SEMESTER-VII

Subject Code	Course Title	Contact Hrs.			Max. Marks			Credits
		L	T	P	Int.	Ext.	Total	
BMECS1-701	Refrigeration & Air Conditioning	3	0	0	40	60	100	3
YYYYY	Department Elective -IV	3	0	0	40	60	100	3
XXXXX	Open Elective$	3	0	0	40	60	100	3
YYYYY	Department Elective -V	3	0	0	40	60	100	3
BMECS1-702	*Mechanical Engineering Lab-VII (DMS&IAR Lab) Lab)	0	0	2	60	40	100	1
BMECS1-703	** Mechanical Engineering Lab-VIII (RAC Lab)	0	0	2	60	40	100	1
BMECS1-704	***Industrial Training	0	0	--	60	40	100	3
Total		**-**	**-**	**-**	**340**	**360**	**700**	**17**

$ Open Electives (OE) can also be taken from existing lists of Open Elective-I, Open Elective-II and Open Elective-III subject lists.

***DMS- Design & Manufacturing Software**

IAR – Industrial Automation and Robotics

****RAC- Refrigeration & Air Conditioning**

*****The industrial Training to be imparted at the end of 6th semester for Six weeks.**

Department Elective-IV (Choose any one from the following)

1. Computer Aided Design– **BMECD1-711**
2. Finite Element Analysis– **BMECD1-712**
3. Additive Manufacturing– **BMECD1-713**
4. Heat Exchanger Design– **BMECD1-714**

Department Elective-V (Choose any one from the following)

1. Non-Destructive Testing– **BMECD1-721**
2. Composite Materials– **BMECD1-722**
3. Mechanical Vibrations – **BMECD1-723**
4. Advance Fluid Mechanics– **BMECD1-724**

SEMESTER-VIII

Subject Code	Course Title	Contact Hrs.			Max. Marks			Credits
		L	T	P	Int.	Ext.	Total	
YYYYY	Department Elective -VI	3	0	0	40	60	100	3
YYYYY	Department Elective -VII	3	0	0	40	60	100	3
XXXXX	Open Elective$	3	0	0	40	60	100	3
XXXXX	Open Elective$	3	0	0	40	60	100	3
BMECS1-801	Major Project	0	0	6	60	40	100	3
Total		**-**	**-**	**-**	**220**	**280**	**500**	**15**

$ Open Electives (OE) can also be taken from existing lists of Open Elective-I, Open Elective-II and Open Elective-III subject lists.

Department Elective-VI (Choose any one from the following)

1. Industrial Safety & Environment**– BMECD1-811**
2. Process Planning & Cost Estimation– **BMECD1-812**
3. Total Quality Management– **BMECD1-813**
4. Principles of Management– **BMECD1-814**
5. Energy Conservation and Management– **BMECD1-815**

Department Elective-VII (Choose any one from the following)

1. Operations Research**– BMECD1-821**
2. Operation Management– **BMECD1-822**
3. Sustainable Manufacturing– **BMECD1-823**
4. Work Study & Ergonomics– **BMECD1-824**

REFRIGERATION AND AIR CONDITIONING

Subject code: BMECS1-701 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I (10 Hrs)

Basic Concepts: Definition of Refrigeration and Air conditioning; Difference between Refrigeration, cooling and Air conditioning; EPR, COP of a refrigerator; and COP/EPR of a heat pump; Single Phase and two phase Reversed Carnot cycle and its limitations; and its Applications.

Aircraft Refrigeration & Air conditioning: Necessity, Applications and Classification of aircraft refrigeration and air conditioning systems, Bell Coleman/Reversed Brayton / Reversed Joule Cycle and its analysis; various types of air refrigeration systems; Air Refrigeration Cycle for aircraft with Ram compression; Performance of air-refrigeration systems; DART; Comparison of different aircraft refrigeration and air conditioning systems; Numerical.

UNIT-II (15 Hrs)

Simple Vapour Compression Refrigeration Cycle: Representation of Simple/Theoretical Vapour compression refrigeration cycle on h-s, T-s and P-h diagrams; C.O.P. ; Dry versus wet compression; expansion versus throttling of liquid refrigerant; Determination of properties of sub cooled, saturated and superheated refrigerant by using saturated properties & specific heat tables/saturated & superheated properties tables and P-h diagram; Compressor work and volumetric efficiency; Effect on performance and cooling capacity due to change in evaporator pressure, condenser pressure, sub cooling of liquid refrigerant, super heating of suction vapours, pressure drop in evaporator and condenser; Numericals, Actual vapour compression refrigeration cycle on T-s and P-h diagrams (No mathematical analysis);

Compound Vapour Compression Refrigeration Cycle: Introduction, its advantages, schematic representation of these systems with use of flash chamber, water intercooler, flash intercooler, liquid sub-cooler (independent and combination of these); Introduction and schematic representation of multiple evaporator systems with use of individual and multiple expansion valves

arrangements, with single and multiple (individual and compound) compressor. Flash gas, its advantages and disadvantages, and its removal: flash chamber, liquid sub-cooler; Numericals.

Vapour Absorption Refrigeration Cycle (No Mathematical Analysis): Principle and advantages of vapour absorption refrigeration system over compression system; Simple-Ammonia Absorption system; Practical Aqua - ammonia vapour absorption refrigeration system; Lithium Bromide - water absorption system (Single and double effect); Electrolux refrigeration system.

UNIT-III (10 Hrs)

Refrigerants: Classification and nomenclature of refrigerants; Desirable thermodynamic, chemical and physical properties of refrigerants; Azeotropes; Zeotropes; environmental aspects of conventional refrigerants; Eco friendly refrigerants and action plan to reduce ecological hazards. Global Warming Potential (GWP) and Total Equivalent Warming Impact (TEWI).

Alternative Refrigeration Systems and Low Temperature Refrigeration: (No Mathematical Analysis) Principle, advantages, limitations and applications of Steam Jet Refrigeration; Mixed Refrigeration Systems; Vortex Tube Refrigeration, Thermoelectric refrigeration; Cascade Refrigeration System; Linde and Claude cycles, Liquefaction of gases, cryogenics and its engineering applications.

Refrigerant Control Devices: Purpose; Theory of operation; Description of different valves; capillary tubes; Basic functions, principles and application of piping, points to be considered in piping design, piping layout.

UNIT-IV (10 Hrs)

Air Conditioning Concepts and Applications: Classification of air-conditioning systems; Psychrometric properties of air, Adiabatic mixing of moist air streams without condensation and with condensation; Numerical. Human requirement of comforts; effective temperature and comfort charts; Industrial and comfort air conditioning.

Psychometric Processes: Basic psychrometric processes; Sensible heat; Latent heat and Total heat process; Sensible heat factor; Evaporative cooling; cooling with dehumidification; Heating with dehumidification; chemical dehumidification; By-pass factor; Contact factor; Psychrometric processes in air conditioning equipment: Cooling coils, Heating coils, cooling and dehumidification coils, Evaporative coolers, Adiabatic dehumidifiers, Steam injection, mixing of air streams, Air washer ; Summer, winter and year round air conditioning systems; Numerical.

Calculations for Air Conditioning Load: Cooling and heating load estimation; Apparatus dew point temperature; Rate and state of supply air for air conditioning of different types of premises; Numerical, Package and central air conditioning plants. Room air conditioners; split units.

Refrigeration and Air Conditioning Equipment: Brief description of compressors, condensers, evaporators; Purpose and main components of Cooling towers; Defrosting methods; types of dampers, grills and air filters; types and comparison of various air-handling equipments, Air distribution and design of design of air conditioning ducts; Types and working of humidifiers.

Recommended Books

1. C.P. Arora, 'Refrigeration and Conditioning', Tata McGraw Hill.
2. Manohar Prasad, 'Refrigeration and Conditioning', Wiley Eastern Limited.
3. Jordan and Priester, 'Refrigeration and Conditioning', Prentice Hall of India.
4. W.F. Stoecker, 'Refrigeration and Conditioning', McGraw Hill.
5. Arora &Domkundwar, 'Refrigeration and Air conditioning', Dhanpat Rai.

COMPUTER AIDED DESIGN

Subject code: BMECD1-711 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I (10 Hrs)

Fundamentals of Computer Graphics: Product cycle, sequential and concurrent engineering, Computer Aided Design system architecture, computer graphics, coordinate systems, 2D and 3D transformations

UNIT-II (10 Hrs)

Geometric Modeling: Representation of curves, Hermite curves, Bezier curves, B-spline curves, rational curves, Techniques of surface modeling, surface patches, Bezier and B-spline surfaces, Solid modeling techniques, CSG and B-rep.

UNIT-III

Visual Realism: Hidden line-surface-solid removal algorithms, shading, coloring, computer animation **10 Hrs**

Assembly of Parts: Assembly modeling, tolerance analysis, mass property calculations, mechanism simulation and interference checking **5 Hrs**

UNIT-IV

CAD Standards: Graphical Kernel System (GKS), standards for exchange images, Open Graphics Library (OpenGL), Data exchange standards- IGES, STEP, CALS etc., Communication standards **5 Hrs**

Finite Element Modeling: Overview of FEM, Advantages and applications, recent advancements in FEM, FEA software, Basic principles and general procedure of FEM. **5 Hrs**

Reference Books:

1. Ibrahim Zeid, Mastering CAD CAM, Tata McGraw Hill Publishing Co.
2. C. McMohan and J. Browne, CAD/CAM Principles, II edition, Pearson Education
3. W. M. Neumann and R.F. Sproul, Principles of Computer Gra[hics, McGraw Hill
4. D. Hearn and M.P Baker, Computer Graphics, Prentice Hall Inc.

FINITE ELEMENT ANALYSIS

Subject code: BMECD1-712 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I (10 Hrs)

Historical Background, Mathematical modeling of field problems in engineering, governing equations, discrete and continuous models, boundary and initial value problems, Weighted Residual Methods, Variational formulation of boundary value problems, Ritz technique, Basic concept of Finite Element Method.

UNIT-II (11 Hrs)

One dimensional second order equation, discretization, linear and higher order elements, derivation of shape functions, Stiffness matrix and force vectors, assembly of elemental matrices, solution of problems from solid mechanics and heat transfer, longitudinal vibration and mode shapes, fourth order beam equation, transverse deflections and natural frequencies.

UNIT-III (12 Hrs)

Two dimensional equations, variational formulation, finite element formulation, triangular elements shape functions, elemental matrices and RHS vectors; application to thermal problems, torsion of non-circular shafts, quadrilateral and higher order elements. Plane stresses and plane strain problems, body forces and thermal loads, plate and shell elements.

UNIT-IV (12 Hrs)

Natural coordinate systems, isoperimetric elements and shape functions, numerical integration and application to plane stress problems, matrix solution techniques, solution of dynamic problems, introduction to FE software.

Reference Books:

1. Reddy J.N., An Introduction to Finite Element Method, Tata McGraw Hill.
2. Seshu P., Text Book of Finite Element Analysis, Prentice Hall, New Delhi.
3. Rao S.S., The Finite Element Method in Engineering, Butterworth Heinemann.
4. Chandraputla & Belegundu, Introduction to Finite Elements in Engineering, Prentice Hall.
5. Concepts and Applications of Finite Element Analysis, R D Cook, Wiley India.
6. C.S. Krishnamoorty, Finite Element Analysis, Tata McGraw-Hill

ADDITIVE MANUFACTURING

Subject Code: BMECD1-713 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I (10 Hrs)

Introduction to Rapid Prototyping: Classification of Manufacturing Processes, Introduction to Rapid Prototyping and Additive Manufacturing, History of development of RP, Engineering design process, Rapid Prototyping and its Impact, Product development, Product Prototyping and Product Development

Product Prototyping: Need of Product Prototyping, Prototype Planning and Management, Product and Prototype Cost Estimation, Prototype Design Methods and tools

UNIT-II(5 Hrs)

CAD Modeling: Geometrical Modeling Techniques, Wireframe Modeling, Surface Modeling and solid modeling, Slicing methods using design software

UNIT-III (15 Hrs)

Rapid Prototyping Processes: Rapid Prototyping Overview, Rapid Prototyping Procedure, Liquid-Based RP Processes, Solid-Based RP Processes, Powder-Based RP Processes, Prototyping Materials, Modeling of Material Properties, Modeling and Design of Materials and Structures.

Direct Digital Prototyping and Manufacturing: Solid Models and Prototype Representation, Reverse Engineering for Digital Representation, Prototyping and Manufacturing Using CNC Machining, Fully Automated Digital Prototyping and Manufacturing.

UNIT-IV (15 Hrs)

Direct Methods for Rapid Tool Production: Classification of Direct Rapid Tool Methods, Direct ACESTM Injection Moulds, Laminated Object Manufactured Tools, DTM Rapid Tool, Sand Form, EOS Direct Tool Process, Direct Metal Tooling using 3Dp.

Applications of Rapid Prototyping: Functional Models, Rapid Tooling, Rapid Manufacturing, Engineering Applications, Medical Model, and Art Models, Engineering Analysis Models.

Indirect Methods for Rapid Tool Production: Metal Deposition Tools, RTV Tools, Epoxy Tools, Ceramic Tools, Cast Metal Tools, Investment Casting, Fusible Metallic Core, Sand Casting, Keltool Process.

Reference Books:

1. Frank W. Liou, 'Rapid Prototyping and engineering Applications', CRC Press

2. D.T. Pham and S.S. Dimov, 'Rapid Manufacturing', Springer.

3. Kevin Otto, Kristin Wood, 'Product Design', Pearson.

HEAT EXCHANGER DESIGN

Subject Code: BMECD1-714 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT I

Basic Design Methodologies: Classification of heat exchanger, selection of heat exchanger, Thermal-Hydraulic fundamentals, Overall heat transfer coefficient, LMTD method for heat exchanger analysis for parallel, counter, multipass and cross flow heat exchanger, e-NTU method for heat exchanger analysis, Fouling, Rating and sizing problems, heat exchanger design methodology **10Hrs**

UNIT II

Fouling of Heat Exchangers: Basic consideration, effect of fouling on heat transfer and pressure drop, cost of fouling, design of heat exchangers subject to fouling, fouling resistance, cleanliness factor, techniques to control fouling **06 Hrs**

UNIT III

Design of Double Pipe Heat Exchangers: Thermal and Hydraulic design of inner tube and annulus, hairpin heat exchanger with bare and finned inner tube, total pressure drop.

06Hrs

Design of Shell & Tube Heat Exchangers: Basic components, basic design procedure of heat exchanger, TEMA code, J-factors, conventional design methods, Bell-Delaware method

06 Hrs

Design of Compact Heat Exchangers: Heat transfer enhancement, plate fin heat exchanger, tube fin heat exchanger, heat transfer and pressure drop **05 Hrs**

UNIT IV

Condenser: Shell and tube condenser, plate condenser, air cooled condenser, direct contact condenser, condenser for refrigeration and air-conditioning, thermal design of shell and tube condenser **04 Hrs**

Evaporator: Evaporator for refrigeration and air-conditioning, thermal analysis of evaporator, standards for evaporators and condensers **04 Hrs**

Heat Transfer Enhancement and Performance Evaluation: Enhancement of heat transfer, Performance evaluation of Heat Transfer Enhancement technique. Introduction to pinch analysis.

04 Hrs

Reference Books:

1. Sadik, Kakac, 'Heat Exchanger Selection, Rating and Thermal Design', CRC Press.
2. Ramesh K. Shah, 'Fundamentals of Heat Exchanger Design', Wiley Publication.
3. V.A. Kays and A.L. London, 'Compact Heat Exchangers', McGraw Hill.
4. T. Kuppan, 'Heat Exchanger Design Handbook', Marcel Dekker, CRC Press.
5. E.U. Schunder, 'Heat Exchanger Design Hand Book', Hemisphere Pub.
6. Donald Q. Kern, 'Process Heat Transfer', McGraw Hill.

NON-DESTRUCTIVE TESTING

Subject code: BMECD1-721 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I

Introduction: Scope and Classification of techniques of material testing, NDT Versus Mechanical testing, Need for NDT in Industry and Significance of Non Destructive Testing methods, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterization, type of Non Destructive testing methods. Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Equipment and procedure, Characteristics of Developers. Testing Procedure, Interpretation of results. **12 Hrs**

UNIT-II

Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetization methods: Basic principles, scope and applications, magnetic analysis, magnetization methods, equipment, inspection medium, Principles and methods of demagnetization, advantages and disadvantages of Magnetic particle testing. Interpretation and evaluation of test indications, Residual magnetism. **11 Hrs**

UNIT-III

Ultrasonic Testing: Basics of Ultrasonic Testing: Principles, Techniques, Applications, Limitations, Codes, standards and Specifications related to Ultrasonic Testing flaw detection in rails and tubes (Sperry Detector), Ultrasonic testing, Detection of defects in ferrous and non-ferrous metals, plastics, ceramics, measurement of thickness, hardness, stiffness, sonic material analyzer, concrete test hammer. **11 Hrs**

UNIT-IV

Radiographic Examination: Basics of Radiographic Testing: Principles, Techniques, Applications, Limitations, Codes, standards and Specifications related to Radiography, Radiant energy and radiography, practical applications, X-ray and Gamma–ray equipment, effect of variables on

radiographs, requirement of a good radiograph, interpretation of radiograph, Xeroradiography, Fundamentals of radiation safety and safety precautions.

11 Hrs

Reference Books:

1. H.E. Davies, G.E. Troxell and G.F.W. Hauck, 'The Testing of Engineering Materials', McGraw Hill.
2. W.H. Armstrong, Mechanical Inspection, McGraw Hill.
3. P.J. Shull, 'Nondestructive Evaluation - Theory, Techniques, and Applications', Marcel Decker Inc.
4. D.E. Bray and R.K. Stanley, 'Non-destructive Evaluation - A Tool in Design, Manufacturing and Service', CRC Press.
5. 'NDT Hand Books', ASNT Press, OH, USA.
6. Baldev Raj, T. Jaya Kumar, 'Practical Non-destructive Testing', Woodhead Publishing Ltd.
7. Paul E. Mix, 'Introduction to NDT: A Training Guide', John Wiley.

COMPOSITE MATERIALS

Subject code: BMECD1-722 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I

Introduction to Composites: Fundamentals of composites - need for composites – Glass Fibers, Graphite Fibers, Aramid, Metallic and Other Fibers. Matrix materials and Polymers Metals and Fillers Enhancement of properties. Laminated Composites.

Classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – Particle reinforced composites, Fibre reinforced composites. Applications of various types of composites materials and rule of mixture, Manufacturing of thermoset composites and other Composite Fabrication Methods. Advances in Composites. **13 Hrs**

UNIT-II

Polymer Matrix Composites: Polymer matrix resins – Thermosetting resins, thermoplastic resins – Reinforcement fibre – Rovings – Woven fabrics – Non woven random mats – various types of fibre. PMC processes - Hand lay-up processes – Spray up processes – Compression moulding – Reinforced reaction injection moulding - Resin transfer moulding – Pultrusion – Filament welding – Injection moulding. Fibre reinforced plastics (FRP), Glass fibre reinforced plastics. Behavior of unidirectional composites, Short-fiber composites **10 Hrs**

UNIT-III

Metal Matrix Composites: Characteristics of MMC, Various types of Metal matrix composites Alloy vs. MMC, Advantages of MMC, Limitations of MMC, Metal Matrix, Reinforcements – particles – fibre. Effect of reinforcement - Volume fraction – Rule of mixtures for MMC. Processing of MMC – Powder metallurgy process - diffusion bonding – stir casting – squeeze casting. **10 Hrs**

UNIT-IV

Ceramic Matrix Composites: Engineering ceramic materials – properties – advantages – limitations – Monolithic ceramics - Need for CMC – Ceramic matrix - Various types of Ceramic

Matrix composites- oxide ceramics – non oxide ceramics – aluminum oxide – silicon nitride – reinforcements – particles- fibres- whiskers. Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing). Failure of Composites. **12 Hrs**

Reference Books:

1. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill.
2. Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill.
3. Mallick, P. K. , "Fibre-Reinforced Composites", CRC press, New York.
4. Jones, R.M., "Mechanics of Composite Materials", McGraw Hill, New Delhi.
5. K.K. Chawla, 'Composite Materials, Springer – Verlag'.
6. S.C. Sharma, 'Composite Materials, Narosa Publications.
7. Broutman and Agarwal, "Analysis and Performance of Composite materials", John Willey and Sons, New York.

MECHANICAL VIBRATIONS

Subject Code: BMECD1-723 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I

Introduction: Basic concepts, Types of vibration, Periodic & Harmonic vibrations, Methods of vibration analysis. Undamped free vibrations damped free vibrations and damped forced vibration system, Modelling of stiffness and damping (both viscous and coulomb), estimation of damping by decay plots, vibration isolation transmissibility, vibration measuring instruments.

13 Hrs

UNIT-II

Two degrees of Freedom systems: Principal modes of vibrations, natural frequencies, amplitude ratio, undamped free, damped free, forced harmonic vibration, semi-definite systems, combined rectilinear & angular modes; Lagrange'sequation.

Application to un-damped and damped absorbers: Vibration absorber – principle; centrifugal pendulum vibration absorber, torsional vibration damper, untuned dry friction and viscous vibration damper, torsional vibration absorber. **14 Hrs**

UNIT-III

Multi-degree of freedom: Undamped free vibrations, influence coefficients, Generalized coordinates, orthogonality principal, matrix iteration method, Rayleigh and Dunkerley, Holzer's, Stodola method,Eigen values and eigenvectors. **08 Hrs**

UNIT-IV

Continuous systems: Lateral vibrations of a string, longitudinal vibrations of bars, transverse vibrations of beams, Euler's equation of motion for beam vibration, natural frequencies for various end conditions, torsional vibration of circular shafts. **10 Hrs**

Reference Books:

1. G.K. Grover, Mechanical Vibrations Hem Chand andBros
2. K.K. Pujara, Mechanical Vibrations, Dhanpat Rai and Sons, Delhi
3. V.P.Singh, Mechanical Vibrations Dhanpat Rai and Sons, Delhi
4. Debabrata Nag, Mechanical Vibration, John WileyIndia
5. Thomson, Mechanical Vibration, PrenticeHall

ADVANCED FLUID MECHANICS

Subject Code: BMECD1-724 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I

Potential Flow: Stream function and velocity potential functions for standard flow patterns uniforms flow, source/sink, doublet and free vortex; combination of certain flows to obtain flow patterns of various shapes, circulation, Kutta Joukowski Theorem-lift on a cylinder. **10 Hrs**

UNIT-II

Viscous Flow: Navier Stokes equation of motion; Fluctuation velocity components; intensity and scale of turbulence; Reynolds equations Relationship between shear stress and pressure gradient; two dimensional laminar flow between two fixed parallel planes; Plain Couette flow and its application to hydro-dynamic theory of lubrication. **13 Hrs**

UNIT-III

Boundary Layer: Salient features of flow pattern in a boundary layer; Velocity and shear stress distribution along the boundary; Von-Karman momentum integral equation, Quantitative correlation for boundary layer thickness, local skin friction coefficient and drag coefficient in laminar, flow over a curved surface, boundary layer separation and its control. **12 Hrs**

UNIT-IV

CFD: Comparison of the three basic approaches in engineering problem solving – Analytical, Experimental and Computational Methods. The standard procedure for formulating a problem Physical and Mathematical classification of problems; Types of governing Differential equations and Boundary conditions. Methods of Discretization: Techniques for solution of PDEs in fluid mechanics – finite difference method, finite element method and finite volume method, Finite volume (FV) method in one dimension. **10 Hrs**

Reference Books:

1. Frank M. White ,Viscous Fluid Flow, McGraw-Hill international edition.
2. Yunus Cengel, John Cimbala, Fluid Mechanics, McGraw-Hill international edition.
3. Dr. D.S. Kumar, Fluid Mechanics, S K Kataria and Sons.
4. S K Som, G Biswas, S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Laxmi Publications.
5. Suhas V. Patankar, Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation.
6. John D. Anderson, Jr. Computational Fluid Dynamics the Basics with Applications, McGraw Hill Education.

MECHANICAL ENGINEERING LABORATORY-VII
(DMS & IAR LAB)

Subject code: BMECS1-702 **L T P C**
0 0 2 1

Course Objectives: ----------

Course Outcomes: ----------

EXPERIMENTS

1. Modeling of machine parts and components using any 3D modeling software.
2. Assembling of any two machine parts with proper mating conditions and checking of tolerances and fits using CAD software.
3. Design analysis of any two machine parts using analysis software.
4. Practice the modeling of various types of curves, surfaces and solids.
5. Introduction of Part programming for CNC Machines (e.g. G and M codes).
6. Manual part programming on CNC machine (for any 02 different profiles).
7. Assembly of hydraulic / pneumatic circuit.
8. Demonstration and working of power steering mechanism.
9. Study of different types of hydraulic and pneumatic valves.
10. Study of reciprocating movement of double acting cylinder using pneumatic direction control valves.
11. Use of direction control valve and pressure control valves clamping devices for jig and fixture.
12. Study of robotic arm and its configuration.

MECHANICAL ENGINEERING LABORATORY-VIII
REFRIGERATION AND AIRCONDITIONING LAB

Subject code: BMECS1-703 **L T P C**
0 0 2 1

Course Objectives: ----------

Course Outcomes: ----------

EXPERIMENTS

1. Study of various elements of a vapour compression refrigeration system through cut section models / actual apparatus.
2. Study and performance testing of domestic refrigerator.
3. Study the performance testing of Electrolux refrigerator.
4. Study and performance testing of an Ice plant.
5. Calculation/ Estimation of cooling load for a large building.
6. Visit to a central Air conditioning plant for study of processes for winter and summer air conditioning.
7. Visit to a cold storage for understand its working.
8. Study and performance testing of window type room air conditioner.
9. Study and performance testing of water cooler.
10. To find the performance parameter of cooling tower.

INDUSTRIAL SAFETY AND ENVIRONMENT

Subject code: BMECD1-811 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I

Meaning & Need for Safety: Relationship of safety with plant design, equipment design and work environment. Industrial accidents, their nature, types and causes. Assessment of accident costs; prevention of accidents. Industrial hazards, Hazard identification techniques, Accident investigation, reporting and analysis. **10 Hrs**

UNIT-II

Planning for Safety & its Measures: Definition, purpose, nature, scope and procedure. Range of planning, variety of plans. Policy formulation and implementation of safety policies. Safety measures in a manufacturing organization, safety and economics, safety and productivity. Employees participation in safety. Safety standards and legislation.

10 Hrs

UNIT-III

Meaning of Environment and Need for Environmental Control: Environmental factors in industry. Effect of temperature, Illumination, humidity noise and vibrations on human body and mind. Measurement and mitigation of physical and mental "fatigue" Basics of environment design for improved efficiency and accuracy at work. Environment Standards: Introduction to ISO 14000; Environment standards for representative industries. **10 Hrs**

UNIT-IV

Ventilation and Heat Control Purpose of ventilation, Lighting, Noise & Vibrations: Physiology of heat regulation. Thermal environment and its measurement. Thermal comfort. Indices of heat stress. Thermal limits for comfort, efficiency and freedom from health risk. Natural ventilation. Mechanical ventilation. Air conditioning Process ventilation. Control of heat exposures: control at source, insulation, and local exhaust ventilation. Control of radiant heat, dilution ventilation. Local relief. Industrial Lighting: Purpose of lighting, benefits of good illumination. Phenomenon of lighting and safety. Lighting and the work. Sources and types of artificial lighting. Principles of good illumination. Recommended optimum standards of illumination. Design of lighting installation. Maintenance standards relating to lighting and colour.

Noise & Vibrations, Continuous and impulse noise. The effect of noise on man. Noise measurement and evaluation of noise. Noise absorption techniques. **15 Hrs**

Reference Books:

1. H.W. Heinrich, 'Industrial Accident Prevention', McGraw Hill.
2. Beranek, 'Noise Reduction', McGraw Hill.
3. D.C. Reamer, 'Modern Safety and Health Technology', R. Wiley.

PROCESS PLANNING AND COST ESTIMATION

Subject code: BMECD1-812 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I

Introduction of Process Planning- methods of process planning, drawing interpretation, material evaluation, steps in process selection, production equipment and tooling selection.

Process planning activities- process parameter calculation for various production processes, selection of jigs and fixtures, selection of quality assurance methods, documents for process planning, economics of process planning, case studies. **13 Hrs**

UNIT-II

Introduction to cost estimation- importance of costing and estimation, methods of costing, elements of cost estimation, types of estimates, estimating procedure, estimation of labor cost, material cost, allocation of overhead charges, calculation of depreciation cost. **11Hrs**

UNIT-III

Machining time estimation- importance of machine time calculation, machining time for different lathe operations, drilling and boring time calculations, Machining time calculation for Milling, Shaping, Planning and Grinding. **11 Hrs**

UNIT-IV

Production costs- different production processes for different jobs, estimation of forging, welding, foundry cost and machining cost **10 Hrs**

Reference Books:

1. Peter Scalon, Process Planning, Design/ Manufacture Interface, Elsevier Sci.&Tech..
2. Ostwaal P.F. and Munez J., Manufacturing Processes and Systems, John Wiley.
3. Chitale A.V. and Gupta R.C., Product Design and Manufacturing, Prentice Hall.

TOTAL QUALITY MANAGEMENT

Subject code: BMECD1-813 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I

Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality. **11 Hrs**

UNIT-II

TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; Plan-do-check-act (PDCA) cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; Failure Modes and Effects Analysis (FMEA), its stages and types. **13 Hrs**

UNIT-III

TQM tools and techniques, control charts, process capability, concepts of six sigma, **Quality function deployment** (**QFD**), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures. **10 Hrs**

UNIT-IV

Quality systems need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation, Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors. **11 Hrs**

Reference Books:

1. Bester field D.H. et al., Total quality Management, Pearson Education Asia.
2. Evans J.R. and Lindsay W.M., The management and Control of Quality, first Indian edition, Cengage Learning.
3. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India.
4. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India.

PRINCIPLES OF MANAGEMENT

Subject code: BMECD1-814 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I

Definition of management, science or art, manager vs entrepreneur; Types of managers-managerial roles and skills; Evolution of management- scientific, human relations, system and contingency approaches; Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management. **11 Hrs**

UNIT-II

Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes.

9 Hrs

UNIT-III

Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management, Career planning and Management.

Directing, individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication. **14 Hrs**

UNIT-IV

Controlling system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting. **11 Hrs**

Reference Books:

1. Robins S.P. and Couiter M., Management, Prentice Hall India.
2. Stoner JAF, Freeman RE and Gilbert DR, Management, Pearson Education.
3. Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill.

ENERGY CONSERVATION AND MANAGEMENT

Subject code: BMECD1-815 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I

Introduction to energy & power scenario of world, National Energy consumption data, environmental aspects associated with energy utilization; Energy Auditing- need, types, methodology and barriers, role of energy managers, instruments of energy auditing. **09 Hrs**

UNIT-II

Components of Electricity Billing. High Tension (HT) and Low Tension (LT) supply, transformers, cable sizing; Concept of capacitors, power factor improvement, harmonics; Electric motors- motor efficiency computation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting.

11 Hrs

UNIT-III

Thermal systems, Boilers, Furnaces and Thermic Fluid heaters- efficiency computation and energy conservation measures; Steam distribution and usage, steam traps, condensate recovery, flash steam utilization; Insulation & Refractories. **12 Hrs**

UNIT-IV

Energy conservation in major utilities; pumps, fans, blowers, compressed air systems, Refrigeration& Air Conditioning systems, Cooling Towers, DG sets. Energy Economics- discount period, payback period, internal rate of return, net present value; Life Cycle costing- ESCO concept. **13 Hrs**

Reference Books:

1. Witte L.C., Schmidt P.S. and Brown D.R., Industrial Energy Management and Utilization, Hemisphere Publ., Washington
2. Callaghn P.W., Design and Management for Energy Conservation, Pergamon Press, Oxford
3. Murphy W.R. and McKay G., Energy Management, Butterworths, London
4. Energy Manager Training Manual, Bureau of Energy Efficiency (BEE) under Ministry of Power, GOI (available at www.energymanager training.com).

OPERATIONS RESEARCH

Subject Code: BMECD1-821 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I

Introduction: Origin of OR and its role in solving industrial problems: General approach for solving OR problems. Classification of mathematical models: various decision-making environments.

Linear Programming: Formulation of linear mathematical models: Graphical and simplex techniques for solution of linear programming problems, Big M method and two-phase method, Introduction to duality theory and sensitivity analysis. **15 Hrs**

UNIT-II

Transportation and Assignment Models: Various initial basic feasible solutions methods, Optimization of transportation and assignment using different methods considering the concept of time and cost function.

Dynamic Programming: Introduction to deterministic and probabilistic dynamic programming.

10 Hrs

UNIT-III

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

Network models: Shortest route and traveling sales - man problems, PERT &CPM introduction, analysis of time bound project situations, construction of networks, identification of critical path, slack and float, crashing of network for cost reduction. **10 Hrs**

UNIT-IV

Non-linear Programming Models: Introduction to non-linear programming models. Problems related to the topic.

Inventory Models: Introduction to inventory costs. Models with deterministic demand – model (a) demand rate uniform and production rate infinite, model (b) demand rate non-uniform and production rate infinite.

Game Theory: Competitive games, rectangular games, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games. **10 Hrs**

Reference Books:

1. H.A. Taha, Operations Research, An Introduction, PHI
2. Hira and Gupta, Operations Research, S. Chand
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi
4. H.M. Wagner, Principles of Operations Research, PHI, Delhi
5. Hitler Libermann Operations Research: McGraw Hill Pub.
6. Pannerselvam, Operations Research: Prentice Hall of India

OPERATION MANAGEMENT

Subject Code: BMECD1-822 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I

Need and Scope of Operation Management: Types of production system and their characteristics, productivity definition, types and measurements.

Product Design and Development: Steps involved in product design and development, considerations of technical, ergonomic, aesthetic, economic and time factors. Use of concurrent engineering in product design and development. **09 Hrs**

UNIT-II

Planning and Forecasting: Role of market survey and market research in pre-planning, long medium and short range forecasting, objective and techniques of forecasting, smoothening and revision of forecast, Production planning: Production planning objective and functions, Bill of material, Capacity and man power requirement planning, operation analysis and process planning, long range planning, aggregate planning; Objective, Strategies, graphical and mathematical techniques of aggregate planning, master production scheduling, MRP-I and MRP II Systems. **14 Hrs**

UNIT-III

Production Control: Capacity control and priority control, production control functions; Routing, scheduling, dispatching, expediting and follow up. Techniques of production control in job shop production, batch production and mass production systems,

Material Management: Objectives, scope and functions of material management, planning, procurement, storing, ending and inventory control. Purpose of inventory, inventory cost, inventory control systems, Selective inventory control systems, Determination of EOQ, Lead time and reorder point. Methods of physical stock control. **13 Hrs**

UNIT-IV

Quality Control: Meaning of quality and quality control, quality of design, quality of conformance and quality of performance, functions of quality control. Introduction to statistical quality control-control charts and sampling plans, QC tools.

Management Information Systems: Introduction to MIS, steps in designing MIS, Role of Computers in MIS. **09 Hrs**

Reference Books:

1. Charry, 'Production and Operation Management', Tata-McGraw Hill.
2. J.G. Monks, 'Production/Operation Management', Tata-McGraw Hill.
3. R.N. Nauhria and Rajnish Prakash, 'Management of Systems', Wheeler Publishing, New Delhi.
4. E.L. Grant and R.S. Leaven Worth, 'Statistical Quality Control', McGraw Hill.

SUSTAINABLE MANUFACTURING

Subject Code: BMECD1-823 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I

Introduction to Sustainability - Sustainability, need and concept of sustainability, Concept of triple bottom line, Environmental, economic and social dimensions of sustainability, Sustainable development, challenges for sustainable development, Environmental legislations in India, Corporate Social Responsibility (CSR). **10 Hrs**

UNIT-II

Green Manufacturing: Why Green Manufacturing, Motivations and Barriers to Green Manufacturing, Environmental Impact of Manufacturing, Life cycle assessment, Strategies for Green Manufacturing, Introduction to green energy concepts - Environmental Impact parameters - Environmental degradation- Environmental pollution – Pollution due to manufacturing industries – Remedies **10 Hrs**

UNIT-III

Lean Manufacturing (LM): Introduction and need of LM, Lean manufacturing tools; Comparison of conventional manufacturing and lean Manufacturing; Introduction to seven waste and their narration; Value flow and Muda, Muri and Mura; Advantages and Limitations of lean Manufacturing.

Various tool of LM, Need for Total Productivity Management (TPM), Pillars of TPM, Implementation of TPM, Pull Method, Kanban; Just In Time; value stream mapping. **15 Hrs**

UNIT-IV

Product Recovery Management: Introduction to product recovery management, types of product recovery methods, end-of-use, end-of-life products, reverse logistics, closed loop supply chain management, zero waste management, concept of circular economy. **10 Hrs**

Reference Books:

1. Davim, J.P., Sustainable Manufacturing, John Wiley and Sons.
2. Davim.J.Pauls, Green Manufacturing Processes and Systems, Springer
3. Gopalakrishnan N, Simplified Lean Manufacture: Elements, Rules, Tools and Implementation; PHI Publications

WORK STUDY AND ERGONOMICS

Subject code: BMECD1-824 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I

Productivity: Definition of productivity and its measurement, factors affecting the productivity, productivity improvement programs.

Work Study: Definition, objective and scope of work study, Human factor in work study Work study and management, work study and supervision, work study and worker.

09 Hrs

UNIT-II

Introduction to Method Study : Definition, objective and scope of method study, basic procedure, selection of job, various recording techniques like outline process charts, flow process charts, man machine charts, two handed process charts, string diagram, flow diagram, multiple activity chart, SIMO, cyclographs and chrono-cyclographs; critical examination, development, installation and maintenance of improved method; principles of motion economy and their application in work design; micro motion study, memo motion study and their use in methods study. **13 Hrs**

UNIT-III

Introduction to Work Measurement: Definition, objective and benefit of work measurement, Work measurement techniques, work sampling, need of confidence levels, sample size determination, random observation with simple problems.

Time Study: Definition, time study equipments, selection of jobs, steps in time study, breaking jobs into elements, recording information, rating, standard performance, scales of rating, factors affecting rate of working, allowances, standard time determination. **13 Hrs**

UNIT-IV

Ergonomics: Introduction, areas of study under ergonomics, man-machine system, Components of man-machine system and their functions, study of development of stress in human body and their consequences, computer-based ergonomics.

Display systems and anthropometric data: Display- types of visual display, visual indicators and warning signals, factorial and graphic display types of control, layouts of panels and machines, Design of workplaces, Introduction to anthropometry, Task analysis to reduce Musclo-Skeletal disorders, influence of climate on human efficiency, Influence of noise, vibration and light on human efficiency. **10 Hrs**

Reference Books:

1. ILO -Introduction to work study, Publisher: India Book House Pvt. Ltd
2. Niebel, B.W., Motion & Time Study, 9th Edition McGraw Hill Higher education
3. Kanawaty, G., Work Study, ILO, Geneva
4. Barnes, R. M., Motion & Time Study, John Wiley & Sons
5. Bridger, R.S., Introduction to Ergonomics, McGraw Hill
6. Halender, M., A guide to Human Factors and Ergonomics. Taylor & Francis

MAJOR PROJECT

Subject code: BMECS1-801 **L T P C**
0 0 6 3

Course Objectives: ----------

Course Outcomes: ----------

Course Details:

The problem formulated during minor project is to be extended and executed in major project by the same group of students. Thus, complete project may consist of the following steps-

1. Modelling and Simulation (if required)
2. Design of components.
3. Fabrication of Individual components.
4. Assembly of the components.
5. Demonstration of working of assembled device.
6. Discussions about the utility and practical applications.
7. Cost calculations.
8. Report writing.