI, New Delhi	1984

B.E. MECHANICAL ENGINEERING SEMESTER – VII			
Power Plant Engineering			
Course Code	UME 720 E	CIE Marks	50
Teaching Hours/Week (L: T: P)	3:0:0	SEE Marks	100
Credits	03	SEE Exam Hours	03

UNIT - I

Introduction: **04 Hours**

Energy and power, Sources of power, Need power generation, Power plant cycles and classification of power plant cycles, Layout of modern steam power plant, Essential requirements of steam power station, Selection of site for steam power station, Capacity of steam power plant, Choice of steam conditions.

Steam Power Plant: **06 Hours**

Different types of fuels used for steam generation, Coal handling, Requirements of good coal handling plant, Coal handling systems, Equipment for burning coal in lump form, Strokers, Different types of stokers, Advantages and disadvantages of using pulverized fuel, Equipment for preparation and burning of pulverized coal, Unit system and bin system, Coal burners, Fluidized bed combustion.

UNIT - II

Ash and dust handling: **04 Hours**

Ash handling equipment and ash handling systems, Dust collection, Removal of smoke and dust, Dust collectors, Efficiency of dust collectors, Uses of ash and dust, General layout of ash and dust collection systems, Fly ash, Fly ash composition, disposal and application.

Chimney draught: **06 Hours**

Classification, Natural draught, Chimney height and diameter, Condition for maximum discharge through chimney, Efficiency of chimney, Draught losses, Artificial draught, Forced, Induced and Balanced draught, Advantages of mechanical draught, Numerical problems on chimney draught.

UNIT - III

Boilers: **04 Hours**

Classification and comparison, Selection of a boiler, Essentials of good boiler, Generation of steam using forced circulation, High and supercritical pressures, L Mont, Benson, Velox, Schmidt, Loeffler and Ramson steam generators.

Accessories: **02 Hours**

Accessories for the Steam Generator such as super-heaters, Desuperheater, Control of super heaters, Economisers, Air Pre-heaters and re-heaters, Feed water heaters and evaporators.

Performance of boilers: **04 Hours**

Evaporative capacity, Equivalent evaporation, Factor of evaporation, Boiler efficiency, Heat losses in a boiler plant, Numerical problems on boiler performance.

UNIT - IV

Steam turbines: **05 Hours**

Steam nozzles, Nozzle efficiency, Compounding of steam turbines, Difference between impulse and reaction steam turbines, Turbine efficiencies. Steam condensers; Classification, Comparison between jet and surface condensers, Numerical problems on steam turbines.

Cooling ponds and Cooling towers: **03 Hours**

Introduction, Natural and artificial ponds, Cooling ponds, Spray ponds. Cooling towers: Introduction, Natural and forced draft cooling towers, Comparison between natural and forced draft cooling towers. Feed water treatment: Impurities in water and troubles caused by the impurities, Methods of feed water treatment, pH value of water.

Cogeneration power plants: **02 Hours**

Classification, Topping and bottoming cycles, Advantages and disadvantages of steam power plants.

Assignment: As decided by the Course Instructor

Course Outcomes: At the end of the course, the student will be able to:

- **CO1** *Apply* the knowledge of power plant engineering in selecting the types of fuels and burning methods to produce steam.
- **CO2** *Apply* the knowledge of power plant engineering in selecting ash, dust handling and chimney draught for a steam power plant.
- **CO3** *Apply* the knowledge of power plant engineering to *analyze* boilers, boiler accessories and performance of boilers.
- **CO4** *Apply* the knowledge of power plant engineering to *analyze* steam turbines, cooling ponds, towers and co-generation power plants.

Question paper pattern:

- Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
- Each question carries 20 marks and should not have more than 4 subdivisions.
- Any five full questions are to be solved choosing at least one from each unit

Sl No	Title of the Book	Name of the Author(S)	Name of the Publishers	Edition and Year
Textbook(S)				
1	Power Plant Technology	M.M. EL-Wakil	McGraw Hill, International.	1994.
2	Power Plant Engineering	P.K Nag	Tata McGraw Hill	3rd Ed. 2001
Reference Books				
1	Power Plant Engineering	R.K.Rajput	Laxmi Publications	4th Ed. 2008
2	Power Plant Engineering	Domakundawar	Dhanpath Rai sons.	2003

B. E. MECHANICAL ENGINEERING SEMESTER - VII			
Refrigeration and Air Conditioning			
Course Code	**UME 729 E**	CIE Marks	50
Teaching Hours/Week (L:T:P)	2:2:0	SEE Marks	100
Credits	2-1-0	SEE Exam Hours	03

UNIT – I

BRIEF REVIEW OF VARIOUS METHODS OF REFRIGERATION: (6+6) Hours

Vapour compression cycle: Analysis of Vapour Compression cycle using P-H and T-S diagrams- calculations, standard rating of operating conditions, Actual vapour compression cycle, Second law analysis of Vapour Compression Cycle.

REFRIGERANTS:

Types of Refrigerants, Comparative study of Ethane and Methane derivatives, of Refrigerants, Requirements of Refrigerants, Effects of lubricants in Refrigerants, substitutes of CFC Refrigerants, Mixture Refrigerants-azeotropic mixtures.

UNIT- II

MULTI PRESSURE VAPOUR COMPRESSION SYSTEMS: **(6+6)Hour**

Multi stage compression, Multi evaporator systems, Cascade systems, calculation, production of solid carbon dioxide, System practices for multistage system.

EQUIPMENTS USED IN VAPOUR COMPRESSION REFRIGERATION SYSTEM: Compressors, Principle, types of compressors, capacity control. Condensers: Types and construction, Expansion devices: Types- Automatic expansion valve, Thermostatic expansion valves, capillary tube. Sizing Evaporator: Types & construction.

UNIT - III

VAPOUR ABSORPTION SYSTEM: (7+7) Hours

Common refrigerant absorbent combinations, Binary mixtures, Ammonia Water Absorption system, Actual vapour absorption cycle and its representation on enthalpy. Composition diagram, calculations. Triple fluid vapour absorption refrigeration system. Water-Lithium Bromide absorption chiller.

PSYCHOMETRY OF AIR CONDITIONING PROCESS-REVIEW:

Review of Psychometric processes, Summer Air conditioning, Apparatus Dew point, winter air conditioning. DESIGN CONDITIONS: Outside design conditions, choice of inside conditions, comfort chart. Choice of supply design condition.

UNIT - IV

LOAD CALCULATIONS AND APPLIED PSYCHOMETRICS: (7+7) Hours

Internal heat gains, system heat gains, break up of ventilation load and effective sensible heat factor, Bypass factor, cooling load estimate. Psychometric calculations for cooling. Selection of Air conditioning

apparatus for cooling and dehumidification, evaporative cooling.

TRANSMISSION AND DISTRIBUTION OF AIR:
Room Air Distribution, Friction loss in ducts, dynamic losses in ducts, Air flow through simple Duct system, Duct design.

CONTROLS IN REFRIGERATION AND AIR CONDITIONING EQUIPMENTS:
High pressure and low pressure cut out, thermostats, pilot operated solenoid valve, motor controls, bypass control-Damper motor. VAV controls.

Assignment: (Mention the contents of the Assignment to be submitted)

Course Outcomes: At the end of the course, the student will be able to:

- **CO1** Students will demonstrate the ability to understand vapor compression refrigeration and types of refrigerants
- **CO2** Students will demonstrate the ability to understand multistage vapor compression refrigeration system and equipment used in vapor compression refrigeration system.
- **CO3** Student will demonstrate the ability to understand vapor absorption system and psychrometric of air conditioning
- **CO4** Students will demonstrate the ability to understand load calculations and applied psychromet transmission and distribution of air, controls in refrigeration and air conditioning equipment's

Question paper pattern:

- Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
- Each question carries 20 marks and should not have more than 4 sub divisions.
- Any five full questions are to be answered choosing at least one from each unit.

Sl No	Title of the Book	Name of the Author/s	Name of the Publishers	Edition and Year
Textbook/s				
1	Refrigeration and air conditioning	C.P.Arora	Tata McGraw Hill Publication,	2nd edition, 2001.
2	Refrigeration and air conditioning	W. F. Stoecker	Tata McGraw Hill Publication,	2nd edition, 1982
Reference Books				
1	Principles of Refrigeration' -	Dossat	Pearson	2006.
2	Air conditioning' PITA, 4th edition, pearson-2005	pita	Pearson	4th edition, 2005
3	Refrigeration and air conditioning	Manohar Prasad		Any edition
Data Hand Book:				
[1] Refrigeration and Air conditioning data hand book				

B. E. MECHANICAL ENGINEERING SEMESTER - VII			
Operations Management			
Course Code	**UME 730 E**	CIE Marks	50
Teaching Hours/Week (L:T:P)	2:2:0	SEE Marks	100
Credits	2-1-0	SEE Exam Hours	03

UNIT - 1

Introduction: **5 Hours**

Functional subsystems of organization, System concept of production, Types of production system, Productivity, strategic management, World class manufacturing.

Product Design and Analysis: **5 Hours**

New product development concepts, Process planning and design, Value analysis/Value engineering, Make or buy decision, Ergonomic consideration in product design

UNIT - 2

Forecasting: **6 Hours**

Nature and use of forecasting, Sources of data, Demand patterns, Factors affecting forecast, types of forecasting, Forecasting Models – Linear Regression, Simple moving average, weighted moving average, e, Single exponential smoothing, Double exponential smoothing, Adjusted exponential smoothing and Delphi method.

Facility Location: **4 Hours**

Introduction, factors influencing plant location, break even analysis, single facility location problem, Minimax location problem and gravity location problem.

UNIT - 3

Plant Layout and Materials Handling: **6 Hours**

Introduction, Classification of layout, Layout design procedures – Computerized Relative Allocation of Facilities Technique (CRAFT), Automated Layout Design Program (ALDEP) and, Computerized Relationship Layout Planning (CORELAP).

Line Balancing: **4 Hours**

Concept of mass production system, objective of assembly line balancing, rank positional weight method and the COMSOL Algorithm.

UNIT - 4

Modern Production Management Tools: **10 Hours**

Just-In-Time manufacturing – introduction and overviews of JIT, basic principles, push/pull production, kanban systems (pull systems). Total Quality Management – scope of TQM, benefits of TQM, quality control activities during product cycle, operating quality costs. Kaizen – Key elements of kaizen, classification of kaizen, steps of implementation of kaizen Blitz, guidelines of kaizen team, benefits of kaizen. Lean Manufacturing – steps of lean manufacturing, components of lean manufacturing.

Assignment: (Mention the contents of the Assignment to be submitted)

Course Outcomes: At the end of the course, the student will be able to:

CO1
CO2
CO3
CO4

Question paper pattern:

- Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
- Each question carries 20 marks and should not have more than 4 sub divisions.
- Any five full questions are to be answered choosing at least one from each unit.

Sl No	Title of the Book	Name of the Author/s	Name of the Publishers	Edition and Year
Textbook/s				
1	Production and Operations Management	R. Panneerselvam	Prentice Hall of India Pvt Ltd	2005
2	Analysis and Control of Production Systems	Elsayed A. Elsayed, Thomas O. Boucher	Pearson	2nd Edition, 1995
3	Production and Operations Management	R. B. Khanna	PHI	2010
Reference Books				
1	Modern Production/Operations Management	Buffa	Wiley Eastern Ltd	2001
2	Operations Management	Joseph G Monks	Mc Graw Hill	1987

B. E. MECHANICAL ENGINEERING SEMESTER - VII			
Six Sigma			
Course Code	**UME 731 E**	CIE Marks	50
Teaching Hours/Week (L:T:P)	2:2:0	SEE Marks	100
Credits	2-1-0	SEE Exam Hours	03

Unit-I

History of Quality and Six Sigma **5 Hours**

Introduction, Common Six Sigma Principles, Challenges of Six Sigma, Six Sigma History and Applications: The development of Statistical Process Control, Normal Curve, PDCA-Cycle, Levels of Six Sigma Certification.

Lean Concepts **5 Hours**

Continuous Process Improvement: Toyota and Lean, Motorola's focus on defects, Lean Process Management, The seven Muda: Transportation, Inventory, Motion, Waiting, Over-production, Over-processing, Defects.

Unit-II

Basic tools of Lean and Six Sigma **5 Hours**

Run chart: Meaning, Use and Construction of Run charts. Control Charts: Meaning, Uses of control charts, Creating control charts. 5S (Seiri, Seiton, Seiso, Seiketsu, Shitsuke): Meaning, Use and Benefits.

Advanced tools of Lean and Six Sigma **5 Hours**

Supplier-Inputs-Process-Output-Customer (SIPOC): Meaning, Construct of SIPOC diagram, Use of SIPOC diagram, General rules for drawing SIPOC diagram, Practical application of SIPOC.
Value Stream Mapping (VSM): Meaning, Use of VSM, Benefits of VSM.

Unit-III

Lean Production System and Lean Six Sigma **5 Hours**

Meaning and Principles of Lean Production System, Benefits of Lean Production System.
Meaning and Myths of Six Sigma, Benefits of Six Sigma, Challenges in implementation of Six Sigma.

Lean Six Sigma (LSS) Project Selection **5 Hours**

Meaning of LSS-project, Selection and prioritization of Lean Six Sigma project, Management of project reviews, Tips for making LSS projects successful.

Unit-VI

Six Sigma Methodology: (DMAIC) **5 Hours**

Define: Define the customers, Project boundaries, the process to be improved.
Measure: Develop a data collection plan for process and determine types of defects and metrics.
Analyze: Find gaps in current process, prioritize opportunity to improve & identify sources of variation.

Improve: Create innovate solutions, Develop, and deploy implementation plan.
Control: Control the improvements to keep the process on the new course.

Industrial Case Studies: **5 Hours**

1. Application of Six Sigma methodology in casting industry.
2. Application of Six Sigma methodology in an automobile industry.

Assignment: (Mention the contents of the Assignment to be submitted)

Course Outcomes: At the end of the course, the student will be able to:

- **CO1** Explain the Principles, Challenges, Applications and Certification of Six Sigma. Also Lean, Seven Wastes, and Continuous Process Improvement.
- **CO2** Distinguish between basic and advanced tools of Lean Six Sigma and their application.
- **CO3** Evaluate the significance of Lean production system and Lean Six Sigma.
- **CO4** Apply, Lean Six Sigma methodology (DMAIC) to Manufacturing Industries.

Question paper pattern:

- Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
- Each question carries 20 marks and should not have more than 4 sub divisions.
- Any five full questions are to be answered choosing at least one from each unit.

Sl No	Title of the Book	Name of the Author/s	Name of the Publishers	Edition and Year
Textbook/s				
1	Lean Six Sigma for Small and Medium Sized Enterprises: A Practical Guide	Jiju Antony, S. Vinodh, E. V. Gijo	CRC Press, Taylor & Francis Group, Publication	31st March 2021, 1st Edition, ISBN: 9780367782955.
2	Six Sigma: A Complete Step-by-Step Guide	The Council of Six Sigma Certification	The Council of Six Sigma Certification	2018 Edition,
Reference Books				
1	Six Sigma for Small Business	Greg Brue	Entrepreneur Media, Inc.	2006
2	The Six Sigma Handbook	Thomas Pyzdek	McGraw-Hill Publisher	2003