हरकोर्ट बटलर प्राविधिक विश्वविद्यालय
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100 YEARS 1921 -2021

Department: Mechanical Engineering
School: Engineering
Name of Programme: B. Tech. Mechanical Engineering

Academic Session 2021-22

Total no. of courses in the Programme: 28
%Change in the course **curriculum: 21.42%**

Number of Courses where syllabus revision was carried out BoS

Sl. No.	Subject Name	Subject Code	Details
1.	Material Science	EME-203/253	Syllabus change shown in red
2.	Machine Drawing	EME-207/257	Syllabus change shown in red
3.	Applied Thermodynamics	EME-206	Change in credits and syllabus shown in red
4.	Manufacturing Science-II	EME-301	Change in credits and syllabus shown in red
5.	Computer Added Design	EME-306	Change in credits and syllabus shown in red
6.	Finite Element Methods	EME-415/436	Change in syllabus shown in red

Number of Courses related **with employability/ entrepreneurship/ skill** development

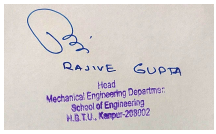
Sl.no.	Name of the Course	Course Code	Year of introduction
1.	Finite Element Methods	EME-415	2017 onwards
2.	Automobile Engineering	EME-417	2017 onwards
3.	Computer Aided Design	EME-306	2017 onwards
4.	Measurement and Control	EME-419	2017 onwards
5.	Mechanical Vibrations	EME-427	2017 onwards
6.	Power Plant Engineering	EME-429	2017 onwards
7.	Production Planning & Control	EME-431	2017 onwards
8.	Computer Aided Manufacturing	EME-421	2017 onwards
9.	Alternative Energy Sources	OME-482	2020 onwards
10.	Mechatronics	EME-467	2020 onwards
11.	Robotics	EME-463	2020 onwards
12.	Additive Manufacturing	EME-459	2020 onwards
13.	Industrial Engineering and Automation	OME-483	2020 onwards
14.	Advance Strength of Material	EME-458	2020 onwards
15.	Optimization Methods in Engineering	OME-486	2020 onwards

Elective Courses in the Programme

S. No.	Program Elective Courses	Name of Course	Course code
1	PEC I	Mechanical Vibrations	EME-455
		Industrial Engineering	EME-457
		Additive manufacturing	EME-459
		Robotics	EME-463
2	PEC II	Welding Processes	EME-465
		Mechatronics	EME-467
		Non-conventional Energy Resources &	EME-469
		Engineering Materials	EME-473
3	PEC III	Unconventional Manufacturing Processes	EME-452
		Finite Element Method	EME-454
		Thermal Turbo Machines	EME-456
		Advanced Strength of Material	EME-458
		Production Planning & Control	EME-460
4	PEC IV	Automobile Engineering	EME-462
		Optimization Methods in Engineering	EME-464
		Experimental Stress Analysis	EME-466
		Product Design & Development	EME-468
		Non-Destructive Testing	EME-470

New Courses Introduced

Sl. No.	Subject Name	Subject Code
1.	Internal Combustion Engine	EME-309/359
2.	Energy Conversion	EME-310
3.	Measurement	EME-358
4.	Power Plant Engineering	EME-362
5.	Computer Added Manufacturing	EME-353
6.	Additive Manufacturing	EME-419
7.	Robotics	EME-421
8.	Welding Processes	EME-425
9.	Mechatronics	EME-429
10.	Advance Strength of Materials	EME-443



Signature and Seal

Head of Department

HARCOURT BULTER TECHNICAL UNIVERSITY KANPUR SCHOOL OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

Semester wise Course Structure

B. Tech. Mechanical Engineering

(Applicable from Session 2019-2020 for new entrants)

SEMESTER III

Sr. No.	Course Type	Subject Code	Course Title	Credits (L-T-P)	Sessional Marks				ESM	Total Mark
					MSE	TA	Lab	Total		
1.	BSC	BMA 251	Maths-III	4(3-1-0)	30		-	50	50	100
2.	ESC	EME 251	Strength of Material	5(3-1-2)	15	20	15	50	50	100
3.	PCC	EME 253	Material Science	4(3-0-2)	15	20	15	50	50	100
4.	PCC	EME 255	Engineering Thermodynamics	4(3-1-0)	30	20	-	50	50	100
5.	PCC	EME 257	Machine Drawing	2(0-0-4)	-	20	30	50	50	100
6.	HSMC	HHS 251	Engg. Economics & Management	3(3-0-0)	30	20	-	50	50	100
7.	MC (Non- credit)	HHS 255	Indian Constitution	0(2-0-0)	30	20	-	50	50	100
Total Credits				**22**						

SEMESTER IV

Sr. No.	Course Type	Subject Code	Course Title	Credits (L-T-P)	Sessional Marks				ESM	Total
					MSE	TA	Lab	Total		
1.	BSC	BMA 256	CONM	4(3-1-0)	30	20	-	50	50	100
2.	ESC	ECE 252	Engineering Fluid Mechanics	5(3-1-2)	15	20	15	50	50	100
3.	PCC	EME 256	Applied Thermodynamics	3(3-0-0)	30	20	-	50	50	100
4.	PCC	EME 254	Manufacturing Science-I	4(3-0-2)	15	20	15	50	50	100
5.	PCC	EME 258	Kinematics of Machine	3(3-0-0)	30	20	-	50	50	100
6.	HSMC	HHS 254	Organizational Behavior	3(3-0-0)	30	20	-	50	50	100
7.	MC (Non-credit)	ECS 260	Cyber Security	0(2-0-0)	30	20	-	50	50	100
Total Credits				**22**						

SEMESTER V

Sr. No.	Course Type	Subject Code	Course Title	Credits (L-T-P)	Sessional Marks				ESM	Total Marks
					MSE	TA	Lab	Total		
1.	PCC	EME 351	Manufacturing Science-II	4(3-0-2)	15	20	15	50	50	100
2.	PCC	EME 353	Heat & Mass Transfer	4(3-0-2)	15	20	15	50	50	100
3.	PCC	EME 355	Dynamics of Machine	4(3-0-2)	15	20	15	50	50	100
4.	PCC	EME 357	Machine Design-I	4(3-0-2)	15	20	15	50	50	100
5.	PCC	EME 359	IC Engines	3(3-0-0)	30	20	-	50	50	100
6.	OEC (Maths)	BMA 351	Operation Research	3(3-0-0)	30	20	-	50	50	100
Total Credits				22						

SEMESTER VI

Sr. No.	Course Type	Subject Code	Course Title	Credits (L-T-P)	Sessional Marks				ESM	Total Marks
					MSE	TA	Lab	Total		
1.	PCC	EME 352	Fluid Machinery	4(3-0-2)	15	20	15	50	50	100
2.	PCC	EME 354	Machine Design II	4(3-0-2)	15	20	15	50	50	100
3.	PCC	EME 356	Computer Aided Design	3(3-0-0)	30	20	-	50	50	100
4.	PCC	EME 358	Measurements	3(2-0-2)	15	20	15	50	50	100
5.	PCC	EME 360	Energy Conversion	3(2-0-2)	15	20	15	50	50	100
6.	PCC	EME 362	Power Plant Engineering	2(2-0-0)	30	20	-	50	50	100
7.	OEC (Humanities)	HHS 352	Entrepreneurship Development	3(3-0-0)	30	20	-	50	50	100
Total Credits				22						

SEMESTER VII

Sr. No.	Course Type	Subject Code	Course Title	Credits (L-T-P)	Sessional Marks				ESM	Total Mark
					MSE	TA	Lab	Total		
1.	PCC	EME 451	Refrigeration & Air Conditioning	4(3-0-2)	15	20	15	50	50	100
2.	PCC	EME 453	Computer Aided Manufacturing	3(3-0-0)	15	20	15	50	50	100
3.	PEC	PEC-I	List is attached	3(3-0-0)	30	20	-	50	50	100
4.	PEC	PEC-II	List is attached	3(3-0-0)	30	20	-	50	50	100
5.	OEC	OEC-I	List is attached	3(3-0-0)	30	20	-	50	50	100
6.	Industrial Training	EME-461	Industrial Training	1(0-0-2)	-	50	-	50	50	100
7.	Seminar	EME-471	Seminar	1(0-0-2)	-	50	-	50	50	100
8.	Project	EME-497	Project	4(0-0-8)	-	50	-	50	50	100
Total Credits				22						

SEMESTER VIII

Sr. No.	**Course Type**	**Subject Code**	**Course Title**	**Credits (L-T-P)**	**Sessional Marks**				**ESM**	**Total Mark**
					MSE	**TA**	**Lab**	**Total**		
1.	PEC	EME 415/454	Finite Element Method	4(3-1-0)	30	20	-	50	50	100
2.	PEC	PEC-IV	List is attached	4(3-1-0)	30	20	-	50	50	100
3.	OEC	OEC-II	List is attached	4(3-1-0)	30	20	-	50	50	100
4.	Project	EME-498	Project	10(0-0-20)	-	50	-	50	50	100
Total Credits				**22**						

Total Programme Credits : 172

MATERIAL SCIENCE (EME-203)

Type	L	T	P	Credits
PCC	3	0	2	4

Prerequisite: Fundamental knowledge of Intermediate level physics and chemistry.

Course Objectives:

The objective of the subject is to know the fundamental science and engineering principles relevant
to materials. To understand the structure, properties, processing and performance of the principalclasses of materials.

Course Content:

Unit I

Introduction: Importance of materials, Brief review of modern atomic concepts, atomic models, chemical bonding, metallic bonds; Crystalline and non-crystalline structures; Concept of unit cell, Bravis space lattices, common crystal structures- cubic and hexagonally closed packed structures, co- ordination number, packing factor, Miller indices for crystallographic planes and directions, X-ray crystallography techniques. Micro structural examination and grain size determination. Structure- property interrelationship, comparative study of microstructure of various metals & alloys such as mild steel, cast iron, brass and bronzes.

Unit II

Structural imperfections- point, line, planer and volume defects. Dislocations in solids- edge, screw and mixed dislocations, energy of dislocations, Frank Reed source of dislocation, strain hardening, slip systems, twin and tilt boundary, grain boundary defects and their significance.
Diffusion in solids - Fick's first and second laws of diffusion.
Mechanical properties and testing: stress- strain diagram, ductile v/s brittle materials. stress v/s strength, toughness, hardness, fracture, fatigue and creep, Mechanical testing- tensile test, hardness test, impact test, fatigue test, creep test, non destructive evaluation.

Unit III

hase diagram and equilibrium diagrams: Unary and binary diagrams, phase rules, types of equilibrium diagrams, types of solid solution, Hume-Rothery criteria of solid solution formation, intermetallic compounds.
Ferrous materials: Classification of steels, alloy steels, their applications, cast irons- its properties and uses. Iron carbon equilibrium diagram, time-temperature-transformation (T-T-T) curves- pearlite, bainite and martensite formations.
Heat treatment processes- annealing, normalizing, quenching, tempering, important case hardening processes; Non-ferrous metals and alloys, brasses, bronzes, bearing materials- its properties and uses, aluminum alloys such as Duralumin.

Unit IV

Magnetic Properties: magnetism – dia-, para- and ferro-magnetism, hysteresis, Soft and hard magnets, Magnetic storages; Electric properties: Energy band concept of conductor, insulator and semi- conductors, p-n junction and transistors, Basic devices and its application, Superconductivity and its applications, Messier effect, type I & II superconductors, high temperature superconductors.

Unit V

Ceramics- structure, properties and applications of ceramics, Polymers- types and its applications. Composite materials- its types and uses; Performance of materials in service- brief theoretical consideration of fracture, fatigue, corrosion and its control.

Text books:

1. Material Science & Engineering by W.D. Callister, Jr., Addison-Wesley Pub.Co.
2. Engineering Materials, Vol. I &II by Ashby & Jones, Pergemon Press.

Reference books:

1. Elements of Material Science & Engineering by Van Vlack, John Wiley & Sons
2. Material Science by V. Raghvan, Prentice Hall of India

MATERIAL SCIENCE & TESTING LAB

Any 8 experiments out of following:

1. To identify different kind of materials by observation.

2. To prepare specimen for metallographic examination.

3. To perform Jominy End Quench Test to determine hardenability of steel.

4. To determine Rockwell Hardness of given test specimen.

5. To determine Brinell Hardness of given test specimen.

6. To determine Vicker's hardness of given test specimen.

7. To perform tensile test on given specimen using UTM.

8. To perform Compression Test on given specimen using UTM.

9. To perform Izod&Charpy Impact test.

10. To perform Torsion test on given specimen.

11. To perform fatigue test on given specimen.

12. To perform Creep test.

13. To perform Bend (flexural) test on the given specimen.

MACHINE DRAWING (EME257)

Type	L	T	P	Credits
PCC	0	0	4	2

Prerequisite: Fundamental knowledge of engineering graphics.

Course Objectives:

The objective of this subject is to make student acquire knowledge of joints such as riveting, threaded joints etc.. The student also is enabled to prepare the assembly of various machine or engine components and miscellaneous machine components.

Course Outcomes:

1. Student will be aware with fundamentals of machine drawing.
2. Student will be able to understand principles of orthographic projections for machine drawing.
3. To draw the projections of machine elements including keys, couplings, cotters, riveted, bolted and welded joints.
4. To draw the assembled view using drawings of machine components and Engines.
5. To free hand sketches of machine elements

Course Content:

In this subject all the topics will be covered with a lecture at start of class

Introduction: Graphic language, Classification of drawings, Principles of drawing, IS codes for Machine drawing, Lines, Scales, Sections, Dimensioning, Standard abbreviations.

Orthographic Projections: Principles of first and third angle projections, drawing and sketching of machine elements in orthographic projections, spacing of views.

Screwed (Threaded) fasteners: Introduction, Screw thread nomenclature, forms of threads, Thread series, Thread designation, Representation of threads, Bolted joints, Locking arrangement for nuts, Foundation bolts.

Keys and cotters: Keys, Cotter joints.

Shaft couplings: Introduction, Rigid and flexible coupling.

Riveted Joints: Introduction, Rivets and riveting, Rivet heads, Classification of riveted joints.

Assembly drawing Introduction, Engine parts, Stuffing box etc.

Free hand sketching: Introduction, Need for free hand sketching, Free hand of sketching of some threaded fasteners and simple machine components.

Exposure to suitable 2D/3D drafting software.

Reference books:

2. Machine Drawing by N.Siddeshwar, P.Kannaiah, V V S Shastry,TMH, New Delhi
3. Machine Drawing by K L Narayana, P. Kannaiah, K VenkatReddy,New Age IntnlPubl
4. Engineering Drawing Practice for Schools & Colleges, SP46-1998 (BIS)

APPLIED THERMODYNAMICS (EME-206)

Type	L	T	P	Credits
PCC	3	1	0	4

Prerequisite: A course on Engineering Thermodynamics

Course Objectives:

This course focuses upon the application of different laws and principles of thermodynamics as well as physics for realizing useful thermodynamic processes in different thermal systems.

Course Content:

Unit-I

Boilers: Steam generators-classifications. Working of fire-tube and water-tube boilers, boiler mountings & accessories, supercritical boilers, waste heat recovery steam boilers, Draught & its calculations, air pre heater, feed water heater, super heater. Boiler efficiency, Equivalent evaporation. Boiler trial and heat balance.

Condenser: Classification of condenser, Air leakage, Condenser performance parameters

Unit-II

Steam Engines: Rankine and modified Rankine cycles, Working of stream engine, Classification of steam engines, Indicator diagram, Saturation curve, Missing quantity.

Steam & Gas Nozzles: Flow through nozzle, Variation of velocity, Area and specific volume, Choked flow, Throat area, Nozzle efficiency, Off design operation of nozzle, Effect of friction on nozzle, Super saturated flow.

Unit-III

Vapour Power cycles: Carnot vapour power cycle, Effect of pressure & temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration.

Steam Turbines : Classification of steam turbine, Impulse and reaction turbines, Staging, Stage and overall efficiency, Reheat factor, Bleeding, Velocity diagram of simple & compound multistage impulse & reaction turbines & related calculations work done efficiencies of reaction, state pointlocus, Losses in steam turbines, Governing of turbines.

Unit-IV

Gas Turbine: Gas turbine classification Brayton cycle, Principles of gas turbine, Gas power cycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, Isentropic efficiency, Polytropic efficiency. Deviation of actual cycles from ideal cycles.

Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines & their processes, Principle of rocket propulsion, Introduction to Rocket Engine.

Unit-V

Compressors:

Classification, Reciprocating compressors, Single and Multi stage compressors; Rotary compressors, Classification, Centrifugal compressor fundamentals, Surging and stalling, Roots blower, Vaned compressor, Air Motors, Compressor characteristic curves. **Unconventional Energy Systems:** Sterling engines, Thermo-ionic converters, Thermoelectric generators, Photovoltaic generators,

Magneto-hydrodynamic generators, Solar thermal collectors, Heliostats, Fuel Cells.

Textbooks:

1. Applied thermodynamics by Onkar Singh, New Age International (P) Publishers Ltd.
2. Basic and Applied Thermodynamics by P.K. Nag, Tata McGraw Hill

Reference books:

1. Theory of Stream Turbine by W.J. Kearton
2. Steam & Gas Turbine by R.Yadav, CPH Allahabad
3. Gas Turbine, by V. Ganeshan, Tata McGraw Hill Publishers.
4. Gas turbine Theory & Practice, by Cohen & Rogers, Addison Weslay Long man
5. Reciprocating and Rotary Compressors, by Chlumsky, SNTI Pub., Czechoslovakia
6. Turbines, Compressors and Fans, by S.M.Yahya, Tata McGraw Hill Pub.

MANUFACTURING SCIENCE-II (EME-351)

Type	L	T	P	Credits
PCC	3	0	2	4

Prerequisite: Basic course in Workshop Practice and strength of material

Course Objective:

The course aims at understanding basic manufacturing process viz. chip removal process, Grinding process, understanding of abrasive process, joining processes and chip less metal removal processes.

Course Outcomes:

After completion of course a student will:

CO1	Understand basic importance of tools, cutting fluid, tool materials in order to have high quality of production
CO2	Understand the applications of grinding and super finishing processes,
CO3	Understand the various methods of welding and their applications,
CO4	Understand the capabilities of various machine tools and components that can be manufactured on a particular machine tool
CO5	Understand manufacturing processes and their capabilities.
CO6	Understand the working of various manufacturing machines.

Course Content:

Unit-I

Metal Cutting: Mechanics of metal cutting. Geometry of tool and nomenclature.ASA system orthogonal vs. oblique cutting. Mechanics of chip formation, types of chips. Shear angle relationship. Merchant's force circle diagram. Cutting forces, power required for turning, milling and drilling. Cutting fluids/lubricants. Tool materials. Tool wear and tool life. Machinability. Force measurement. Economics of metal cutting.

Unit-II

Grinding &Super finishing

(i) Grinding: Grinding wheels, abrasive & bonds, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and grinding criteria. Surface and Cylindrical grinding. Centerless grinding.

(ii) Super finishing: Honing, lapping, polishing.

Unit-III

Joining Methods: Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding : Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam, projection etc. Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing. Shrinkage/residual stress in welds. Distortions & Defects in welds and remedies. Weld decay in HAZ. Joining of non metallic components, Introduction to unconventional welding.

Unit-IV

Machine Tools: (i) Lathe : Principle, construction, types, operations, Turret / capstan, semi / Automatic, Tool layout ; (ii) Shaper, slotter, planer : Construction, operations & drives; (iii) Milling : Construction, Milling cutters, up & down milling. Dividing head & indexing. Various types of milling cutters; (iv) Drilling and boring: Drilling, boring, reaming tools. Geometry of twist drills.

Unit V:

Limitations of conventional manufacturing process and need of unconventional manufacturing processes. Mechanical processes such as Ultrasonic machining, Abrasive jet machining, Abrasive water jet machining; Thermal energy based processes such as Electro chemical, Electro discharge, Laser and Electron beam machining.

Textbooks:

1. Manufacturing science by Ghosh and Mallik
2. Manufacturing science by Degarmo

Reference books:

1. Fundamentals of Metal Cutting and Machine tools by Boothroyd
2. Production Technology by R.K. Jain
3. Production Engineering Science by P.C. Pandey
4. Modern Machining Processes by P.C. Pandey& H.S. Shan
5. Fundamentals of metal cutting & machine tools – Juneja, Shekhon& Seth, New Age Publ.
6. Process & materials of manufacturing - Lindburg.
7. Metal Cutting Principles by M.C. Shaw, Oxford Univ. Press.

EME351: MANUFACTURING SCIENCE-II LAB

Any 8 experiments out of the following:

1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe Machine.
2. Taper turning operation on lathe.
3. Bolt (thread) making on Lathe machine.
4. Tool grinding (to provide tool angles) on tool- grinder machine.
5. Gear cutting on Milling machine.
6. Machining a block on shaper machine.
7. Finishing of a surface on surface- grinding machine.
8. Drilling holes on drilling machine and study of twist-drill.
9. Study of different types of tools and its angles & materials.
10. Experiment on tool wear and tool life.
11. Gas welding of a lap/butt joint.
12. Arc welding of a lap/butt joint.
13. Resistance spot welding of two thin metallic sheets.
14. Experiment on Electro discharge machining.
15. Experiment on CNC machines.

COMPUTER AIDED DESIGN (EME-306)

Type	L	T	P	Credits
PCC	3	1	2	5

Prerequisite:

Course Objectives:

To introduce the student to the roles of CAD for part design and complete product development.

Course Content:

UNIT-1

Introduction to CAD- Computer systems & hardware for CAD-Input & output devices, types of display devices- CRT, principles of raster scan and vector graphics. Scan conversions, Plotting of points, Line drawing, Computer Graphic & its standards- GKS, IGES. Computer Graphics Software & its configuration. Graphics Standard.

UNIT-2

Transformations: Homogenous coordinate system, Scaling, Translation, shear, Reflection about axis & line. Viewing 3D on 2D screen: Representation of 3D shapes, rendering of surfaces and solids, hidden lines, edges and surface removals, Shading models, Shadows, Representation scheme for colors and its mixing; Curves: Analytical & Parametric curves, Continuity, Hermite curves, Bezier curves, B-spline curves, NURBS.

UNIT-3

Surface generations- Hermite & Bezier, ruled, lofted, revolved and swept surfaces. Mesh based Numerical methods for integration & differential equations, Finite Difference Method. Basic Concepts of FEM: Governing equations, Stiffness matrix, Selection of approximation functions, Shape functions & its derivation. Derivation of stiffness matrix, Approaches of FEM,

UNIT-4

1-D FEM applications with one degree approximation function: Stress & strain, Heat conduction, Truss, Beam elements-1-D with 2 degree of freedom applications & problems

UNIT-5

2D Applications: 2D elements and applications: Triangular element-Constant strain triangle (CST) problems, Meshless methods. Reverse Engg & Rapidprotoyping - FDM based 3D printer, scope of 3D printing

Textbooks:

1. Computer Graphics by Hearn and Baker
2. Finite Element Method with applications in Engg. by Desai, Eldho, Shah, Pearson

Reference books:

1. CAD/CAM by Groover & Zimmers, PHI Ltd.
2. CAD/CAM: Theory &Parctice by Zeid & Sivasubramanian, TMH
3. CAD by Tai-Ram Hsu &Dipendra K Sinha, West Publ. Co.
4. Finite Element Method Dhanraj & Prabhkaran, Oxford Higher Education
5. Finite Element in Engineering by Singiresu S. Rao, Elsevier

CAD LAB

Any 5 experiments out of following:

1. Transformations algorithm experiment for translation/rotation/scaling: writing program and running it on

computer.

2. 2DGeometry drawing algorithm experiment e.g. for straight line and circle: writing theprogram and running it on computer.

3. 2DGeometry drawing algorithm experiment e.g. for Bezier curves, B-Spline curves and circle:writing the program and running it on computer

4. Study of types of modeling e.g. wire frame, B-Rep etc.
5. Computer Aided Drafting: understanding and use of available CAD package commands, 3Ddrawing.

6. Writing a small program for FEM for 2 spring system and running it. or using a FEM package.

Course Outcomes:

Student will be able to

1. Understand the role of computers for design and manufacturing.
2. Understand basic hardwares and computer graphics for CAD.
3. Understand the parametric mathematical formulation for geometric transformations, curve& surface generation and 3D modeling.
4. Understand the fundamentals of finite element method with engineering applications.
5. Physically observe CAD workstations and develop the programs to generate curves andsurfaces. Create 2D and 3D model of components using CREO.
6. Use FEA packages to solve engineering problems.

FINITE ELEMENT METHOD (EME-415/ 454)

Type	L	T	P	Credits
PEC	3	1	0	4

Prerequisite:

Course Objectives:

To provide the theoretical and practical knowledge of the finite element based modeling and analysis for the mechanical systems.

Course Content:

UNIT-1

Fundamental Concepts: Introduction, Historical Background, FEM/FDM/Mesh free Methods, Stresses and Equilibrium, Boundary Conditions, Strain Displacement Relations, Stress-Strain Relations, Rayleigh-Ritz Method, Galerkin Method, Saint Venant's Principle. MatrixAlgebra: Basic Matrix Operations, Basic Types of Matrices, Eigenvalues and Eigenvectors

UNIT-2

One Dimensional Problems: Finite element Modeling, Coordinates and Shape Functions, Potential Energy Approach, Galerkin Approach, Assembly of the Global Stiffness Matrix and Load Vector

UNIT-3

Two Dimensional Problems: Finite Element Modeling, Constant Strain Triangle (CST), Problem Modeling and Boundary Conditions, Axisymmetric Solids subjected to Axisymmetric Loading: Axisymmetric Formulation.

UNIT-4

Finite Element Modeling: Triangular Element, Problem Modeling and Boundary, Conditions, Two-Dimensional Isoparametric Elements: Four-Node Quadrilateral, Numerical, Integration, Higher- Order Elements.

UNIT-5

Scalar Field Problems: Steady-State Heat Transfer, Torsion, Potential Flow, Electric and Magnetic Fields, Dynamic Analysis: Formulation, Element Mass Matrices, Evaluation of Eigen values and Eigenvectors, Overview of a Commercial Finite Element Code: ANSYS

Textbooks:

1. Introduction to Finite Elements in Engineering by T.R. Chandrupatla and A.D. Belegundu, Prentice-Hall of India
2. An Introduction to the Finite Element Method by J.N. Reddy, McGraw-Hill

Reference Books:

1. Finite Element Procedures in Engineering Analysis by K.J. Bathe, Englewood Cliffs, Prentice Hall
2. Concepts and Applications of Finite Element Analysis by R.D. Cook, Wiley
3. Introduction to the Finite Element Method by C.S. Desai and J.F. Abel, Van Nostrand Reinhold
4. The Finite Element Method - Linear Static and Dynamic Finite Element Analysis by T.J.R. Hughes, Englewood Cliffs, Prentice-Hall
5. The Finite Element Method in Engineering by S.S. Rao, Pergamon.
6. An Analysis of the Finite Element Method by G. Strang and G.J. Fix, Englewood Cliffs, PrenticeHall
7. The Finite Element Method by O.C, Zienkiewicz, McGraw-Hill

FINITE ELEMENT METHOD LAB

1. To find the deflection, stress and strain in a cantilever beam with point load at the end.

2. To find the deflection, stress and strain in a cantilever beam with uniformly distributed load.

3. To study the effect of the change of geometrical properties for the beahviourof cantilever beam.

4. To find the temperature within the composite wall with the transfer of heat using conduction mode.

5. To study the stress strain analysis of a rectangular plate (thick and thin).

6. To study the vibrational performance of beam.

Course Outcomes:

Students will be able to

1. To get the historical mathematical background of FEM and application of advanced computersfor this.
2. Apply finite element method to solve problems in solid mechanics, heat transfer and fluid mechanics. Apply the FEM for two dimensional problems.
3. Develop the codes using MATLAB for solving the FEM problems and also use of FEMsoftware.
4. Develop the codes using MATLAB for solving the FEM problems
5. Use FEM software to solve problems.